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The completed Recruitment Toolbox contains a total of 92 activities that cover a range of age levels (Kindergarten through 12th Grade) and topic areas (e.g., environment and energy, planning and urban development, traffic safety, etc.). The companion Outreach Guidelines focus on understanding your audience and effectively engaging student participants. The proposed Assessment Plan includes three levels of information gathering: website access, pre-activity survey, and post-activity survey. The first two products will be available to outreach providers from the ITE website (www.ite.org) beginning January 2007.

The development of the Recruitment Toolbox represents a first step in encouraging higher quality and more frequent outreach to pre-college students. As a next step, existing activities should be reviewed and enhanced with additional preparatory information and/or more constructive hands-on applications. Information gathered through the Assessment Plan can help to guide the priority of improvements.
DEVELOPING A "RECRUITMENT TOOLBOX"
FOR TRANSPORTATION PROFESSIONALS

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August 2006
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ACKNOWLEDGEMENT

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Additional support, primarily in the form of staff time, was provided by the Institute of Transportation Engineers.
The transportation engineering workforce in the U.S. is facing a concerning shortage. While the need to address this shortage is well-recognized, substantive tools and funding mechanisms for making progress towards the recruitment of transportation professionals are lacking. In cooperation with the Institute of Transportation Engineers (ITE), this project developed a tool - a Recruitment Toolbox - to better support professional participation in local recruitment efforts.

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EXECUTIVE SUMMARY

The transportation engineering workforce in the United States is facing a concerning shortage. Nationwide, 50 percent of the state transportation workforce will be eligible to retire by 2010 (National Research Council (NRC) 2001 and Transportation Research Board (TRB) 2003). The Federal Highway Administration (FHWA) reports that 18 percent of its workforce will reach retirement eligibility by 2010 (FHWA 2000). While the need to address this workforce shortage is well-recognized, substantive tools and funding mechanisms for making progress towards the recruitment of transportation professionals are lacking.

National programs such as the American Association of State Highway and Transportation Official’s (AASHTO) TRAC Program, the U.S. Department of Transportation’s (USDOT) Garrett A. Morgan Program and the American Society of Civil Engineers (ASCE) Building Big Program are a step in the right direction in providing informational websites, advocacy in schools, scholarships, internship opportunities, mentors, etc. but more opportunities are needed to facilitate recruitment at the local levels.

At present, a subset of transportation professionals working in the public sector, private industry and academia have independently developed quality, hands-on activities or exercises intended to spark interest in transportation engineering. These activities are intended for a range of age groups (Kindergarten through 12th Grade) and are typically administered in the classroom or during science or engineering oriented "camps". Participation in these events is often prompted through involvement in professional societies such as ASCE or the Institute of Transportation Engineers (ITE) and often involves the assistance of university students already enrolled in transportation engineering or similar programs.

Greater involvement of the professional community in recruitment efforts is largely precluded by the time, energy and creativity requirements to develop companion transportation-related activities and exercises. This project resulted in a tool - a Recruitment Toolbox - to better support professional participation in local recruitment efforts.

The completed Recruitment Toolbox contains a total of 92 activities that cover a range of age levels and topic areas. The number of activities, by age group and topic area, is summarized in Table A. The Recruitment Toolbox will be accessible electronically from the ITE website beginning in January 2007 (to allow ITE’s web services personnel time to develop the Recruitment Toolbox database and user interface).

To further support the use of the Recruitment Toolbox and its activities, companion Outreach Guidelines were developed. These guidelines were intentionally kept brief to increase the likelihood for review by outreach providers (i.e., local transportation professionals and students enrolled in transportation-related curricula). The guidelines focus on: (1) understanding your outreach audience with respect to their developmental level, scientific understanding, and mathematics capabilities and (2) adequately preparing to perform the activity including responding to questions regarding transportation engineering as a career choice. These Outreach Guidelines will be provided as a link from the Recruitment Toolbox website.
Table A. Number of Recruitment Toolbox Activities by Age Level and Topic Area

<table>
<thead>
<tr>
<th>Topic Area</th>
<th>Kindergarten – 2nd Grade</th>
<th>3rd – 5th Grade</th>
<th>6th – 8th Grade</th>
<th>9th – 12th Grade</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aviation, Marine, Rail</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>7</td>
</tr>
<tr>
<td>Buses/Public Transportation</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Environment/Energy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Multimodal</td>
<td>10</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>Pedestrians/Bicycles</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>Planning/Urban Development</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>Roadway Design/Structures</td>
<td>-</td>
<td>-</td>
<td>12</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>Roadway Maintenance</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Traffic Markings, Signs, Signals</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Traffic Safety</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td>Transportation Technology</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Trucking and Freight Systems</td>
<td>1</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>20</strong></td>
<td><strong>22</strong></td>
<td><strong>31</strong></td>
<td><strong>19</strong></td>
<td><strong>92</strong></td>
</tr>
</tbody>
</table>

A third product resulting from this effort was an Assessment Plan. The primary goal of developing the Recruitment Toolbox was to encourage and support participation in recruitment efforts by local transportation professionals and students enrolled in transportation-related curricula. As such, the audience targeted for assessment of project effectiveness included these outreach providers. While it is also of interest to determine how outreach recipients (i.e., pre-college students and teachers) perceive the activities, this was not included in the proposed Assessment Plan because of the significant volunteer effort required to compile, assimilate, and analyze survey data from student/teacher audiences.

The proposed Assessment Plan consists of three levels of information gathering: (1) Website Access, (2) Pre-activity Survey, and (3) Post-activity Survey. Website Access provides the lowest level of information, indicating Recruitment Toolbox success through the number of website accesses or “hits”. The Pre-activity Survey solicits additional information regarding the outreach provider (i.e., the local transportation professional or students enrolled in transportation-related curricula) and the outreach event to gain better understanding of how the Recruitment Toolbox is actually being used. The final stage of assessment, the Post-activity Survey, provides the most rigorous indication of Recruitment Toolbox effectiveness, describing how the Recruitment Toolbox assisted in the outreach event, its ease of use, and how well the activities were received by the outreach recipients (from the provider’s point of view).

The development of the Recruitment Toolbox was not without challenge. Professional and student transportation communities demonstrated a profound lack of responsiveness in this development effort. This observation is not entirely surprising. As with many volunteer-based activities, time constraints and other priorities often take precedence over volunteer contributions.
Outside of the professional and student transportation communities, a wealth of information currently exists both through other programs specifically targeting transportation, engineering, and math and science education and through general educator resources. To date, transportation professionals and students have not widely accessed this information because: (1) visiting individual sites related to transportation, engineering, and math and science to find an activity/exercise that is appropriate with respect to age level, duration, available resources, etc. can be time-consuming and unsuccessful and (2) they may be unaware of general educator resources targeting pre-college teachers or may be unwilling to pay the annual subscription fee charged to access some of the more comprehensive sites.

In looking specifically at the types of activities collected for the Recruitment Toolbox, two areas for improvement exist. Many of the activities require the outreach provider to gather preparatory information (in addition to materials and supplies for the exercises) on their own. For example, the outreach provider may be directed to access pictures of or historical facts for a particular bridge from the Internet or other sources to support the activity. If this information were added to the activity, it would eliminate duplicate efforts by outreach providers utilizing the outreach “tool”. Second, many of the activities instruct students to “draw a picture of…” or “write in a journal about….” as a means to actively engage them in the event. Transportation professionals and students, with a more extensive understanding of the topic areas (many of these activities were developed by pre-college teachers without specific transportation-related knowledge), may be able to develop more constructive hands-on applications to supplement these activities.

The development of the Recruitment Toolbox represents a first step in encouraging higher quality and more frequent outreach to pre-college students by transportation professionals and students currently enrolled in transportation curricula. Researchers were tasked with bringing together previously-developed transportation-related activities and exercises into a common database. Improvements or expansions to these activities were beyond the scope of this effort. However, this is a logical next step. Existing activities should be reviewed and enhanced with additional preparatory information or more constructive hands-on applications. Information gathered through the Assessment Plan can help to guide the priority of improvements.
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CHAPTER 1.
INTRODUCTION

PROBLEM STATEMENT

The transportation engineering workforce in the United States is facing a concerning shortage. Nationwide, 50 percent of the state transportation workforce will be eligible to retire by 2010 (National Research Council (NRC) 2001 and Transportation Research Board (TRB) 2003). The Federal Highway Administration (FHWA) reports that 18 percent of its workforce will reach retirement eligibility by 2010 (FHWA 2000). While the need to address this workforce shortage is well-recognized, substantive tools and funding mechanisms for making progress towards the recruitment of transportation professionals are lacking.

National programs such as the American Association of State Highway and Transportation Official’s (AASHTO) TRAC Program, the U.S. Department of Transportation’s (USDOT) Garrett A. Morgan Program and the American Society of Civil Engineers (ASCE) Building Big Program are a step in the right direction in providing informational websites, advocacy in schools, scholarships, internship opportunities, mentors, etc. but more opportunities are needed to facilitate recruitment at the local levels.

At present, a subset of transportation professionals working in the public sector, private industry and academia have independently developed quality, hands-on activities or exercises intended to spark interest in transportation engineering. These activities are intended for a range of age groups (Kindergarten through 12th Grade) and are typically administered in the classroom or during science or engineering oriented "camps". Participation in these events is often prompted through involvement in professional societies such as ASCE or the Institute of Transportation Engineers (ITE) and often involves the assistance of university students already enrolled in transportation engineering or similar programs.

Greater involvement of the professional community in recruitment efforts is largely precluded by the time, energy and creativity requirements to develop companion transportation-related activities and exercises. This project resulted in a tool - a Recruitment Toolbox - to better support professional participation in local recruitment efforts.

BACKGROUND

The transportation engineering profession is not singularly affected by this workforce shortage. The Bureau of Labor Statistics (2002) expects employment in engineering to increase from 3 to 9 percent between 2000 and 2010. Employment in traditional engineering fields such as aerospace, civil, electrical and environmental engineering are expected to see an increase from 10 percent to 20 percent (Noeth, Cruce, and Harmston 2003). Despite the increasing demand for engineers, the number of engineering degrees is expected to remain unchanged during this same time period. Students are choosing to major in fields not related to science and engineering.
To complicate the issue of a shrinking science and engineering workforce, a large cohort of science and engineering professionals educated in the 1950’s and 1960’s will soon retire. A talented workforce is needed to replace these professionals.

To combat the shortage of science and engineering professionals, the consensus among leaders in the engineering community (Congressional Commission on the Advancement of Women and Minorities in Science - Engineering and Technology Development 2000) is that this can only be achieved through the recruitment of a more diverse workforce. The need for a large and diverse pool of skilled engineers is as great as ever. Though representation of women and minorities has increased, the engineering workforce remains predominately male Caucasian. The U.S. Census Bureau (2000) indicates the number of Caucasian 18 to 24 year olds will decrease over the next few decades. By the year 2010, only 30 percent of 18 to 24 year olds will be Caucasian, while 60 percent will be African Americans, American Indians, and Hispanics (Barton 2002). Recruitment of a diverse engineering workforce is not a new concept; in 1980 Congress passed the Science and Engineering Equal Opportunities Act, stating:

It is the policy of the United States to encourage men and women, equally, of all ethnic, racial, and economic backgrounds to acquire skills in science, engineering and mathematics, to have equal opportunity in education, training, and employment in scientific and engineering fields, and thereby to promote scientific and engineering literacy and the full use of the human resources of the Nation in science and engineering. To this end, the Congress declares that the highest quality science and engineering over the long-term requires substantial support, from currently available research and educational funds, for increased participation in science and engineering by women and minorities. (Sec. 32(b))

Currently, only 10.6 percent of employed engineers are women (Statistical Abstract of the United States 2000). Many attribute this low participation rate to a lack of interest or confidence in math-based fields, like engineering. Contrary to this theory, a University of Michigan Institute on Women in Engineering study found that women aren’t lacking in confidence in math-based fields but rather seek people-oriented professions (American Society of Engineering Education 2003). In general, women value working with and for people; recognition of this distinction is important for the success of any recruitment efforts.

While a focus on diversity in gender and ethnicity is important across all science and engineering professions, the transportation engineering profession can also take advantage of diversity in education to enhance its workforce. Historically, the “supplier” of transportation professionals has been civil engineering education programs. Transportation professionals now possess an array of education backgrounds including computer programming, statistics, mechanical engineering, industrial engineering, and electrical engineering as well as public policy, economics, planning, law, and real estate development (Polzin and Ward 2002).

**PROJECT OBJECTIVES**

The previously cited shortcomings related to the development of substantive tools and funding mechanisms for making progress towards the recruitment of transportation professionals are reflected in the nature of research being conducted in this same topic area. Numerous efforts
have been conducted to quantify the extent of the workforce challenge, identify causative factors such as non-competitive salary rates and tout general strategies for addressing workforce shortages. Little prior work has been done to develop usable tools, particularly at the local levels, to enhance the recruitment of transportation professionals.

The primary objective of this project was to develop a tool - a Recruitment Toolbox - to better support professional participation in local recruitment efforts. In partnership with ITE's Transportation Education Council, this project assimilated transportation-related activities and exercises from around the country and various sources into an easily accessible, electronic database intended to expose and recruit a variety of age groups to the transportation profession.

**PROJECT BENEFITS**

The development of a Recruitment Toolbox will encourage higher quality and more frequent outreach to students by providing proven, easily accessible activities or exercises to transportation professionals and students currently enrolled in transportation curricula (i.e., typical outreach providers). Greater involvement of the professional community in recruitment efforts is currently precluded by the time, energy and creativity requirements to develop companion transportation-related activities and exercises.

The development of this tool also supports broader workforce development goals by increasing the level of involvement by potential outreach providers (i.e., transportation professionals and students currently enrolled in transportation-related curricula) in recruitment efforts and in addressing the larger workforce challenge. Through outreach at the local levels and by local volunteers, a much broader student audience can be exposed to the transportation profession and with greater frequency of exposure.

The hope is that through high-quality and frequent exposure to transportation-related topics, students may develop a strong interest in pursuing a transportation-related career.
CHAPTER 2
METHODOLOGY

This project directly employed two undergraduate students (one each from the University of Texas and Texas A&M University) and solicited assistance from student volunteers nationwide through ITE’s Student Chapter Program. The research team contacted ITE Student Chapters at other colleges and universities to solicit their help in gathering example recruitment activities appropriate for inclusion in the Recruitment Toolbox. These activities may have been developed and conducted previously by the Student Chapter members or local transportation professionals. To supplement these submittals, a review via the World Wide Web was conducted to uncover other potentially appropriate activities (i.e., available through the AASHTO TRAC Program, USDOT Garrett Morgan Program, ASCE Building Big Program or others).

More specifically, the work plan for this effort consisted of the following ten tasks:

Task 1: Develop Targeted Communications Plan
Task 2: Develop/Distribute Solicitation
Task 3: Review ITE Submissions
Task 4: Review Other Program Resources
Task 5: Develop Electronic Recruitment Toolbox
Task 6: Develop Companion Outreach Guidelines
Task 7: Develop Assessment Plan
Task 8: Develop/Distribute Availability Announcement
Task 9: Identify Venues for “Showcase”
Task 10: Document Development Process/Observations

Each of these tasks is described in more detail below.

TASK 1: DEVELOP TARGETED COMMUNICATIONS PLAN

Significant communications with the larger transportation engineering community (i.e., professionals working in the public sector, private industry and academia and students currently enrolled in transportation-related curricula) took place at the onset of this project to solicit proven transportation-related activities and will occur a second time following completion of this project to announce the availability of the newly-developed Recruitment Toolbox as a resource.

During the solicitation phase, the research team partnered with, and relied upon the resources of, ITE. More than 13,000 transportation professionals working for public agencies, private industry, or academic institutions are currently members of ITE. In addition, ITE has a well-
established Student Chapter Program, with active involvement from both faculty advisors and student leaders. Working in close cooperation with ITE, the research team developed a communications plan that targeted: (1) professionals working in academia, (2) students currently enrolled in transportation-related curricula, and (3) professionals working in the public sector and private industry who have expressed a noted interest in transportation education activities. (A solicitation to the full membership of ITE was thought to be too invasive.) By limiting the target group to these three types of individuals, communications via email utilizing ITE’s Faculty Advisor Listserv, Student Chapter Listserv, and Transportation Education Council Listserv (comprising faculty, students, and public and private sector professionals) was deemed to be most appropriate.

**TASK 2: DEVELOP/DISTRIBUTE SOLICITATION**

Once the communication medium and audience were identified, solicitation materials requesting submittal of proven transportation-related activities were developed and distributed accordingly. Solicitation materials attempted to address the unique motivating factors for participation of the various audiences; student leaders may be motivated through the ability to develop a more competitive Student Activities Report while public sector professionals may be motivated by a strong community service ethic. Two separate solicitation letters were developed for: (1) professionals working in the public sector, private industry, and academia and (2) students currently enrolled in transportation-related curricula (see Figures 1 and 2, respectively). These solicitation letters were distributed electronically to both groups on December 1, 2005.

In addition to this general solicitation, researchers included a call for submittals in both the Winter 2006 and Summer 2006 editions of the ITE Transportation Education Council Newsletter and at the ITE Transportation Education Council meetings in conjunction with the Transportation Research Board Annual Meeting in January 2006 and the ITE Technical Conference and Exhibit in March 2006. At these same events, a call for submittals was made at the ITE Traffic Engineering Council meetings through the Traffic Engineering Council liaison.

**TASK 3: REVIEW ITE SUBMISSIONS**

Response to both the general solicitation and the more targeted solicitations to the ITE Transportation Education and ITE Traffic Engineering Councils was meager. Two total responses were received; one from a student leader and one from a private industry professional. Unfortunately, neither submittal conformed to the hands-on activity format of the Recruitment Toolbox. The first submittal described activities/demonstrations that were included at a local career fair (i.e., “used SimTraffic™ to demonstrate signal timings”) but did not provide any instructional information for how the activities were conducted or how demonstrations were made to be interactive. The second submittal included broader articles about successful recruitment programs but was not activity-focused.

Because of the meager response to the solicitation for transportation-related activities from ITE professional and student members, the effort originally planned for review and modification of ITE submissions was shifted to focus on activities and exercises available from other program resources.
Hello All,

As a respected transportation professional, you have no doubt been asked at some point to participate in recruitment events and activities hosted by primary or secondary schools, colleges or universities, community groups (i.e., Boy Scouts of America), or other. In response to this request, you have likely either (1) spent significant time and energy outside of your workday researching available recruitment resources and independently developing transportation-related presentation materials and hands-on activities or exercises or (2) politely declined due to time and energy constraints. If your response was the latter, you are not alone.

The ITE Transportation Education Council, in cooperation with the Southwest Region University Transportation Center (SWUTC), has initiated a project to make it easier for transportation professionals to participate in local recruitment events and activities. The primary objective of this project is to develop a “Recruitment Toolbox” that assimilates the best ideas from around the country into an easily accessible, electronic database of proven transportation-related activities and exercises intended to expose and recruit a variety of age groups to the transportation profession.

If you have previously participated in transportation-related recruitment events or activities and are willing to contribute to the Recruitment Toolbox:

1. Please contact me at j-carson@tamu.edu or (512) 467-0946 and provide: (1) a brief description of your presentation/activity/exercise, (2) the intended age group, and (3) the source (i.e., if you developed the material yourself or if you used other resources such as the USDOT Garrett A. Morgan Program, AASHTO TRAC Program, etc.).

Whether you have or have not previously participated in transportation-related recruitment events or activities:

1. Please spread the word about this project by making announcements at local ITE Chapter or Section meetings, ITE Student Chapter meetings, etc. and have individuals interested in contributing contact me at j-carson@tamu.edu or (512) 467-0946.

2. Mark your calendar; the Recruitment Toolbox is scheduled for completion by May 31, 2006.

National programs such as the American Association of State Highway and Transportation Official's (AASHTO) TRAC Program, the U.S. Department of Transportation's (USDOT) Garrett A. Morgan Program and the American Society of Civil Engineers (ASCE) Building Big Program are a step in the right direction in providing informational websites, advocacy in schools, scholarships, internship opportunities, mentors, etc. but more opportunities are needed to facilitate recruitment at the local levels.

This project will encourage higher quality and more frequent outreach to students by providing proven, easily accessible activities or exercises to transportation professionals and students currently enrolled in transportation curricula. Through outreach at the local levels and by local volunteers, a much broader student audience can be exposed to the transportation profession and with greater frequency of exposure. The hope is that through high-quality and frequent exposure to transportation-related topics, students may develop a strong interest in pursuing a transportation-related career.

Please feel free to contact me with any questions. Thank you in advance for helping to make the "Recruitment Toolbox" a success!

Sincerely,

Jodi L. Carson, Ph.D., P.E.
Chair, ITE Education Council
Hello Student Chapter Leaders,

As you may or may not be aware, the transportation engineering workforce in the United States is facing a concerning shortage. Nationwide, 50 percent of the state transportation workforce will be eligible to retire by 2010; 18 percent of the Federal Highway Administration (FHWA) workforce will reach retirement eligibility in the same year. While the need to address this workforce shortage is well-recognized, substantive tools and funding mechanisms for making progress towards the recruitment of transportation professionals are lacking.

As a student enrolled in a transportation-related curriculum, you may have been asked, by a professor or advisor or through your involvement in ITE or ASCE, to participate in recruitment events and activities hosted by primary or secondary schools, colleges or universities, community groups (i.e., Boy Scouts of America), or other. In response to this request, you likely spent significant time and energy researching available recruitment resources and independently developing transportation-related presentation materials and hands-on activities or exercises.

The ITE Transportation Education Council, in cooperation with the Southwest Region University Transportation Center (SWUTC), has initiated a project to make it easier for transportation students and professionals to participate in local recruitment events and activities. The primary objective of this project is to develop a “Recruitment Toolbox” that assimilates the best ideas from around the country into an easily accessible, electronic database of proven transportation-related activities and exercises intended to expose and recruit a variety of age groups to the transportation profession.

If you or your student group have previously participated in transportation-related recruitment events or activities and are willing to contribute to the Recruitment Toolbox:

1. Please contact me at j-carson@tamu.edu or (512) 467-0946 and provide: (1) a brief description of your presentation/activity/exercise, (2) the intended age group, and (3) the source (i.e., if you developed the material yourself or if you used other resources such as the USDOT Garrett A. Morgan Program, AASHTO TRAC Program, etc.).

Whether you have or have not previously participated in transportation-related recruitment events or activities:

1. Please contact and encourage your local professionals to contribute previously-developed presentations/activities/exercises; have individuals interested in contributing contact me at j-carson@tamu.edu or (512) 467-0946.

2. Mark your calendar; the Recruitment Toolbox is scheduled for completion by May 31, 2006.

As a student and an ITE Student Chapter, the benefits to being involved in this effort are wide-ranging. This project provides an opportunity for students to interact with transportation professionals and cooperatively take steps to address the workforce development challenge. Participation in this project can and should be reported in your ITE Student Chapter Annual Report, gaining exposure for your Chapter and supporting ITE’s larger workforce development goals. If you take a more active role in soliciting and contributing multiple presentations/activities/exercises for the Recruitment Toolbox, you will be recognized by this Committee for your efforts.

Please feel free to contact me with any questions. Thank you in advance for helping to make the "Recruitment Toolbox" a success!

Sincerely,

Jodi L. Carson, Ph.D., P.E.
Chair, ITE Education Council
TASK 4: REVIEW OTHER PROGRAM RESOURCES

Concurrent with the solicitation for transportation-related activities from ITE professional and student members, the research team reviewed existing activities available through programs outside of ITE. National programs such as the AASHTO TRAC Program, the USDOT Garrett A. Morgan Program and the ASCE Building Big Program and others currently provide informational websites, advocacy in schools, scholarships, internship opportunities, mentors, etc. The American Society of Engineering Education’s (ASEE) Engineering K12 Center website (www.engineeringk12.org) provided an extensive list of online resources and proved a valuable resource for this project.

Contrary to the results achieved through a general solicitation of ITE professionals and students, a review of other program resources uncovered a wealth of transportation-related activities and exercises. Researchers reviewed more than 40 education-related websites related to:

- transportation
- engineering
- math and science
- general educator resources.

A full list of the reviewed websites is provided in Table 1. While the transportation, engineering, and math and science education websites provided useful information, the general educator resource websites were invaluable in locating transportation-related “lesson plans” efficiently through a single key-word search engine. Some of sites, such as Lesson Planet, contain 30,000 to 45,000 lesson plans on various subjects, many of which are drawn from or duplicated on the transportation, engineering, and math and science education websites. Through these combined online resources, approximately 150 to 200 transportation-related activities were initially identified for possible inclusion in the Recruitment Toolbox. This preliminary set of activities was reduced by approximately half once any duplicates were removed.

TASK 5: DEVELOP ELECTRONIC RECRUITMENT TOOLBOX

As a first step in developing the Recruitment Toolbox, researchers developed an activity template to provide consistency in layout and content. An example activity is provided in Figure 3. Each of the candidate activities were converted to the template format and saved as an individual file to support a search by age group, topic area, etc. Age groups included:

- Kindergarten – 2nd Grade
- 3rd – 5th Grade
- 6th – 8th Grade
- 9th – 12th Grade.
<table>
<thead>
<tr>
<th><strong>Transportation Programs</strong></th>
<th><strong>Description</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lying Lightly on the Land, Design Your Own Park Road (<a href="http://www.efl.fhwa.dot.gov/nbme/design1.htm">www.efl.fhwa.dot.gov/nbme/design1.htm</a>) allows &quot;design&quot; of a roadway feature or features using various design options. Design visualization allows the design to be displayed as if it were already constructed.</td>
</tr>
<tr>
<td></td>
<td>Garrett A. Morgan Technology and Transportation Futures Program coordinates public and private transportation, technology, and educational resources to enable Americans to make a greater contribution toward meeting the country’s transportation needs.</td>
</tr>
<tr>
<td></td>
<td>National Highway Traffic Safety Administration's Safety School Teachers’ Lounge provides educational and enjoyable lesson plans to help teach students about safety issues.</td>
</tr>
<tr>
<td></td>
<td>Safe Routes Lesson Plans for the Classroom developed by Marin County teachers.</td>
</tr>
<tr>
<td></td>
<td>TRAC teaches secondary students how to apply a variety of math and science concepts to common engineering problems occurring in transportation systems. The TRAC program is also designed to allow the students to identify and evaluate the social and environmental impacts associated with the development of new transportation systems within their communities. TRAC is built around a set of tools and activities that include electronic components to collect and analyze data, and software programs to graph results and test a series of models.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Engineering Programs</strong></th>
<th><strong>Description</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>American Society of Mechanical Engineers Pre-College education services to help teachers and engineers to strengthen the math, science, engineering, and technology skills of young people and to assist them in becoming more aware of the role of engineering in their lives.</td>
</tr>
<tr>
<td></td>
<td>The American Ceramics Society: Pre-college Education encourages student interest in math and science and promotes ceramic awareness.</td>
</tr>
<tr>
<td></td>
<td>Building Big Educators' Guide includes handouts and educator ideas with each activity.</td>
</tr>
<tr>
<td></td>
<td>Discover Engineering Online includes a list of activities from PBS's Zoom.</td>
</tr>
<tr>
<td></td>
<td>Design and Discovery is a free curriculum developed to interest youth (ages 11-14) in design and engineering. It provides a hands-on, inquiry-based experience.</td>
</tr>
<tr>
<td></td>
<td>National Engineers Week: Discover &quot;E&quot; is an opportunity for students and teachers to gain hands-on math and science experiences by working with someone who uses those subjects every day.</td>
</tr>
</tbody>
</table>
### Table 1. Other Program Resources (ASEE 2006, Continued)

<table>
<thead>
<tr>
<th><strong>Math and Science Programs</strong></th>
<th><strong>Description</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CSE</strong></td>
<td>Center for Science Education Design It! Program offers special programming in design engineering for elementary school-age children (ages 7 to 12). After school engineering activities challenge children to build and refine working models of small machines and toys over a period of three to six weeks.</td>
</tr>
<tr>
<td><strong>Discovery &amp; School</strong></td>
<td>Discovery Lesson Plans Library provides hundreds of original lesson plans, all written by teachers for teachers. The pull-down menus allow one to browse by subject, grade, or both.</td>
</tr>
<tr>
<td><strong>enc</strong></td>
<td>Eisenhower National Clearinghouse offers a compilation of sites with teaching materials that may include teaching units, activity books, and lab manuals categorized by math and science subject area.</td>
</tr>
<tr>
<td><strong>NASA</strong></td>
<td>NASA Quest has many K-12 lesson plans for home and classroom use.</td>
</tr>
<tr>
<td><strong>National Geographic</strong></td>
<td>National Geographic allows teachers to search its site for educational materials.</td>
</tr>
<tr>
<td><strong>National Science Foundation</strong></td>
<td>The National Science Foundation provides new hands-on science activities.</td>
</tr>
<tr>
<td><strong>Science NetLinks</strong></td>
<td>In Science NetLinks, lessons are sorted according to grade level and lesson title or benchmark.</td>
</tr>
<tr>
<td><strong>Smithsonian Education</strong></td>
<td>Smithsonian Institution - Lesson Plans emphasize inquiry-based learning with primary sources and museum collections.</td>
</tr>
<tr>
<td><strong>StudyWorks! Online</strong></td>
<td>StudyWorks! Online is a free learning site delivering innovative approaches that help students develop an understanding of math and science concepts traditionally taught from grades 7 to 12.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>General Educator Resources</strong></th>
<th><strong>Description</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A to Z Teacher Stuff</strong></td>
<td>A to Z Teacher Stuff was designed to help teachers find online lesson plans and resources more quickly and easily.</td>
</tr>
<tr>
<td><strong>The Educator's Reference Desk</strong></td>
<td>The Educator's Reference Desk provides high-quality resources and services to the education community. From the Information Institute of Syracuse, the Educator's Reference Desk brings you: 2,000+ lesson plans, 3,000+ links to online education information, and 200+ question archive responses.</td>
</tr>
<tr>
<td><strong>Annenberg/CPB Learner.org</strong></td>
<td>The mandate of Annenberg/CPB is to use media and telecommunications to advance excellent teaching in American schools.</td>
</tr>
<tr>
<td><strong>Can Teach</strong></td>
<td>Can Teach offers hundreds of lesson plans, thousands of links, and tons of other resources.</td>
</tr>
<tr>
<td><strong>Curriculum Archive</strong></td>
<td>The Curriculum Archive is a central repository for lessons and classroom projects.</td>
</tr>
<tr>
<td><strong>The Educator's Network</strong></td>
<td>The Educator's Network incorporates an educational search tool that searches its entire site first, and then searches a number of other lesson-plan sites.</td>
</tr>
<tr>
<td><strong>ForLessonPlans Directory</strong></td>
<td>ForLessonPlans Directory is an online directory of free lesson plans for K-12 teachers.</td>
</tr>
<tr>
<td>General Educator Resources</td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>The Gateway</strong></td>
<td>a one-stop, any-stop access to high-quality lesson plans, curriculum units, and other education resources on the Internet.</td>
</tr>
<tr>
<td><strong>Lesson Planet</strong></td>
<td>lets teachers search over 30,000 links to lesson plans.</td>
</tr>
<tr>
<td><strong>Lesson Plan Search</strong></td>
<td>Lesson Plan Search offers free lesson plans, webquests, worksheets, student links, and clipart.</td>
</tr>
<tr>
<td><strong>Lesson PlanZ.com</strong></td>
<td>The Lessons Plans Page Keyword Search Engine searches its site for specific lesson plan topics, as well as a variety of other educational sites.</td>
</tr>
<tr>
<td><strong>Microsoft Education</strong></td>
<td>Microsoft Education Lesson Plans allows teachers to search for lesson plans that integrate technology into one's curriculum.</td>
</tr>
<tr>
<td><strong>The New York Times/Learning Network</strong></td>
<td>Lesson Plans archive contains hundreds of free lesson plans for grades 6-12.</td>
</tr>
<tr>
<td><strong>PBS Teacher Source</strong></td>
<td>allows teachers to find lesson plans, activities, and more by selecting from various options.</td>
</tr>
<tr>
<td><strong>Sanford: Create Art</strong></td>
<td>offers hands-on activities and techniques.</td>
</tr>
<tr>
<td><strong>The Teacher's Domain</strong></td>
<td>offers structured lessons for teachers online and the ability to save favorite lessons in a personal folder.</td>
</tr>
<tr>
<td><strong>TeachersFirst.com</strong></td>
<td>At TeachersFirst, teachers can select either a subject area or use a keyword to find resources on a specific topic.</td>
</tr>
<tr>
<td><strong>Teacher Link</strong></td>
<td>offers units and lesson plans that can be searched through by keyword(s).</td>
</tr>
<tr>
<td><strong>TeacherVision.com</strong></td>
<td>Browse hundreds of lessons, resources, and activities at Teacher Vision Lesson Plans. The numbers indicate the quantity of content items in that particular topic area.</td>
</tr>
<tr>
<td><strong>TeachNet.com</strong></td>
<td>has grown to over 3 million pages and 300,000 unique visitors per month.</td>
</tr>
<tr>
<td><strong>Teach-nology</strong></td>
<td>Lesson Plan Mega Search contains more than 17,000 unique lesson plans that have been reviewed by the TeAch-nology.com staff. Teach-nology also provides access to other teaching search engines.</td>
</tr>
</tbody>
</table>
Figure 3. Example Recruitment Toolbox Activity

**DESIGN/CONSTRUCT A ROAD SIGN SUPPORT**

**TOPIC AREA:** Roadway Design/Structures  
**AGE LEVEL:** 6th - 8th Grade  
**DURATION:** Four 50-minute sessions  
**RESOURCES:**  
- What Is the Design Process?  
- Road Signs Gallery  
- Train Truss Animation  
- Firth of Forth Cantilever Bridge  
- Shapes Lab  
- Triangles: Designing a Straw Bridge

**MATERIALS:**  
- Thick spaghetti noodles (uncooked) or drinking straws  
- Small paper cups  
- String  
- Glue  
- Rulers  
- File folders  
- Scissors  
- Index cards  
- Newspaper  
- Small weights (marbles, coins)  
- Fan or hair dryer  
- Clay or cellophane tape

**OBJECTIVES:** Understand the engineering design process (define challenge, research and brainstorm solutions, choose solution that fits within constraints, design and build solution, test solution, evaluate and redesign if necessary). Recognize the benefit of using triangular shapes in construction.

**TASKS:**

**Part I: Defining the Challenge**

1. Tell students that they will be designing, building, and testing models of the structures that support overhead highway signs. Start with a discussion about the steps they will need to follow. Make a list of these steps, either together as a class or in small groups. Show them the What Is the Design Process? video. Compare and contrast the steps that students came up with to the steps in the video.

2. Have students view the Road Signs Gallery still images and encourage them to notice the structures used to support the signs.

2. Have students observe sign support structures on their way home from school for next day discussion.

**Part II: More Brainstorming and Research**

3. The next time the class meets, discuss the following: (a) What type of sign support structures did you see? (b) Did they cross the road completely or overhang just part of it? (c) What do you think keeps them from collapsing or falling over?

4. Show students the Train Truss Animation video and the Firth of Forth Cantilever Bridge video, and encourage them to look for similarities in design between the bridges and sign support structures. Ask students: (a) Which types of bridges are similar in design to sign support structures? (b) What design element do they have in common, and why do you think it is used?

5. To help the students understand the strength of triangles, have them explore the Shapes Lab interactive activity.
6. To review the engineering design process, show the Triangles: Designing a Straw Bridge video. Ask students: (a) What steps of the design process did the ZOOM cast use to build their straw bridge? (b) How do you think the information on the video will help you when you build your sign support structures?

7. Divide the class into small groups and have them draw pictures of the sign support structures that they want to build. Give them the following design specifications: road width = 40 cm; maximum truck height = 15 cm; number of signs = 1 large or 2 small. Have each group review their designs and choose one to build.

Part III: Construction

8. The structure should be built by gluing the material to the 1 cm squares. See example: Straw Structure Diagram. This allows for easy cross-member attachment. The index cards are to be used as the signs.

Part IV: Testing/Evaluation

9. Test the structures, as follows:

   **Wind load test:** Set up the sign support structure, holding it in place by anchoring the column(s) in clay or taping them to a desk and blow air at the sign(s). (If possible, use a fan or a hair dryer on the lowest setting.)

   **Weighted load test:** Set up the sign support structure again. Select a location farthest from the structure’s vertical support(s) and attach a small paper cup by a string, so that the cup hangs straight down but does not touch the “ground.” Load the cup with weights (marbles or coins), one by one.

DISCUSSION:

- Were some steps in the engineering design process more important than others? Explain.
- What are the steps in the engineering design process?
- Much can be learned from structures that fail. What did you learn from your test results?
- How was your design similar to or different from the other designs in the class?
- What would you do next time to make your structure stronger or lighter?

SOURCE: WGBH Educational Foundation
Transportation topic areas included:

- Aviation, Marine, Rail
- Buses/Public Transportation
- Environment/Energy
- Multimodal
- Pedestrians/Bicycles
- Planning/Urban Development
- Roadway Design/Structures
- Roadway Maintenance
- Traffic Markings, Signs, Signals
- Traffic Safety
- Transportation Technology
- Trucking and Freight Systems.

The Recruitment Toolbox will be hosted on the ITE website and maintained by ITE web services personnel. When a request is made by an area high school, college, university or secondary school for a presentation, demonstration, or activity at an upcoming engineering fair or other recruitment event, a transportation professional or student enrolled in transportation-related curricula can access the Recruitment Toolbox from the ITE website and search for and select from a variety of age-appropriate activities and exercises.

The Recruitment Toolbox will be accessible beginning in January 2007 (to allow ITE’s web services personnel time to develop the Recruitment Toolbox database and user interface). Researchers will continue to work closely with ITE personnel to resolve any issues related to search/sort requirements, content, access/integrity, and performance tracking, being sensitive to both the utility requirements of the Recruitment Toolbox and the resource requirements for ongoing maintenance of the website.

**TASK 6: DEVELOP COMPANION OUTREACH GUIDELINES**

Each of the individual activities in the Recruitment Toolbox includes guidance (provided by the original source) to help ensure successful conduct of the activity. In addition to the activity-specific guidance, general Outreach Guidelines were developed as part of this project to encourage success in any outreach event. These general guidelines were developed using various sources of published literature and information available through the World Wide Web (Zimmers 2003, K-12 Education Subcommittee 2003, Arizona Department of Education 2003). These general Outreach Guidelines will be provided as a link from the Recruitment Toolbox website.

**TASK 7: DEVELOP ASSESSMENT PLAN**

To gauge the effectiveness of the Recruitment Toolbox as a means to more actively engage local professionals and students enrolled in transportation-related curricula in outreach activities and hence, increase and enhance overall outreach and recruitment efforts, an assessment plan was developed as part of this project. Candidate audiences for assessment include: (1) student and teacher outreach recipients (i.e., what was the most important thing you learned, do you want to learn more about transportation, will you integrate these materials into your classroom, etc.) and (2) professionals and student outreach providers (i.e., how many times this year have you utilized...
the Recruitment Toolbox, did these materials assist you in preparing for and conducting outreach events, would you have participated if these materials had not been available, how could these materials be improved, etc.). Outreach recipients can be surveyed in-person at the close of each outreach event, depending on the nature of the event. Outreach providers can be surveyed electronically through ITE on an annual or more frequent basis.

Following discussion and deliberation among researchers and with ITE personnel, the focus of the assessment plan was narrowed to include only outreach providers (i.e., transportation professionals and students enrolled in transportation-related curricula). While it is of interest to determine how student and teacher outreach recipients perceive the activities, this assessment task was thought to require too great a volunteer effort.

**TASK 8: DEVELOP/DISTRIBUTE AVAILABILITY ANNOUNCEMENT**

The same communications plan developed at the onset of this project, utilizing email communications via ITE’s Faculty Advisor Listserve, Student Chapter Listserve and Transportation Education Council Listserve (comprising faculty, students, and public and private sector professionals), will be followed in January 2007 when the Recruitment Toolbox will be made electronically accessible. In addition, announcements will be included in the Winter 2007, Summer 2007, and Fall 2007 editions of the ITE Transportation Education Council Newsletter.

**TASK 9: IDENTIFY VENUES FOR “SHOWCASE”**

In addition to communicating electronically with professional and student members of ITE regarding the availability of the Recruitment Toolbox, opportunities for additional “showcase” will be exploited during ITE’s Transportation Education and Traffic Engineering Council Meetings held during:

- TRB’s Annual Meeting in 2007
- ITE’s Mid-year Meeting in February 2007
- ITE’s Annual Meeting in August 2007.

**TASK 10: DOCUMENT DEVELOPMENT PROCESS/OBSERVATIONS**

While the primary purpose of this investigation was to develop a Recruitment Toolbox and supporting guidance, this companion report documents any notable findings or observations related to:

- participation rates among students and professionals in developing the Recruitment Toolbox
- the nature of transportation-related activities available for inclusion
- any challenges encountered throughout the development process
- any other issues of interest.
CHAPTER 3
RESULTS

Three primary products resulted from this effort: (1) the Recruitment Toolbox for Transportation Professionals, (2) general Outreach Guidelines, and (3) a recommended Assessment Plan. Each of these products is described more fully below.

RECRUITMENT TOOLBOX FOR TRANSPORTATION PROFESSIONALS

The completed Recruitment Toolbox contains a total of 92 activities that cover a range of age levels and topic areas. The number of activities, by age group and topic area, is summarized in Table 2. A full summary of activities, including activity title, is provided in Table 3. Actual activity sheets for each of the 92 activities are provided in Appendix A. As mentioned previously, the Recruitment Toolbox will be accessible electronically from the ITE website beginning in January 2007 (to allow ITE’s web services personnel time to develop the Recruitment Toolbox database and user interface).

Table 2. Number of Recruitment Toolbox Activities by Age Level and Topic Area

<table>
<thead>
<tr>
<th>Topic Area</th>
<th>Number of Activities</th>
<th>Age Level</th>
<th></th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Kindergarten – 2nd Grade</td>
<td>3rd – 5th Grade</td>
<td>6th – 8th Grade</td>
<td>9th – 12th Grade</td>
<td></td>
</tr>
<tr>
<td>Aviation, Marine, Rail</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Buses/Public Transportation</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Environment/Energy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Multimodal</td>
<td>10</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td>14</td>
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<tr>
<td>Pedestrians/Bicycles</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Planning/Urban Development</td>
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<td>4</td>
<td>5</td>
<td>6</td>
<td></td>
<td>16</td>
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<tr>
<td>Roadway Design/Structures</td>
<td>-</td>
<td>-</td>
<td>12</td>
<td>1</td>
<td></td>
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<td>Roadway Maintenance</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Traffic Markings, Signs, Signals</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Traffic Safety</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>7</td>
<td></td>
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<td>-</td>
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<td>1</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Trucking and Freight Systems</td>
<td>1</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>22</td>
<td>31</td>
<td>19</td>
<td></td>
<td>92</td>
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</tbody>
</table>
Table 3. Summary of Recruitment Toolbox Activities by Topic Area and Age Level

<table>
<thead>
<tr>
<th>FILE</th>
<th>ACTIVITY TITLE</th>
<th>TOPIC AREA</th>
<th>AGE LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMR01</td>
<td>BOAT FLOAT</td>
<td>Aviation, Marine, Rail</td>
<td>Kindergarten-2nd Grade</td>
</tr>
<tr>
<td>AMR02</td>
<td>AIRPORT DESIGN</td>
<td>Aviation, Marine, Rail</td>
<td>3rd - 5th Grade</td>
</tr>
<tr>
<td>AMR03</td>
<td>CALIFORNIA AND THE SEA</td>
<td>Aviation, Marine, Rail</td>
<td>3rd - 5th Grade</td>
</tr>
<tr>
<td>AMR04</td>
<td>EGGS AHOO!</td>
<td>Aviation, Marine, Rail</td>
<td>3rd - 5th Grade</td>
</tr>
<tr>
<td>AMR05</td>
<td>THE RAILROAD: SETTLEMENT IN THE WEST</td>
<td>Aviation, Marine, Rail</td>
<td>6th – 8th Grade</td>
</tr>
<tr>
<td>AMR06</td>
<td>COMMERCE IN THE INDIAN OCEAN</td>
<td>Aviation, Marine, Rail</td>
<td>6th – 8th Grade</td>
</tr>
<tr>
<td>AMR07</td>
<td>THE PROBLEM: AIR TRANSPORTATION</td>
<td>Aviation, Marine, Rail</td>
<td>6th – 8th Grade</td>
</tr>
<tr>
<td>BPT01</td>
<td>WAYS TO GET FROM HERE TO THERE</td>
<td>Buses/Public Transportation</td>
<td>Kindergarten-2nd Grade</td>
</tr>
<tr>
<td>BPT02</td>
<td>CATCH THE UNIVERSITY SHUTTLE</td>
<td>Buses/Public Transportation</td>
<td>3rd - 5th Grade</td>
</tr>
<tr>
<td>BPT03</td>
<td>PEOPLE MOVERS</td>
<td>Buses/Public Transportation</td>
<td>6th – 8th Grade</td>
</tr>
<tr>
<td>BPT04</td>
<td>STRIKING UP A CONVERSATION</td>
<td>Buses/Public Transportation</td>
<td>9th - 12th Grade</td>
</tr>
<tr>
<td>EE01</td>
<td>AIR POLLUTION: WHAT CAN YOU DO?</td>
<td>Environment/Energy</td>
<td>Kindergarten-2nd Grade</td>
</tr>
<tr>
<td>EE02</td>
<td>NOISE POLLUTION</td>
<td>Environment/Energy</td>
<td>3rd - 5th Grade</td>
</tr>
<tr>
<td>EE03</td>
<td>AIR POLLUTION</td>
<td>Environment/Energy</td>
<td>3rd - 5th Grade</td>
</tr>
<tr>
<td>EE04</td>
<td>STOP THE BUS! AMERICA WANTS A RIDE</td>
<td>Environment/Energy</td>
<td>6th – 8th Grade</td>
</tr>
<tr>
<td>EE05</td>
<td>CALCULATE YOUR CONTRIBUTION</td>
<td>Environment/Energy</td>
<td>6th – 8th Grade</td>
</tr>
<tr>
<td>EE06</td>
<td>ECO TRAVEL LOG</td>
<td>Environment/Energy</td>
<td>6th – 8th Grade</td>
</tr>
<tr>
<td>EE07</td>
<td>COOL CARS</td>
<td>Environment/Energy</td>
<td>9th - 12th Grade</td>
</tr>
<tr>
<td>MM01</td>
<td>ALL ABOARD!</td>
<td>Multimodal</td>
<td>Kindergarten-2nd Grade</td>
</tr>
<tr>
<td>MM02</td>
<td>TRANSPORTATION IN THE COMMUNITY</td>
<td>Multimodal</td>
<td>Kindergarten-2nd Grade</td>
</tr>
<tr>
<td>MM03</td>
<td>LET’S GO!</td>
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<td>6th – 8th Grade</td>
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<td>TFS04 U.S. TRADE AND TRANSPORT</td>
<td>Trucking/Freight Systems</td>
<td>3rd - 5th Grade</td>
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</table>
OUTREACH GUIDELINES

To further support the use of the Recruitment Toolbox and its activities, companion Outreach Guidelines were developed. These guidelines were intentionally kept brief to increase the likelihood for review by outreach providers (i.e., local transportation professionals and students enrolled in transportation-related curricula). The guidelines focus on: (1) understanding your outreach audience with respect to their developmental level, scientific understanding, and mathematics capabilities and (2) adequately preparing to perform the activity including responding to questions regarding transportation engineering as a career choice. These Outreach Guidelines, provided here in Figure 4, will be provided as a link from the Recruitment Toolbox website.

ASSESSMENT PLAN

A third product resulting from this effort was an Assessment Plan. The primary goal of developing the Recruitment Toolbox was to encourage and support participation in recruitment efforts by local transportation professionals and students enrolled in transportation-related curricula. As such, the audience targeted for assessment of project effectiveness included these outreach providers. While it is also of interest to determine how outreach recipients (i.e., pre-college students and teachers) perceive the activities, this was not included in the proposed Assessment Plan because of the significant volunteer effort required to compile, assimilate, and analyze survey data from student/teacher audiences.

The proposed Assessment Plan consists of three levels of information gathering:

1. Website Access
2. Pre-activity Survey

Website Access provides the lowest level of information, indicating Recruitment Toolbox success through the number of website accesses or “hits”. The Pre-activity Survey solicits additional information regarding the outreach provider (i.e., the local transportation professional or students enrolled in transportation-related curricula) and the outreach event to gain better understanding of how the Recruitment Toolbox is actually being used. The final stage of assessment, the Post-activity Survey, provides the most rigorous indication of Recruitment Toolbox effectiveness. Outreach providers would complete this survey following an outreach event, describing how the Recruitment Toolbox assisted in the outreach event, its ease of use, and how well the activities were received by the outreach recipients (from the provider’s point of view). Each of these assessment levels is described in greater detail below.

Website Access

The number of visitors to the Recruitment Toolbox website will give a preliminary indication of the success of the Recruitment Toolbox. This data will be collected through a typical website
Figure 4. Recruitment Toolbox Outreach Guidelines

OUTREACH GUIDELINES

UNDERSTAND YOUR AUDIENCE

Understanding the developmental level, scientific understanding and mathematics capabilities of your audience will help you deliver an effective outreach experience. Here are some general student characteristics to consider:

<table>
<thead>
<tr>
<th>ELEMENTARY SCHOOL</th>
<th>MIDDLE SCHOOL</th>
<th>HIGH SCHOOL</th>
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<td><strong>Scientific Understanding</strong></td>
<td><strong>Mathematics Capabilities</strong></td>
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<tr>
<td>• highly impressionable</td>
<td>• science not always a separate subject</td>
<td>• counting, decimals, simple fractions, percents</td>
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<tr>
<td>• highly curious</td>
<td>• subjects covered may include:</td>
<td>• addition/subtraction (K-2nd)</td>
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<tr>
<td>• reasoning tied to concrete experiences</td>
<td>• characteristics of organisms that co-exist with us</td>
<td>• multiplication/division (3rd-5th)</td>
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<tr>
<td>• rapid shift of interest</td>
<td>• personal health and hygiene</td>
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<tr>
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<td>• poison awareness, including drugs, alcohol, tobacco</td>
<td>• shape recognition (K-2nd)</td>
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<tr>
<td>• boundless energy</td>
<td>• environmental awareness and responsibility</td>
<td>• area/perimeter calculations (3rd-5th)</td>
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<td>• units of measure, accuracy</td>
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<td>• matrix multiplication</td>
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Figure 4. Recruitment Toolbox Outreach Guidelines (Continued)

**PREPARE TO DELIVER**

Adequately preparing for your outreach event will further increase chances of success, regardless of the audience.

1. Select an activity that is age appropriate. ITE’s Recruitment Toolbox allows you to search by age range.
2. Remember your audience. Use the appropriate vocabulary for the age group that you are addressing.
3. Bring an attention grabber or a hook (and your own enthusiasm!) to focus the students’ attention at the beginning of your activity. Keep in mind that your goal is to arouse curiosity, excitement, and an eagerness to learn.
4. Use Props. Bring something to pass around that you use in your profession. These objects may seem ordinary to you, however students love to touch, hold, and explore unfamiliar objects. If possible also bring a small item that the students can take home. They will keep thinking about what you’ve said every time they look at it.
5. Don’t lecture. Let students explore, discover, experiment, solve. Before the hands-on activity begins or after it has ended, involve the students in a question-and-answer period. If you choose to use PowerPoint or other audiovisual aids, make your presentation/demonstration interactive.
6. If you ask a question, allow time for the students to answer. Five seconds of “wait time” will give the students enough time to formulate an answer.
7. Let the students know that you are a real person. Tell them about your family and what got you interested in transportation engineering and engineering in general. Students need to see real life role models. Use humor as often as possible with your personal stories; it’s a great ice-breaker.
8. Be prepared to discuss your career choice in more detail with older students. If appropriate, show ITE’s Careers in Transportation video to the students, followed by a question and answer period. Consider your responses to each of the following questions:
   - How did you choose your career?
   - What exactly do you do during a typical day?
   - What do you like most about your work? What do you like least?
   - How much do you make? How much can you make?
   - Did you like math/science when you were in school?
   - How do you manage your career and family life?
   - What suggestions would you have for a student interested in a career such as yours?

Tell me - I will forget
Show me - I may remember
Involve me - I will understand

Tailor your comments to your audience. For younger students stress some of the basic, but exciting, aspects of your work. Students in middle school are increasingly receptive to discussions about career opportunities, but many do not truly understand the differences between “career” and “job”. Furthermore, at this age, many of them may be easily turned off by the idea of choosing a lifelong-career that involves many more years of school. For older students suggest colleges and universities they may want to look at, potential majors they might consider, and financial rewards they may reap. High school students may be more receptive to the reality of what it takes to succeed in the adult world. Many understand that careers that provide good salaries often require hard work. Some will not aspire toward a career because their environment does not expose them to a lot of options. Others will still be hoping for careers in sports, show business, or other similar fields. Keep the discussion focused more on the benefits and less on the work involved. Your goal should be to make transportation engineering sound exciting so it is something they consider as they mature and pursue their career!

*Most importantly, relax, have fun, and remember that volunteering to work with young students can have a lasting impact on future generations of transportation engineers!*
“hits” counter application. It is recommended that data on both the total number of site accesses and the total number of unique site accesses be collected to distinguish breadth of use (i.e., Recruitment Toolbox used by many different individuals) from depth of use (Recruitment Toolbox used frequently by only a few individuals). This assessment tool should be easily implemented and provides immediate information; no response from the website user is required.

**Pre-activity Survey**

A pre-activity survey will collect information regarding the outreach provider (i.e., the local transportation professionals and students enrolled in transportation-related curricula) and the outreach event. While this assessment tool provides additional information beyond the Website Access tool, it requires input from the site user to be successful. Researchers will work with ITE web services personnel to develop an appropriate user interface that eases the data entry process for outreach providers and hence, encourages their participation in providing this information. In the form of an on-line survey, outreach providers will be prompted for the following information:

- name of outreach provider
- company or agency affiliation (local transportation professionals)
- college or university affiliation (students enrolled in transportation-related curricula)
- contact telephone number
- contact email address
- date of recruitment event
- event description (i.e. class presentation, career fair, summer outreach program, etc.)
- age/grade level of student audience.

It is recommended that as many of the data fields as possible be structured as pull-down menus populated with the most common anticipated responses to minimize the text entry for the outreach provider but also to lend consistency to the type of data received.

In addition to describing who is using the Recruitment Toolbox, how frequently it is used, and the kinds of outreach events for which it is used, this series of prompts also provides a point of contact for later follow-up (i.e., Post-activity Survey).

Options regarding survey delivery include:

- link to online survey
- voluntary pop-up online survey
• mandatory pop-up online survey.

In the case of a simple link to an online survey, a flashing title block should also be included to draw attention to the link. Pop-up surveys are more effective in drawing attention, but may require more effort to implement. If the pop-up survey is made mandatory, users would be required to complete the Pre-activity Survey before downloading any activities. While this latter method would help to ensure capture of assessment data, it might also discourage some users from utilizing the Recruitment Toolbox altogether. Implementation requirements for each of these three options, as well as the advantages and disadvantages of each, will be discussed with ITE’s web services personnel during the continued development process.

Post-activity Survey

The Post-activity Survey has the potential to provide the most useful data to evaluate the effectiveness of the Recruitment Toolbox. However, this data will likely be the most difficult to obtain. Again, an on-line survey is the recommended form of data collection. An additional “reminder” mechanism must be concurrently implemented, prompting outreach providers to return to the Recruitment Toolbox website following the outreach event. When they return, a post-activity on-line survey will prompt outreach providers for the following types of information:

• Outreach Facilitation
  • How easy was it to find a suitable activity in the Recruitment Toolbox?
  • Does this tool make it easier to volunteer for outreach activities?

• Classroom Implementation
  • Did the activity work as intended?
  • Was it easy to implement?
  • Was it easy for students to follow?

• Student/Teacher Reception
  • How did students/teachers react to the activity?
  • Did this activity make students/teachers more aware of career opportunities in the transportation field?
  • Did this activity make students/teachers more interested in transportation careers?
  • Overall, how would you rate this activity?

Again, it is recommended that as many of the data fields as possible be structured as pull-down menus populated with five-point scale rankings (e.g., very good, good, neutral, poor, very poor)
or the most common anticipated responses to minimize text entry for the outreach provider and lend consistency to the type of data received. Because of the qualitative nature of these responses, the Post-activity Survey will include sufficient opportunity for outreach providers to submit general comments. With this level of feedback, particularly on the individual activities, a systematic process for improving activities with poor ratings could be implemented.

Despite the benefits of having this information, the likelihood of capturing it is expected to be low; outreach providers may be reluctant to return to the Recruitment Toolbox website following the outreach event to complete a survey. A two-stage electronic “notification” and “reminder” system is recommended for concurrent implementation with the Post-activity Survey. The email address provided in Pre-activity Survey would be used to send an automated response to outreach providers, thanking them for utilizing the Recruitment Toolbox and informing them of the Post-activity Survey. A second automated email would be sent following the date of the outreach event (again, provided in the Pre-activity Survey), requesting that the outreach provider follow a link to the online Post-activity Survey, and thanking them again for their involvement. The second email would serve as a reminder for the post-activity survey, and is intended to increase participation in this portion of the assessment.

In the longer-term, instituting some form of recognition for outreach providers who actively utilize the Recruitment Toolbox and participate in outreach events may be worth pursuit. One option may be to foster competition among ITE Districts, Sections, or Chapters by providing recognition/awards to those with the most outreach activities each year. To be eligible, both the Pre- and Post-activity Surveys would have to be completed. Such an atmosphere of “friendly competition” may also enhance exposure for the Recruitment Toolbox as District, Section, or Chapter leaders promote its use among members.
CHAPTER 4
CONCLUSIONS

Numerous efforts have been conducted to quantify the extent of the workforce challenge, identify causative factors such as non-competitive salary rates and tout general strategies for addressing workforce shortages. However, little prior work has been done to develop usable tools, particularly at the local levels, to enhance the recruitment of transportation professionals.

In partnership with ITE’s Transportation Education Council, this project assimilated transportation-related activities from around the country and other sources into an easily accessible, electronic database - a Recruitment Toolbox.

The development of a Recruitment Toolbox is intended to encourage higher quality and more frequent outreach to students by providing proven, easily accessible activities or exercises to transportation professionals and students currently enrolled in transportation curricula. The development of this tool also supports broader workforce development goals by increasing the level of involvement by outreach providers (i.e., transportation professionals and students currently enrolled in transportation-related curricula) in recruitment efforts and in addressing the larger workforce challenge. Through outreach at the local levels and by local volunteers, a much broader student audience can be exposed to the transportation profession and with greater frequency of exposure. The hope is that through high-quality and frequent exposure to transportation-related topics, students may develop a strong interest in pursuing a transportation-related career.

The benefits from the development of the Recruitment Toolbox cannot begin to be measured until full implementation occurs in January 2007. Through this investigation, researchers have developed an Assessment Plan that will be implemented concurrently to ensure that the benefits attributable to the development of the Recruitment Toolbox can be effectively measured.

OBSERVATIONS

The development of the Recruitment Toolbox was not without challenge. General observations related to volunteerism, other resources, and activity content are described below.

Volunteerism

Professional and student transportation communities demonstrated a profound lack of responsiveness in this development effort. This observation is not entirely surprising. As with many volunteer-based activities, time constraints and other priorities often take precedence over volunteer contributions. Because most recruitment events are scheduled in the Spring, timing the solicitation for distribution in March/April may have been more effective in directly correlating volunteer contribution with potential benefit from the product. This timeframe may have also captured current student-developed activities/exercises before their graduation and transition to the professional workforce; students that were contacted as part of this solicitation may not have participated in recruitment events held in the prior Spring.
Other Resources

Outside of the professional and student transportation communities, a wealth of information currently exists both through other programs specifically targeting transportation, engineering, and math and science education and through general educator resources. To date, transportation professionals and students have not widely accessed this information because: (1) visiting individual sites related to transportation, engineering, and math and science to find an activity/exercise that is appropriate with respect to age level, duration, available resources, etc. can be time-consuming and unsuccessful and (2) they may be unaware of general educator resources targeting pre-college teachers or may be unwilling to pay the annual subscription fee charged to access some of the more comprehensive sites.

Activity Content

In looking specifically at the types of activities collected for the Recruitment Toolbox, two areas for improvement exist. Many of the activities require the outreach provider to gather preparatory information (in addition to materials and supplies for the exercises) on their own. For example, the outreach provider may be directed to access pictures of or historical facts for a particular bridge from the Internet or other sources to support the activity. If this information were added to the activity, it would eliminate duplicate efforts by outreach providers utilizing the outreach “tool”. Second, many of the activities instruct students to “draw a picture of…” or “write in a journal about….” as a means to actively engage them in the event. Transportation professionals and students, with a more extensive understanding of the topic areas (many of these activities were developed by pre-college teachers without specific transportation-related knowledge), may be able to develop more constructive hands-on applications to supplement these activities.

RECOMMENDATIONS

The development of the Recruitment Toolbox represents a first step in encouraging higher quality and more frequent outreach to pre-college students by transportation professionals and students currently enrolled in transportation curricula. Researchers were tasked with bringing together previously-developed transportation-related activities and exercises into a common database. Improvements or expansions to these activities were beyond the scope of this effort. However, this is a logical next step. Existing activities should be reviewed and enhanced with additional preparatory information or more constructive hands-on applications. Information gathered through the Assessment Plan can help to guide the priority of improvements.
REFERENCES


Zimmers, Sharon P. *Adapting and Delivering Your Best Scientific Lecture Material to a K-12 Class*. K-12 Education Subcommittee, Society of Toxicology. 2003.
APPENDIX A:
RECRUITMENT TOOLBOX ACTIVITIES
WHAT DO SALT TRUCKS DO?

**TOPIC AREA:** Roadway Maintenance  
**AGE LEVEL:** Kindergarten-2nd Grade  
**DURATION:** 1-2 hours  
**RESOURCES:**

**MATERIAL:**  
• 3 ice cubes  
• 2 containers  
• Iodized salt

**OBJECTIVE:** Children predict, and then observe, what happens to ice when salt is applied to it. Note: This is a good activity for a snowy morning when children are likely to have noticed salt trucks on their street spreading salt.

**BACKGROUND:** The salt trucks are on the roads again. That means cold weather, freezing temperatures mixed with ice, sleet, or snow. What does the salt do? Does it melt the snow or ice? Not really. Sun or warm weather does the melting. The salt lowers the temperature at which water freezes. When the truck puts the salt on the road, the temperature at which ice forms changes to 16° C (4° F). This means that the ice and snow stay in its liquid form longer and thus disappear from the road surface faster because it doesn’t change back to ice as soon. However, when the temperature is very low (below -16° C (4° F)), salt water freezes just like regular water. All of this freezing and melting at different temperatures is not what your four or five year olds need to understand. What they can observe is that salt has an effect on freezing of water, and that is the reason it is used on sidewalks and streets during bad winter weather.

**TASKS:**

1. Pass one ice cube around the group ask children to tell something they know about it. Discuss its temperature, color, slipperiness, melting properties, etc. Mention some of the problems people have when there is ice on the ground (e.g. it’s too slippery to walk or drive safely). Ask if the children have noticed salt trucks on the road. Explain that they spread salt to help melt the ice and make the roads safer for cars.

2. Place two remaining ice cubes in separate containers. Pour a generous amount of salt on one, but not the other. Ask children to predict what might happen.

**DISCUSSION:** Ask children to check the two containers periodically. After an hour or so (the rate of melting depends on many things, including the amount of salt used), reconvene the group. Ask them what has happened to the ice and if the salt made a difference.

**SOURCE:** GIANT Encyclopedia of Science Activities for Children 3 to 6, More Mudpies to Magnets
PENNIES ON A PAPER BRIDGE

TOPIC AREA: Roadway Design/Structures

AGE LEVEL: 6th-8th Grade

DURATION: 20–30 minutes

RESOURCES:
• Environmental Loads video, Program Description
• Shapes Lab
• Additional Resources

MATERIALS: Per group of two:
• Plain paper
• 5 paper clips
• Ruler
• 2 books or blocks
• 100 pennies or washers
• Scissors

OBJECTIVE: Changing the shape of a material can change the way it resists forces. Use this opportunity to discuss that while engineers cannot build multiple full-size bridges to test their ideas, they use models and computer simulations to test and redesign structures.

BACKGROUND: Although a piece of paper seems flexible and weak, it can be folded, rolled, twisted, or otherwise altered to support more weight. Folding the paper into the shape of an I-beam or accordion-pleated helps it to resist bending forces created by the live load of the pennies on top of the bridge. Rolling the paper around the pennies and fastening the ends with paper clips is another possible solution.

TASKS: Introduce the Activity. Hold up a single piece of paper. Ask: "How many pennies do you think a bridge made out of this paper can hold?" After kids make some guesses, lay the sheet of paper flat across two books placed 20 cm (about 8 in.) apart. With the kids keeping count, place pennies on the bridge, near the middle, until the bridge fails. (It will hold only a few.) Now introduce the activity challenge.

Can you build a bridge that holds 100 pennies, using 1 sheet of paper and up to 5 paper clips? A bridge must support its own weight (the dead load) as well as the weight of anything placed on it, like the pennies (the live load). Your paper bridge must span 20 centimeters (about 8 in.). The sides of your bridge will rest on two books and cannot be taped or attached to the books or the table.

1. Make a Prediction. Describe how you think the bridge should be constructed in order to support its dead load plus the live load of the pennies.

2. Try It Out. Discuss possible ideas with your partner before you start building. What can you do to the paper to make it stronger? When you have decided on a design, construct your bridge. Place the bridge across two supports that are 20 cm apart. Remember that the space below the bridge must be clear to allow boats to pass! To test your bridge, load it with pennies one at a time, until it collapses. Record how many pennies your bridge supported.

3. Explain It. Describe how well your bridge supported its dead load and the live load you placed on it. Was the bridge as strong as you thought it would be? Where did it fail?

4. Build on It. Redesign your bridge and test it again, using a new sheet of paper. How does your second attempt compare? Is there a difference in the load your bridge can hold if you put the load in the center of the bridge compared to spreading it along the bridge? Make a prediction and test it.

DISCUSSION: Ask kids questions about their designs. What can they do to the paper to make it stronger? Should they cut the paper? How can they use the paper clips? Have a discussion about different types of bridges kids have seen. How long were they? How tall? What were the bridges designed to transport (e.g., trains, cars, people)? What other considerations went into designing the bridges (e.g., earthquakes, boat traffic)? As kids test their bridges, suggest that they observe the bridges closely to determine where they fail. How can engineers test their plans for building a full-size bridge?

SOURCE: Building Big, Public Broadcasting System (PBS)
THE SECRET OF SUSPENSION

TOPIC AREA: Roadway Design/Structures
AGE LEVEL: 6th-8th Grade
DURATION: 30-40 minutes
RESOURCES: • Brooklyn Bridge, Program Description
• Bridge Overview
• Additional Resources

MATERIALS: Per group (2)
• 7 drinking straws
• Masking tape
• Dental floss or thread
• Scissors
• 4 large paper clips
• Paper cup
• Pennies or washers
• Ruler

OBJECTIVE: A suspension bridge’s cables are beautiful to look at, but they also enable the bridge to cross large spans. Make a model suspension bridge to see how it works.

BACKGROUND: A suspension bridge’s cables and towers transmit the dead load of the bridge deck and the live load of traffic to the massive anchor blocks at each end of the bridge. The tension in the cables leading up from the bridge deck is balanced by the tension in the cables leading to the anchor blocks, as well as the compression in the towers. The anchor blocks must be massive enough to resist the tension in the cables caused by the weight of the bridge deck.

TASKS:
1. Make a Prediction. Predict how many pennies your suspension bridge will support, as compared to a simple beam bridge.
2. Try It Out. Cut two short pieces of straw, each 3 centimeters (1.25 in.) long. For each tower, tape two straws on either side of a short piece of straw. Tape the long straws together at the top. Tape one tower to the edge of a desk or chair and the second tower to a second desk or chair of the same height. Position the towers 17 cm (7 in.) apart. Place another straw between the towers so its ends rest on the short pieces (e.g., bridge deck). Now you have a simple beam bridge. Make a load tester by unbending a large paper clip into a V-shape. Poke the ends of the paper clip into opposite sides of a paper cup, near the rim. Use a second paper clip to hang the load tester over the bridge deck. Record how many pennies the paper cup can hold before the bridge fails. Change the beam bridge into a suspension bridge. Tie the center of a 100-cm (4 ft.) cable around the middle of a new straw. Place the straw between the towers. Pass each end of the cable over a tower and down the other side. To anchor the bridge, wrap each end of the cable around a paper clip. Slide the paper clips away from the tower until the cable pulls tight. Then tape the paper clips firmly to the desks. Test it again.
3. Explain It. Can you identify the forces acting on the loaded suspension bridge? Which parts of the bridge are in compression? Which parts are in tension?
4. Build on It. Can you design and build a straw suspension bridge that spans a gap twice as wide and supports the same amount of weight? What parts of the bridge design need to change? Try it.

DISCUSSION: To help kids understand how forces act in a suspension bridge, have them experiment with attaching the cables from the bridge deck only to the tops of the towers, instead of extending them back down to the surface at the ends of the bridge. Ask: How strong is the bridge this way? Why? (This model is less strong than the model in which the cables extend back down to the ground on the other sides of the towers. A load on this bridge deck pulls the tips of the towers inward. There is no balancing tension pulling the towers back out toward the ground.) This basic suspension bridge design can be applied using other materials to build larger, stronger bridges. For example, kids can use paper-towel tubes and string to build the bridge deck and cables, and use the backs of two chairs as the towers.

SOURCE: Building Big, Public Broadcasting System (PBS)
### HOW GOOD ARE YOUR DIRECTIONS?

**TOPIC AREA:** Roadway Design/Structures  
**AGE LEVEL:** 6th-8th Grade  
**DURATION:** 15 minutes  
**RESOURCES:**  
- Hoosac Tunnel, The Chunnel, Program Descriptions  
- Tunnel Challenge  
- Additional Resources  

**MATERIALS:** Per group (2)  
- Large piece of cardboard or foam-core board  
- 2 books or blocks  
- 2 ballpoint pens  
- Paper  
- Ruler

**OBJECTIVE:** One challenge of tunnel engineering is making precise measurements to ensure that teams building from each end of the tunnel come together in the middle. This activity shows students the importance of choosing which measurements to make and communicating them accurately. Kids may measure points on the circle from different sides of the cardboard, or divide the cardboard into imaginary fractions.

**TASKS:** One major challenge of building a tunnel is making sure that the teams digging from each side meet in the middle. In this activity you will need to describe the location of a tunnel opening on one side of a piece of cardboard to your partner, who will try to recreate it on the other side. Play a game of "Hot and Cold" to have kids locate an object in the room. Use the game as a starting point for a discussion about the best ways of communicating information and directions, including giving specific measurements.

1. **Make a Prediction.** Predict how close your partner will be able to get to your tunnel entrance. Why do you think so?
2. **Try It Out.** Stand the cardboard up on one edge between you and your partner. Place a book on each side of the cardboard to hold it up. Holding onto the cardboard to keep it standing, draw a circle about the size of a penny somewhere on your side of the cardboard. Label the circle A. This is the entrance to Tunnel A. Your partner should draw a circle somewhere on the other side of the cardboard, and label it B (the entrance to Tunnel B). Now describe the location of the Tunnel A entrance to your partner as precisely as you can. Your partner should describe the location of the Tunnel B entrance to you. Based on his or her description, draw the other end of your partner’s tunnel on your side of the cardboard. Your partner should do the same. Use the pen to carefully punch a hole where you think your partner’s Tunnel B is. Your partner should punch a hole where he or she thinks Tunnel A is. Now turn the cardboard around to see how well you both communicated!
3. **Explain It.** How closely did the two ends of each tunnel match up? If one tunnel matched more closely than the other, what do you think accounts for the difference? How is this challenge like the challenge engineers face in digging a long underground tunnel?
4. **Build on It.** Sit back to back with a partner so that you are facing away from each other. As you build a simple structure, describe what you are doing. Your partner should follow your directions at the same time. When you are finished, see how closely the two structures match up.

**DISCUSSION:** Kids may ask questions about what they are "supposed to" do in describing the location of their tunnel. Remind them that the goal is to enable their partners to draw a matching tunnel entrance (size and location) on the other side of the cardboard, and part of the challenge is to choose a way of communicating that information as completely as possible. Encourage kids to consider different ways of communicating the locations of their tunnel entrances using the materials they have.

**SOURCE:** Building Big, Public Broadcasting System (PBS)
TUNNEL CHALLENGE

TOPIC AREA: Roadway Design/Structures

AGE LEVEL: 6th-8th Grade

DURATION: 30-40 minutes

RESOURCES: • Building Small: Tunnels,
• Buy the Video
• Interactive Tunnel Challenge

MATERIALS: • Plastic spoon
• 4 toilet-paper tubes
• Paper
• Tape
• Paper cup

OBJECTIVE: Design and build a tunnel through a tub of sand, without touching the sand with your hands. Because they cannot use their hands, kids must find a way to dig out the sand and stabilize the sides of the tunnel before laying in the tunnel sections (the toilet-paper tubes). Or, they may model the "shield" method by covering the ends of the tubes with paper and burrowing into the sand.

TASKS:

1. Give kids the challenges ahead of time so they can think about possible solutions before the activity.

2. Form groups of 3 or 4 kids for these activities. To ensure that all group members actively participate, assign roles such as "architect," "materials buyer," and "construction foreperson." Have kids switch roles during the activity.

3. Incorporate a "design review" stage. Have kids present their plans to another group and trade feedback. Or, you can act as the City Engineer to provide comments and suggestions on each design. The finished projects can serve as outcomes for performance-based assessment.

DISCUSSION: Any of these activities can be extended by adding the consideration of environmental loads such as earthquakes (shaking the table) or wind (using a table fan). Have kids test their structures, redesign them, and test them again.

SOURCE: Building Big, Public Broadcasting System (PBS)
**Bridges: Design and Function**

**Topic Area:** Roadway Design/Structures  
**Age Level:** 6th-8th Grade  
**Duration:** Each group:

**Materials:**  
- Internet access (optional)  
- Butcher block paper  
- Pencils, markers, and crayons  
- Classroom activity sheet: Bridge Research  
- Take-home sheet: Longest Suspension Bridges in the U.S.

**Resources:**  
- Bridges: Design and Function, VHS  
- Bridges: Reaching Out  
- Technology & Bridge Design  
- How Bridges Work  
- Bridge Building-Art and Science  
- West Point Bridge Designer

**Objective:** Students will: (1) understand the benefits and drawbacks of different types of bridges and (2) think about the challenges involved in building bridges.

**Background:** Click on any of the vocabulary words below to hear them pronounced and used in a sentence.

- **arch bridge**: A type of bridge in which its weight is carried outward along the curve to supports at each end. One of the oldest connecting structures, arch bridges can span up to 1,700 ft.
- **beam bridge**: A simple type of bridge composed of horizontal beams supported by vertical posts.
- **cable-stayed bridge**: A bridge in which the roadway deck is suspended from cables anchored to one or more towers. Unlike suspension bridges, cable-stayed bridges do not block view of the water.
- **cantilever bridge**: A projecting structure supported only at one end, much like a shelf bracket or a diving board. A cantilever bridge has two towers located on opposite sides of a body of water.
- **span**: The distance between two supports of a bridge. The Verrazano-Narrows Bridge has a span of 4,260 ft, the longest of any bridge in the United States.
- **stay**: A long, strong wire rope that supports a mast.
- **suspension bridge**: A bridge in which the roadway is hung from strong cables that pass over two towers. The George Washington Bridge is the second longest suspension bridge in New York City.
- **tension**: A force that stretches a material apart, often making the material longer. When cars travel on a suspension bridge, they put tension on the vertical cables.
- **truss**: A rigid frame composed of short, straight pieces joined to form a series of triangles. Many suspension bridges have trusses beneath the roadway to prevent twisting.

**Tasks:**

1. Introduce the lesson by showing the class a picture of a popular bridge, such as the Golden Gate Bridge (San Francisco) or the Brooklyn Bridge (New York City). Ask students to imagine what might happen if all the bridges in New York City or San Francisco were suddenly shut down. Then help the class brainstorm some ways that bridges affect our lives. For example, you could remind students that food and other essential supplies are often transported across bridges.

2. Gather an assortment of bridge photos from library books and Web sites. Ask students to look at some pictures and discuss ways in which the bridges are similar. Then ask the class to speculate on why many bridges are shaped differently and made of different materials. Finally, help students make a list of some of the challenges that successful bridge designers must overcome. Some possible answers include earthquakes, strong winds, and changes in temperature.
3. Divide students into small groups of three or four. Ask each group to select a photograph and research the bridge. Students can write their findings on the Classroom Activity Sheet: Bridge Research. Each group should try to find the following information:
- When and where was the bridge built?
- What type of architecture characterizes the bridge? Is the architecture consistent with an arch, beam, suspension, cable-stayed, cantilever, or moveable design?
- What were some special challenges that the bridge architects and engineers faced? How did they overcome those challenges?
- How much time did construction crews need to complete the bridge?
- Approximately how many cars use this bridge each week (or year)?
- What interesting stories can be found about this bridge? For example, are any fun facts associated with its design, construction, name, or use?

4. Have students in each group draw the bridge on butcher block paper. Specify a scale, such as 1 inch = 1,000 feet, and ask students to write the scale in a corner of the illustration. To demonstrate the scale, instruct students to draw a stick figure that represents a person 5 feet tall. Note: The scale may depend on the available wall space in the classroom or school hallway. As a concluding activity, have the groups imagine that they are bridge tour guides. Ask each group write a short tour script and then select one person to present the tour to the class.

5. For homework, assign the Take-Home Sheet: Longest Suspension Bridges in the United States. The assignment will give students understanding of nationwide bridge locations.

DISCUSSION:

1. Thousands of cars drive over bridges each day. What are some techniques used to enable bridges to withstand this level of wear and tear? What keeps the bridges from falling down?

2. In October 1989, a strong earthquake in the San Francisco Bay Area caused tremendous structural damage to many bridges. What are some ways that such bridge damage might be avoided in the future?

3. What is the longest bridge in your area? Why was it built? What factors determined the materials used to design and build it? Did the builders face any special challenges?

4. Does a career as a bridge builder or engineer sound interesting to you? Why or why not? What challenges do you think would be particularly frustrating?

5. The U.S. government requires states to inspect and evaluate all bridges at least once every two years. What are some ways that technology can be used to make bridge inspection more efficient and effective?

6. In addition to being functional, bridges frequently become attractive landmarks for a town or region. Which bridges do you think are most visually appealing? Why?

EXTENSION: You’re the Engineer! Two online challenges will help students improve their understanding of different kinds of bridges. On each Web site listed below, students will find several scenarios that conclude with a question about the best kind of bridge to build. Students must figure out how to resolve the problem.


NOVA Online Bridge Activity, http://www.pbs.org/wgbh/nova/bridge/build.html

SOURCE: Jordan D. Brown, a freelance author specializing in materials for kids and teachers, DiscoverySchool.com
Bridge Research

Bridge: ____________________________________________________________

Use the questions below to guide your research on the bridge your group selected.

1. When and where was the bridge built?
   _________________________________________________________________
   _________________________________________________________________

2. What type of bridge is it (arch, beam, suspension, cable-stayed, cantilever, moveable)?
   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________

3. What were some special challenges that the architects and engineers of this bridge faced? How did they overcome those challenges?
   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________

4. How long did it take to complete construction of the bridge?
   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________

5. Approximately how many cars use this bridge each week (or year)?
   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________

6. Did you find any interesting stories about this bridge? Any fun facts?
   _________________________________________________________________
   _________________________________________________________________
   _________________________________________________________________
Longest Suspension Bridges in the United States

Some of the most famous bridges in the United States are suspension bridges. On a suspension bridge, the roadway is hung from strong cables that pass over two towers. The span of the bridge is the distance between the two towers. The five longest suspension bridges in the U.S. are listed below.

1. Verrazano-Narrows Bridge
   - New York, NY
   - Built: 1964
   - Span: 4,200 feet

2. Golden Gate Bridge
   - San Francisco, CA
   - Built: 1937
   - Span: 4,200 feet

3. Mackinac Bridge
   - Mackinaw City, MI
   - Built: 1957
   - Span: 3,800 feet

4. George Washington Bridge
   - New York, NY
   - Built: 1931
   - Span: 3,500 feet

5. Tacoma Narrows Bridge
   - Tacoma, WA
   - Built: 1950
   - Span: 2,800 feet

On the map below, mark where each bridge is located. Next to each bridge, name the body of water that the bridge crosses.

[Map of the United States with bridge locations marked]

Draw a bar graph showing the length of each suspension bridge listed below. Include a bar for the world’s longest suspension bridge, the Akashi-Kaikyo, in Kobe-Naruto, Japan. It spans 6,529 feet.

Akashi-Kaikyo
Verrazano-Narrows
Golden Gate
Mackinac
George Washington
Tacoma Narrows

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<th>Length in feet</th>
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[Bar graph with bars for each bridge length]
TUNNELS: UNDERGROUND CONNECTORS

**TOPIC AREA:** Roadway Design/Structures

**AGE LEVEL:** 6th–8th Grade

**DURATION:** Each group:

- 50 blank index cards
- Pens and pencils
- Scrap paper

**RESOURCES:**
- All About Tunnels
- Tunnels: Digging In
- The Chunnel
- Holland Tunnel Story
- Some Notable Tunnels
- Seikan Tunnel—Japan
- Hoosac Tunnel—Massachusetts
- World’s Longest Tunnel Page
- Tunnels: Underground Connectors
- Discovery: Buildings, Bridges, and Tunnels
- Holland Tunnel—New York-New Jersey
- Great Engineering Successes: The Channel Tunnel
- Central Artery/Tunnel Project (Big Dig)—Boston
- Channel Tunnel (Chunnel)—England and France
- Chesapeake Bay Bridge-Tunnel—VirginiaTunnelbuilder.com

**MATERIALS:**
- The class: Internet access (optional)
- Each student: Pens and pencils
- Take-home activity sheet: Design a Tunnel of the Future
- Tunnels Fact Sheet

**OBJECTIVE:** Students will: (1) understand some of the technology involved in constructing tunnels under cities, through mountains, and under water, and (2) examine some notable tunnels that have been constructed over time.

**BACKGROUND:**

- **compressed air**
  A drill that uses pressurized air to cut through rock. The compressed air drill is three times more effective than gunpowder for making tunnels.

- **drill**
  An open trench cut in the earth into which a premade tunnel is dropped; once the tunnel is in place, the workers cover it with soil. Because engineers aren’t able to move buildings and roads out of the way very easily, the cut-and-cover technique isn’t always the best solution for digging under cities.

- **excavate**
  Dig up or remove from the ground. In 1867, dynamite was used to excavate the Hoosac Tunnel in Massachusetts.

- **nitroglycerin**
  An explosive compound made from a mixture of glycerol and concentrated nitric and sulfuric acids. Nitroglycerin is an important chemical found in dynamite.

- **subway**
  An electric underground railway. In the Washington, D.C., metropolitan area, the subway system, known as the Metro, is the most efficient way to travel from the city to suburbs in Maryland and Virginia.

- **tunnel shield**
  A structure used at the head of a tunnel to prevent it from collapsing. Tunnel shields are frequently used when engineers construct subways, water supply systems, and sewers.

- **Tunnel Boring Machine (TBM)**
  An enormous rock-chewing machine that can create tunnels through the ground. As the 200-ton Tunnel Boring Machine works, its round cutter head grinds into the tunnel face and splits large chunks of rock.
TASKS:

1. Begin the activity by asking students what they know about tunnels. For example, ask them if they know where tunnels are usually built and how they are constructed. Then ask students if they can name any tunnels.

2. Divide the class into four teams of six or seven students. Tell students that their assignment is to create a class quiz game that focuses on tunnels. Give each group one of the following categories:
   - History of tunnels
   - Tools and techniques used to build tunnels
   - Notable tunnels
   - New tunnel technology

3. Each group should develop 10 questions in its category. Each game will consist of five questions in each category, worth 100, 200, 300, 400, and 500 points. Have students develop a range of answers, based on easy to difficult questions, and assign a number value to each. (Of their 10 questions, 2 should be worth 100 points, 2 worth 200 points, and so on.) Answers can be prepared in response to a multiple-choice format, true/false questions, or simple questions requiring a short answer.

4. For your information, the Fact Sheet includes some interesting points about each category that you can use to help students start their research. To supplement this information, students can use encyclopedias, books, and other reference materials, as well as the suggested Web sites.

5. After students have completed their answers, play two rounds of the quiz game. One student can be the moderator, another can be the scorekeeper, and three students can be contestants. As the contestants pick categories, the moderator should call on a student from the appropriate team to give the answer. Give each group of three students a chance to respond to five answers. Then select new contestants and a new moderator and scorekeeper. If possible, play the game until everyone has had a chance to be a contestant. Students with the three highest scores win the game.

6. Assign the Take-Home Sheet: The Future of Tunnel Construction for homework. Have students bring their sheets to class and share their ideas.

DISCUSSION:

1. Where are tunnels usually constructed? Think of different types of tunnels, such as those under water, under land, or through a mountain. Why are such tunnels constructed? What benefits do they serve?

2. Why do major tunnel projects take so many years to complete?

3. What are some of the challenges involved in trying to dig through a mountain using a tunnel boring machine (TBM)?

4. Research a tunnel located in your area. Try to find out the estimated number of cars and trucks that pass through it each day.

5. What health hazards do tunnel construction workers face?

6. What precautions can tunnel builders take to prevent injury or death as they work underground?

EXTENSION: Subways Around the World. Most students probably aren’t aware that subways are really tunnels with train tracks built in them. Have students pick one subway system to research. Examples include the system in Washington, D.C., considered one of the best in the world; the subway system in New York City; and the "Tube" in London, England. Have students research when it was built, record any new or unusual technologies or materials used in its construction, and find a map showing the system’s different routes. If time permits, have students share their findings. Stimulate discussion with questions such as the following: How is each subway alike? How is each one different? Which one do you think is the best in the world? Why?

SOURCE: Jordan D. Brown, a freelance author specializing in materials for kids and teachers, DiscoverySchool.com
Design a Tunnel of the Future

Imagine that it is 2030. You and a team of engineers have been asked to build a tunnel under the Bering Strait to link Alaska and Russia. Use what you have learned about tunnels to develop a work plan for the project. Write a paragraph describing your plan and then make a sketch of your ideas. The questions below will help you get started. Imagine what new technologies may be available in the future. Let your imagination go and design a dream tunnel constructed with state-of-the-art equipment. Remember, just about anything is possible!

1. How would engineers construct the underwater portion of the tunnel?

2. What obstacles would engineers most likely face?

3. What current technologies would you use?

4. Now let your imagination go! Invent some new technologies that you could use to complete this project.

Design Your Bridge!

On the back, write a summary and draw a sketch of your work plan.
For the Teacher: Tunnels: Underground Marvels

Tunnels Fact Sheet

Here is some information in each of the categories the students are researching for the Jeopardy game.

1. History of tunnels. Roman engineers built the most extensive and complex network of tunnels in the ancient world. They built aqueducts, sloping structures used to carry water from mountain springs to cities and villages. The structures were used to carry fresh water in and wastewater out. Tunnels continued to be used throughout time, and by the 17th century, tunnels were being constructed for canals as a way to haul freight over long distances. With the invention of trains in the 19th century and cars in the early 20th century, tunnels provided additional space underground on which these vehicles could travel.

2. Tools and techniques used to build tunnels. The four main types of tools and techniques used are drilling and blasting, tunnel boring machines (TBMs), the cut-and-cover technique, and a tunnel shield. In the late 19th century and early 20th century, drilling with dynamite was a way to dig through mountains. Today, they use TBMs, enormous machines with sharp teeth, for cutting through mountains. For digging underwater, engineers use the cut-and-cover technique, which allows them to float a pre-made tunnel into place, sink it into the water, and then attach it to other sections. Finally, shield tunneling is used when digging shallow tunnels, such as subways, water supply systems, and sewers that usually are constructed on soft earth. A structure called a tunnel shield is used at the front of the tunnel to prevent it from collapsing.

3. Notable tunnels. The following are some examples of notable tunnels.

- **Holland Tunnel.** Built in New York and New Jersey in the 1920s, the Holland Tunnel cost $48 million to build and is more than 8,000 feet long. It is built underwater, and the tunnel was designed so that more cars could cross the Hudson River each day. Ventilation was the biggest challenge in constructing the tunnel, but engineer Clifford Holland solved that problem by constructing 84 powerful electric fans that draw fresh air into the tunnel and blow dirty air out. Unfortunately, fans can be dangerous; in 1949, a truck carrying chemicals exploded the tunnel, injuring 69 people and causing extensive damage to the structure. As a result, strict standards for transporting chemicals and explosives in tunnels were established.

- **Chesapeake Bay Bridge-Tunnel.** Completed in 1964, the tunnel is located in Cape Charles and Virginia Beach in Virginia. Its total length is 9,760 feet, and it cost $200 million to construct. The majority of the bridge-tunnel is above water, but it dips over and under open waters with a complex web of artificial islands, tunnels, and bridges. More than 5,000 piers support the structure. Shortly after it opened, it was selected as one of the seven engineering wonders of the modern world in a worldwide competition that included more than 100 major projects.

- **Japan's Seikan Tunnel.** After 10 years of construction, the Seikan tunnel opened in 1974. The railroad tunnel links the main Japanese island of Honshu with the northern island of Hokkaido, and it cost $7 billion to construct. The tunnel is 33 miles long, the longest railroad tunnel in the world. The underwater portion is 14.5 miles, and it is said to have been the hardest underwater dig ever attempted. Engineers used drilling and blasting to construct it; because the ground was so earthquake-scared, TBMs could not be used.

4. New tunnel technology. Engineers now have access to imaging technology that allows them to make a scan of the inside of the earth. The scan works by computing how sound waves travel through the ground. The technology enables engineers to know the obstacles they may face before they begin digging and drilling. Another advanced in tunnel technology is taking place in Switzerland. Engineers are working on tunnels that cut through the base of the Swiss Alps. To work on this project, engineers have designed special TBMs that can cut through the hard, shifting rock found in these mountains. Finally, to give structural engineers the time they need to build a tunnel properly, chemical engineers are working on new ways to mix concrete so that it hardens at different rates instead of the standard time of 90 minutes to 3 hours. The new concrete ideally could be brought to the site at the time of construction and be mixed at the convenience of the work crew. Because of this, the concrete will stay moist until the engineers are ready to use it. This technique is currently in the experimental phase.
UNDERSTANDING CITIES

TOPIC AREA: Planning/Urban Development
AGE LEVEL: 9th-12th Grade
DURATION: 
RESOURCES: 
- Understanding: Cities
- Cities: USA Citylink
- Bridging the Urban Landscape
- Census Bureau Map Stats
- National Safety Council
- International Space Station

MATERIALS: 
- Access, in print or online, to U.S. population statistics from 1950 to the present

OBJECTIVE: Students will understand the following: (1) the U.S. Census counts the population of the United States in a formal way once every 10 years, (2) looking at a 50-year span of census figures helps us see trends within a city and across cities, and (3) one way to compare populations in cities across a period of time is to plot line graphs.

BACKGROUND: Click on any of the vocabulary words below to hear them pronounced and used in a sentence.

aqueduct An artificial channel or conduit built to transport large amounts of flowing water from a remote source. By A.D. 97, aqueducts, built on a gentle downhill grade, carried 85 million gallons of water daily from many miles away.

infrastructure The underlying system of public works, such as schools, highways, and water, of a city, region, or country.

satellite An urban community situated near or around a major city but independent of it. The majority of the nearly 2 million people who work in Brasilia must live in satellite communities which have sprung up in a ring 15 miles away from the modern capital.

community

transformer A device that converts electrical current in a primary circuit into variations of voltage and current in a secondary circuit by means of induction.

TASKS:

1. The ebb and flow of people into and out of urban centers can reveal some interesting cultural and economic trends. Assign small groups of students to research a given U.S. city's population levels over the last 50 years. Cities to assign include the following, some of which have shown more marked change than the others. In any case, though, you may also add other American cities to the list.
   - New York
   - Dallas
   - Atlanta
   - Detroit
   - Seattle
   - Denver
   - San Francisco
   - Los Angeles

2. As the first step, ask students to research the frequency with which the U.S. population is counted, and based on what they learn have them propose the design of a graph with multiple lines that will report on the population of the listed cities from 1950 until 2000. Students in all the groups must agree on a layout and units because all groups will plot their findings on one graph. They may suggest placing the decade years on the horizontal axis and the population figures in hundred thousands or tens of millions on the vertical axis. (If the 2000 census figures are not available when you undertake this project, ask students if they...
should cut the line graph off at 1990 or if there exist population projections made during the 1990s that they can use for the year 2000.)

3. Alert students to sources they may use for research—printed and online (the U.S. Census site is census).

4. Once all the groups have placed on the graph the five or six sets of coordinates for their city and have drawn the line connecting the dots (or, if using software, the line has been drawn for them), open a discussion on what the graphs indicate.

5. Move on to a discussion of possible reasons for trends in each city and across cities.

You might ask students to work independently rather than in groups, to collect the data for all the cities rather than for just one, and to attach to their graph a personal statement on how, if at all, the trends uncovered may influence their decisions on where to move after 12th grade.

DISCUSSION:

1. Why do cities emerge? Why do vibrant cities attract people?

2. Why are the healthiest cities constantly changing?

3. How did the Industrial Revolution affect cities in both Europe and the United States?

4. What do city planners consider as they attempt to account for the needs of the people who will live in a city? Discuss some of the possible results if city planners ignore these needs.

5. To what extent do you agree or disagree with the claim that big cities spawn the popular culture of a nation. Why or why not?

6. Cityscapes have changed dramatically over the years to accommodate industrial growth, transportation needs and popular style. What is the future of the “big city?” Do you think modern technology and telecommunications advances will change the way city dwellers live, work, and interact?

EXTENSION: How Did Your City Evolve? There are two kinds of cities: “natural” or “organic” cities and planned cities. Have your students research when and how their city, or the nearest one, emerged and grew. After determining whether this city was natural/organic or planned, ask each student to create a promotional brochure inviting businesses to relocate there. The brochures should stress the benefits of the city’s origins (e.g., “Our city developed naturally along the banks of the ...” or “Our city was the result of careful and thorough planning, which will ...”).

Help the Economy Grow. Modern cities often see urban wealth flow away from them and into suburbs. How can cities revitalize their economies? Help students generate a list of challenges faced by U.S. cities in general or their own city in particular. Then have groups of four to six students form planning commissions for some of the cities discussed. Ask each commission to propose solutions to selected problems facing the city in question and to present their solutions to the rest of the class. Then call for a vote on the suggestions the groups offered.

SOURCE: Summer Productions, Inc.
TOPIC AREA: Environment/Energy  MATERIALS: • Pens, pencils, paper
AGE LEVEL: 9th-12th Grade  • Poster board, construction paper
DURATION:  • Junkyard Wars: Cool Cars 2 pack, VHS
RESOURCES: • DOE’s Hybrid Electric Vehicle Program
• An Introduction to Building a Model Solar Car
• Celebrating 100 Years
• Creating The Interstate System
• Automotive Learning Online

OBJECTIVE: Students will understand: (1) the reasons why attitudes toward fossil fuel use and alternative energy sources may change over the next 50 years, (2) how changing attitudes toward fossil fuel use and alternative energy sources may affect car technology, and (3) the types of alternative energy sources that are currently under research, particularly for use in cars.

BACKGROUND: Click on any of the vocabulary words below to hear them pronounced and used in a sentence.

**emissions** The output of a car’s engine (the car’s exhaust). Stricter governmental emissions standards have forced car companies to produce more fuel efficient cars.

**ethanol** Grain alcohol commonly produced from corn. Ethanol can be blended with gasoline to create a cleaner-burning fuel than gasoline alone.

**hybrid** Something of mixed origin or composition. Car manufacturers may soon introduce hybrid vehicles, which will still use gasoline but will also have batteries to store energy and thus increase the car’s fuel efficiency.

**internal combustion** An engine that produces power by burning fuel within the engine. Most cars today still have internal combustion engines; not batteries, solar panels, or other alternative power capabilities.

**natural gas** A mixture of hydrocarbons commonly produced along with crude oil. Natural gas is a fossil fuel that is distributed through all 50 states and burns more cleanly than gasoline.

**OPEC** Organization of Petroleum Exporting Countries. A consortium of oil-producing countries, mainly in the Middle East. OPEC’s oil embargo of the 1970s led the United States into a nationwide energy scare, skyrocketing oil prices, and rationing of gasoline.

TASKS:

1. Ask students to discuss what they already know about fuel efficiency in cars:
   - Which types of cars are the most fuel efficient and why?
   - What factors might contribute to a desire for increased fuel efficiency in cars?
   - How fuel-efficient are cars today compared to 50 years ago?

2. Divide the class into small groups (i.e., four students each). Read the following scenario to the class:

   Pretend that you live in the year 3000. Your group is a team of archaeologists who have been studying the very interesting time period of A.D. 2000-2050. You’ve just excavated a site that reveals a great deal about transportation during this time period. At this site, you’ve found dozens of old cars and car pieces. You’ve also found an old sign that says “Joe’s Junkyard, Established 2015.” Therefore, you assume the oldest cars in this junkyard are from about the year 2000. You know that in 2050, a catastrophic earthquake leveled this part of town and all businesses ceased to operate. You can assume that cars in this junkyard are models from about 2000 to 2050. Your assignment is to present a report to the country’s leading archaeologists explaining the following things:
• The ways in which attitudes toward fossil fuel use and the use of alternative energy sources changed between 2000 and 2050, and the reasons for these changes.

• Changes to automobile technology and power sources between 2000 (the year when the oldest cars junked in 2015 would probably have been built) and 2050, and the ways in which these changes reflected changing attitudes toward fossil fuel use and alternative energy sources.

3. When students take themselves out of this futuristic scenario and into the present time, they will therefore need to make predictions about the following things:

• How and why (or whether) attitudes toward fossil fuel use will change over the next 50 years.

• The reasons why we might see changes in the way cars are powered.

• The changes that will occur in car technology in order to accommodate changing attitudes toward fuel efficiency and energy sources.

4. Ask groups to use the Internet, the library, and any other relevant resources they can find to answer the following questions:

• How do present-day internal-combustion car engines work? How is fuel processed in the engine in order to make the car operate?

• What can be done to increase a car’s fuel efficiency?

• What types of alternative energy sources are being developed for future cars? How do these energy sources power the car? What are the advantages and disadvantages of each type of energy source? Which energy sources seem most likely to be commonly used in cars of the future?

• What environmental, political, and cultural factors might contribute to a desire for cars with higher fuel efficiency or cars that use alternative energy sources?

• What factors might detract from creating cars with higher fuel efficiency or cars that use alternative energy sources?

The following Web sites will be helpful in students’ research:

Energy Quest
Fuel Economy Site
Alternative Fuels Data Center

5. Once they’ve finished their research, have groups prepare their reports. The reports should have two components:

• Oral presentation: Have groups make oral presentations to a panel of archaeologists (i.e., the rest of the class) describing the things that their team has found in Joe’s Junkyard and the conclusions it has reached concerning changes in automobile energy sources and attitudes toward energy use from 2000 to 2050. Their presentations should address the questions they investigated in step 4 of this lesson and should include visual aids when appropriate. For example, they can include diagrams of car engines that use different energy sources (traditional versus hybrid, for example) or charts showing the projected supply of fossil fuels or smog reduction goals for a particular city.

• Written paper: Have each student individually write a two- to three-page paper describing the conclusions his or her group has drawn from Joe’s Junkyard and summarizing the group’s predictions for the ways in which energy sources and attitudes toward energy sources will change over the next 50 years (2000-2050).
Note: It’s entirely possible that students will conclude that the public is not likely to change its attitudes toward fossil fuel use, that car companies will not follow through with plans to create cars powered by alternative energy sources, and that things won’t be all that different 50 years from now. It’s fine for them to draw this conclusion, but they must support their argument with detailed evidence from their research. They can claim that the cars in Joe’s Junkyard didn’t change much during this 50-year period (or that they became less fuel efficient), but they must justify their reasoning by showing evidence from current trends and predictions they’ve found in their research.

**DISCUSSION:**

1. Hypothesize the design features that could increase a car’s fuel efficiency. Discuss how aspects of the engine, body, and other components of the car could be modified to minimize the amount of fuel the car requires.

2. Explain why you think there are many more sport utility vehicles on the road today than there were 10 years ago. Compare the design features of a sport utility vehicle with those of a car in terms of their fuel efficiency.

3. Describe the reasons why car manufacturers dramatically increased their cars’ fuel efficiency over the past 50 years.

4. Explain the environmental effects that a large number of cars might have on a city like Los Angeles, which is very spread out and surrounded by mountains.

5. Describe the reasons why people might be reluctant to abandon their sport utility vehicles and trucks in favor of more fuel efficient cars or to give up their traditional cars for electric vehicles or other alternative energy cars.

6. Discuss what events could cause car manufacturers to drastically change the fuel efficiency or energy sources of their cars.

**EXTENSION: Car Advertising.** Have students look through car magazines and/or brochures and identify design features that are more and less fuel efficient. Ask them to figure out which cars are being marketed as fuel efficient and which are not.

**Changing Attitudes.** Have students interview their parents, grandparents, and teachers to find out how they think attitudes toward fossil fuel use and alternative energy sources have changed in their lifetime. Have they noticed significant changes? If so, have they noticed these changing attitudes reflected in car design? Have these changes affected their behavior as consumers? For example, do they take fuel efficiency into consideration when purchasing a vehicle? Why or why not?

**SOURCE:** Betsy Hedberg, freelance curriculum writer and teacher, LessonPlanet.com
URBAN AND AGRICULTURAL SETTLEMENTS: WHY?

TOPIC AREA: Planning/Urban Development
AGE LEVEL: 3rd - 5th Grade
DURATION: 
RESOURCES: 
MATERIALS: • Blank map of South America
• World atlas
• Colored pencils

OBJECTIVE: To identify types of human settlements, urban and agricultural, and determine geographic influence on why people settle where they did by use of maps and charts.

TASKS:

1. What types of settlements are urban and what are the geographic ideals for urban settlement?
   • Divide students into groups. Provide each group with blank maps, atlases, and colored pencils.
   • Have the students locate from the atlas up to five urban areas from throughout the region, stressing the importance that they try to select five different area types, i.e. inland, coastal, etc.
   • Have students develop maps showing urban areas using population symbols. Have one student in each group chart the name of the cities and the type of urban area it is (e.g. governmental center, port city).
   • Using a physical map, have the students locate the cities and determine the type of physical geography for each urban area (e.g. Madrid, Spain; governmental center, grassy plain). Students will also identify and list major waterways or ocean access points to the urban areas.
   • After the students have completed urban mapping and charts, have one student from each group describe to the class the information they have gathered and why they believe the area was selected for the type of settlement found there.
   • After presentations, list the geographic features from each city on the board and look for possible connections and its location relative to the other cities.

2. What types of settlements are agricultural and what are the most suitable geographic characteristics for agricultural settlement?
   • Using a second copy of the South American map, have the students locate in the atlas subsistence farming, crop and livestock and grazing areas. Students should shade in these areas on their maps. Students will develop a chart to communicate the growing season, rainfall/year and population data for these areas.
   • Students will complete this activity in the same manner as Activity 1 with a summary of the information presented to the class and an explanation of why specific regions seem to be better suited for certain agricultural activity.

3. What factors, other than geography, affect human settlement?
   • Using the information from Activities 1 and 2, students will list at least five things that would be important if they were to develop a settlement in both the urban area and the rural/agricultural area. Have the students share their decisions with the other groups so that they may compare and contrast lists. Students may then discuss or defend their choices and identify effects their planning could have on the location of their settlement.

SOURCE: Robert Poff, LessonPlanet.com
HIGHLY POPULATED U.S. CITIES: A COMMON THREAD

TTOPIC AREA: Planning/Urban Development
AGE LEVEL: 3rd - 5th Grade
DURATION: 
RESOURCES: 

MATERIALS: • U.S. population thematic map
• Markers
• Construction paper

OBJECTIVE: To analyze thematic maps, create charts and graphs, to discover the common thread among the three most populous cities in the United States.

TASKS:

Question # 1: What do the three most populated cities have in common?
• Divide students into small groups. Give each group a thematic map of the United States showing population, markers, and construction paper.
• Tell students to look at the map and decide which three cities have the largest populations.
• After the groups have agreed on the three most populous cities, have them create a chart or graph showing the most populous to the lowest population, using the markers and construction paper.

Question # 2: What is the common thread all three cities share that helped make them the three most populated cities in the United States?
• Have the groups look back at the map and discuss the possibilities of what the common thread may be. Remind students to pay close attention to the placement of each city and to look for things that are similar to each city.
• Ask students to share answers with the group next to them.

SOURCE: Joely Hampton, LessonPlanet.com
UNDERSTANDING FRICTION

TOPIC AREA: Traffic Safety

AGE LEVEL: 3rd - 5th Grade

DURATION: 40 minutes

RESOURCES:

MATERIALS: • Set of washers (30-40)
• Four boards with sandpaper, fabric, wax paper, and uncovered
• Two plastic or tin tubs connected by a string
• Wooden block
• Data sheet
• Pencil

OBJECTIVE: Students will make predictions and record results for friction activity. Students will also gain an understanding of how surface material affects movement.

TASKS: On these boards should be a start and finish line of equal distance. The students are to place the boards on the edge of the desk and place tub with the block on the start line. The string should be long enough that the other tub hangs over the edge of the desk. The students then add washers until the tub with the block moves to the finish line. The students will record the number of washers it took to move the tub. Students should first make a prediction for one surface; add washers, record results, make prediction for next surface type and so on. Students should not make all their predictions first because they can make more accurate predictions after they have seen how many washers it takes for other surfaces.

1. Begin the lesson with a class discussion consisting of the lesson explanation, introduction of terms such as prediction, results, and friction, and behavioral expectations.

2. Before beginning the actual activity, provide an example; have students make a prediction for one of the surfaces and then actually conduct the experiment to demonstrate prediction vs. results.

3. After the discussion, break students into small groups of three or four.

4. Pass out materials and data sheets to each group.

5. Once groups have materials, begin the activity. Remind them that they must make their predictions first. During this part of the lesson, walk around the room, monitoring the groups to make sure they understand and are staying on task. Let the students know when their time is almost up. Each group should get through the activity to compare results.

6. Finally, have the students participate in a post discussion or wrap-up. During this time, ask for each group’s data and put them on the board or the overhead. Discuss similarities and differences between group’s data, their predictions and results, and how different surface types affect the movement of the tubs and number of washers used. Ask the students different types of questions. Why did it take more washers to move the tub on sandpaper than it did on wax paper? How did your predictions differ from your results? How did you go about making your predictions? Relate these discussions to traffic safety and the interaction between tires and the roadway surface.

EXTENSION: Have the students make a graph to show predictions and results to integrate math.

SOURCE: Mrs. Thompson, second grade teacher at Fairview Elementary, LessonPlanet.com
### THE PROBLEM: AIR TRANSPORTATION

**TOPIC AREA:** Aviation, Marine, Rail  
**AGE LEVEL:** 6th-8th Grade  
**DURATION:** 3 - 4 hours  
**RESOURCES:**  
- [http://futureflight.arc.nasa.gov/intro.html](http://futureflight.arc.nasa.gov/intro.html)  
- [http://futureflight.arc.nasa.gov/capacity.html](http://futureflight.arc.nasa.gov/capacity.html)  
- [http://futureflight.arc.nasa.gov](http://futureflight.arc.nasa.gov)  
- Internet access  
- Poster paper/markers or presentation software  
- Student logs: [http://futureflight.arc.nasa.gov/pdf/ffd_pbl_student.pdf](http://futureflight.arc.nasa.gov/pdf/ffd_pbl_student.pdf)

**OBJECTIVE:** Students will create a list of current issues/problems in the Air Transportation System. Specifically, students will:
- choose roles and create a list of questions to research the growing need for increased air capacity  
- gather and analyze information to answer their questions that will help them design a solution  
- work as a team to share their research and brainstorm solutions to the capacity problem  
- create a list of trade-offs associated with each of their solutions  
- create and give a presentation that describes one or more solutions to the capacity problem, their associated trade-offs, and is based on factual information gathered from research.

**TASKS:** Invite community members such as parents, airport personnel, staff or administrators to become a “committee member”. Suggested roles are senior airport planner, local resident, environmentalist, investors.

**Preparation:**
- Download and print Student Logs: [http://futureflight.arc.nasa.gov/pdf/ffd_pbl_student.pdf](http://futureflight.arc.nasa.gov/pdf/ffd_pbl_student.pdf)  
- Use computer/projector system to watch Introduction Movie: [http://futureflight.arc.nasa.gov/intro.html](http://futureflight.arc.nasa.gov/intro.html) as a whole class.  
- Allow students to share related personal stories of air travel.

**Step 1: Letter from NASA**
- Read the Letter from NASA on Activity Website. A copy is also provided in the Student Log.  
- Explain that the next step will be to form a Research Team.

**Step 2: Get a Team Together**
- Teams can be anywhere from 2-5 students.  
- Allow students to form teams or assign teams you have already formed.  
- Have students gather in their teams and enter each team member’s name in their Student Logs.

**Step 3: Discuss the Air Transportation Problem**
- In their groups, have students read the Background Information quietly to each other.  
- Allow students 5-10 minutes to discuss and write down their list of problems with air travel today.

**Step 4: Select a Role**
- Explain that each team member is going to role-play a profession related to the air transportation system as they work to solve the problem.
• Allow 5-10 minutes for students to read the biographies and select roles. These are listed both on the Web site and in the Student Log.

• Have students write their new titles next to each team member’s name listed in their Student Logs.

**Step 5: Write Down What You Need to Know**

• At this point, the students should understand the “problem” in this Problem-based Learning scenario: How can our air transportation system handle the large increase in people and cargo that will take place over the next 20 years?

• This step is asking students to do two things: (1) Ask questions that will help them look for solutions to the main problem and (2) Assign questions to each team member that “fit” their chosen roles.

**Step 6: Find the Answers to Your Questions**

• Direct students to [http://futureflight.arc.nasa.gov](http://futureflight.arc.nasa.gov)

• Students will click on the aircraft and end at the Welcome Screen. Students have the option to watch the Introduction Movie again, or to go directly to the Air Transportation Problem.

• Students will see the NASA Letter and should scroll down to the instructions. Here they can either review the role they have chosen or click on the Research link.

• The Research area contains links to all of the articles and videos available to students. Instruct students to navigate through this section to find the answers to their questions. Encourage students to take notes and write down new questions, or ideas. Some students may find new information that leads them in an unexpected, but interesting area of research. Encourage exploration!

**Step 7: Discuss Your Solutions**

• Each team will now come together and discuss their research. Have students read the directions for Step 7 in the Student Log.

• Once each team member has had a chance to contribute, the team should begin brainstorming solutions to the air transportation problem: How can our air transportation system handle the large increase in people and cargo that will take place over the next 20 years?

• Encourage students to be creative as they plan for the air transportation system of the future. Remind students of the following: (1) Each team will make a presentation before an Air Transportation Committee who will evaluate their work. (2) Any solution is possible, but check to make sure that it’s environmentally friendly, isn’t too noisy, and is backed up by facts from the research. Be innovative!

**Step 8: Create a Presentation**

• Once students have discussed all their ideas, they must organize their work into a presentation before an Air Transportation Committee. Designate a time limit for each presentation.

• Review the Evaluation Rubric provided in the Student Log with the students. (Page 12 of Student Log)

• Once students have completed their presentation, have them complete and turn in an “Abstract” that will act as a cover sheet for their evaluation. (Page 13 of Student Log)

**Step 9: Present the Results**

• Seat Air Transportation Committee members at a table and provide each with a copy of the rubric and the presentation abstracts for each group.

• Introduce each committee member and begin presentations. Allow for committee members to comment or ask questions as time permits.
DISCUSSION: Possible Solutions to the Air Transportation Problem

New Aircraft Design

- Design larger airplanes, or design new aircraft that require a shorter distance for take-off and landing. This would lead to shorter lines on the runway because the airplanes would take off and land more quickly. Students may investigate what it would take to shorten the landing distance. Consider the use of a hybrid airplane/rotorcraft (take off and land vertically).

- Develop new aircraft that do not require a pilot or co-pilot. For example, many trains (such as a tram or subway) and most cargo ships do not require a pilot for navigation. A pilot would be on the plane in case something went wrong. A co-pilot would not be required.

Airports

- Use existing small airports for short flights. Use existing large airports for large aircraft that will take many passengers for long distances. Build more airports.

- Streamline operations at existing airports. Change airplane routes, possibly expanding the altitudes in which they can fly. Develop a system that would require fewer stops. Change hub and spoke model to something else (i.e., use local/regional airports for short-medium distances).

- Have airplanes fly more times of the day (like in the middle of the night).

Automation

- Develop computer programs that will automatically reroute aircraft when the weather is bad, taking into consideration all the other aircraft in the area.

- Design software that can take over mundane or complex tasks for air traffic controllers so they don’t get bored, tired, or stressed out.

Human Factors

- Design the controls on an aircraft so that they are not too complicated to use.

SOURCE: NASA Spacelink
WHEELS AND THINGS: TRANSPORTING GOODS

TOPIC AREA:  Trucking/Freight Systems
AGE LEVEL:  Kindergarten-2nd Grade
DURATION:  2–3 hours
RESOURCES:

OBJECTIVE: Students examine the role of transportation in getting goods to market by designing suitable packaging and preparing an export report. Students should understand that transport is a service that is an essential component in the exchange of goods and services.

TASKS: Discuss the role transport plays in the exchange of goods and services with the class.

- Transport is a service which relies on other services. Some goods cannot be transported without storage and special packaging.
- Goods can be stored in a variety of ways. Individually or in bulk, on shelves, in boxes or in large containers.
- Packaging has become an essential part of the transport of goods and helps make sure goods and products arrive safely.
- Transport is part of what is called the economic infrastructure (lots of smaller systems that make the big system work: as in households or in team sports).

No Humpty Dumpty. Students imagine being packaging experts. Producers come to them for help for packing their products in preparation for transport. They have been asked to design packaging to help the transport and storage of (each student selects one item from the list):

- a crystal vase
- home-grown tomatoes
- a chandelier
- a model airplane
- a prized rose
- a pet mouse

Transport yourself. Students, working in pairs or groups, imagine themselves as a producer of a product about to be exported. Products might include flowers, cheese, ice, or computers. Explain that they are to present an export report to the Department of Trade in order to get a permit to trade. The report will need to include a description of the product (which could be written or drawn), and information about how and where it will be transported (from factory to final destination). This is a checklist of information the department has sent you. Make sure your report includes all the following information:

- contents of the product
- type of product (fragile, bulky)
- destination (how far, how long)
- reliability
- size and weight
- packaging
- cost of the product
- speed of delivery

EXTENSION: Transporting, Packaging and Storing Jobs. Ask the class what different jobs are involved in packaging, transporting and storage of a product. Students list the jobs in alphabetical order. Ask them to try to use at least 18 letters of the alphabet. A job guide from the school library will help them.

SOURCE: Developed jointly by the National Industry Education Forum (NEIF) and Curriculum Corporation.
### Major Transport Routes

**Topic Area:** Multimodal  
**Age Level:** 9th-12th Grade  
**Duration:**  
**Resources:**  
- PowerPoint Presentation – Major Transport Routes 1  
- Activity - Major Transport Routes 1  
- PowerPoint Presentation – Major Transport Routes 2  
- Activity - Major Transport Routes 2  
- Projector/PC/Internet access  
- Library or learning resource centre materials as identified  
- Travel and tourism brochures

**Objective:** How should we choose the transport routes we use to travel for leisure and tourism? Why do most people seem to choose to travel by air? What are the consequences of making this choice? And, what are the alternatives to flying to popular holiday destinations?

This lesson requires you to investigate these and other problems. You will plan holiday journeys to a range of commonly visited destinations. You should evaluate the impacts of your travel decisions.

By participating in this lesson students should be able to:

- Explore the background to developments in transport  
- Investigate transport routes used in tourism to and from the United Kingdom  
- Find out about some key developments to the transport infrastructure  
- Highlight the way that transport is key to the development of travel and tourism involving different regions of the world  
- Boost understanding of different transport routes  
- Become more aware of alternatives to flying to holiday destinations  
- Find sources of information on alternative modes of transport  
- Understand why airlines are able to offer very cheap air travel  
- Plan journeys to destinations using alternative modes of transport

**Tasks:**

1. Outline the key learning objectives of the session.  
2. Go through the PowerPoint Presentation.  
3. Give out the Activity sheet and discuss the tasks.  
4. Support and guide students through their investigations of the key Web resources identified in the Activity.  
5. Support individuals as they work through the individual tasks.  
6. Review the learning objectives of the session.

**Source:** BTEC
HOW WE TRAVEL

TOPIC AREA: Multimodal
AGE LEVEL: Kindergarten-2nd Grade
DURATION: 
RESOURCES: 

MATERIALS: • Construction paper
• Paper
• Crayons/markers
• Glue
• String
• Magazines, buttons, cloth, etc.

OBJECTIVE: Students will become familiar with the three modes of transportation (e.g., land, air, and sea) and the types of transportation that can be categorized into each of them. The students will make a mobile using a type of transportation from each of the three modes. The students will create their own form of transportation and explain what mode it fits into to the class.

BACKGROUND: This activity can be used with students at the kindergarten through second grade level. The lesson teaches the students about the three modes of transportation and the various types of transportation that fit into each of them.

TASKS:

1. What do the students think the three modes of transportation are?
2. Discuss the three modes of transportation and the types of transportation that will fit into each of the modes.
3. Go exploring. Go on a walk or bus ride as a class and observe and discuss the different types of transportation everyone sees.
4. Come back into the classroom and review the three modes of transportation and the types of transportation the students observed that would fit into each of them.
5. After discussing what everyone observed, have each student create their own mobile having each mode of transportation represented. They can use magazines, paper, string, and markers to make their creation. -OR- Have the students create their own unique form of transportation and have them explain to the class which mode it would fit into.

DISCUSSION: Ask the students what types of transportation fit into the three modes. Ask the students what the three modes of transportation are. Ask the students which mode of transportation they think is the fastest.

SOURCE: Tonya Their, Mankato State University, LessonPlanet.com
PLANNING A TRANSPORT BUSINESS

TOPIC AREA: Trucking/Freight Systems
AGE LEVEL: 3rd - 5th Grade
DURATION: 1.5 hours
RESOURCES: • http://www.uen.org/ucme/
            • http://heritage.uen.org/resources/activities.html
MATERIALS: • Poster board
             • Markers
             • Colored paper
             • Glue
             • Any other materials for creativity

OBJECTIVE: Groups of students plan a transport business to run between Independence, Missouri and Salt Lake City, Utah between 1850 and 1860. Students will make and display a poster advertising their freight line. It should show a picture of the vehicle, give the name of the freight line, the items that may be transported, costs, destinations, time schedules and any other pertinent information.

BACKGROUND: In the mid-1800’s, there were needs to be met and profits to be made by enterprising individuals willing to work hard and take a few risks.

TASKS: Discuss the needs of settlers in the 1800’s. Brainstorm some of the items pioneers might wish to send East and what they might need to receive from the East.

1. Have students conduct research to determine what they will transport, the route that will be traveled, the time it will take, and the costs involved. Consider using the reference, Utah History Encyclopedia, http://www.uen.org/ucme/.

2. Have students design their vehicle and give it a name.

3. Have students trace on a map the route their freight line will travel.

4. As a group, make a poster advertising your freight line. Give all information your customer might want to know.

EXTENSION: Display the posters for class evaluation. Do the posters give accurate and complete information needed by the customers?

SOURCE: Kathleen Webb, LessonPlanet.com
STRIKING UP A CONVERSATION

TOPIC AREA: Buses/Public Transportation
AGE LEVEL: 9th - 12th Grade
DURATION: 1 hour
RESOURCES:
- http://www.mta.nyc.ny.us/
- Student journals
- Pens/pencils
- Paper
- Classroom board
- Internet access
- Computer projector

OBJECTIVE: Students will:
1. Consider alternatives to the transportation methods upon which they rely on a daily basis.
2. Learn about the New York City public transportation strike.
3. Examine the perspectives of each party involved and impacted by the New York City public transportation strike; draft possible short- and long-term consequences as well as immediate solutions for each party.
4. Write position papers suggesting a final resolution to the strike that would be considered beneficial, in some way, to all.

TASKS:
1. Show "Coping with the Strike." After viewing the slideshow, students respond in their journals to the following prompt: "You have just seen some of the ways in which New Yorkers are coping with a public transportation strike. If your main form of transportation were unavailable for one day, what would you do? How would you get to and from school, go shopping, visit friends, or respond to an emergency? What would you do if this form of transportation were unavailable for a longer period of time, such as a week or even a month?"

2. As a class, read and discuss the article " Millions Are Left to Make It to Work Any Way They Can", focusing on the following questions:
   - According to the article, how many people use public transportation in New York City every day?
   - How did New Yorkers get to work in the morning during the transportation strike?
   - When was the last public transportation strike in New York City?
   - What is the "Taylor Law"?
   - What does "M.T.A." stand for?
   - Why did M.T.A. workers go on strike?
   - Who made the decision to start the strike, according to the article?
   - Who is Roger Toussaint, and what role does he play in the strike?
   - Who is Peter S. Kalikow, and what is his position on the strike?
   - Of the total number of M.T.A. workers, how many will continue to work during the strike?
   - How did the strike impact regular public transportation users on December 20, 2005?
   - Who is Michael Bloomberg, and what role does he play in the strike?
   - According to the article, what is New York Governor George E. Pataki's position on the strike?
   - Which other regional public transportation systems continue to operate in New York City?
   - After this article was published, a state court judge issued a $1-million-a-day fine on the transit union for the duration of the strike. How do you think this might impact the situation?

3. Explain to students that they will be analyzing the key objectives and challenges of each party involved in the New York City public transportation strike they read about in the article. Their goal will be to present both the short-term and long-term consequences of the strike from their assigned party's perspective, as well as one possible solution for the immediate future.
Divide students into five groups and assign each one of the following positions and corresponding questions to guide their respective presentations:

**GROUP 1 Local 100 Transport Workers Union**
- Who represents the union?
- What is the union’s position on the strike, why?
- What are some positive/negative aspects of the strike for the union/members? List two of each.
- What are short-term consequences of the strike on the union/members?
- How might the union/members be impacted in the long run?
- What solution or minimum negotiation might the union offer in the immediate future?

**GROUP 2 Metropolitan Transportation Authority**
- Who represents the M.T.A.?
- What is the M.T.A.’s position on the strike, why?
- What are some positive/negative aspects of the strike for M.T.A. management? List two of each.
- What are the short-term consequences of the strike on the M.T.A. and its members?
- How might the M.T.A. and its members be impacted in the long run?
- What solution or minimum negotiation might the M.T.A. offer in the immediate future?

**GROUP 3 New York City Government**
- Who is the mayor of New York City (NYC)?
- What is his position on the strike, why?
- What are some positive/negative aspects of the strike for NYC? List two of each.
- What are the short-term consequences of the strike on NYC?
- How might NYC be impacted in the long run?
- Should the mayor/other government officials get involved in strike negotiations? Why or why not?
- What solution might the city offer for the immediate future?

**GROUP 4 New York State Government**
- Who is the governor of New York State (NYS)?
- What is his position on the strike, why?
- What are some positive/negative aspects of the strike for NYS? List two of each.
- What are the short-term consequences of the strike on NYS?
- How might NYS be impacted in the long run?
- Should the governor/other state government officials get involved in strike negotiations? Why or why not?
- What solution might the state offer for the immediate future?

**GROUP 5 New York City M.T.A. Ridership (people who use public transportation)**
- Who makes up the public transportation ridership of New York City? (Think of ALL of the people who use public transportation on a regular basis, not just commuters.)
- What are some of the positive/negative aspects of the strike for those who depend on public transportation? List two of each.
- What are the short-term consequences of the strike on those who use public transportation?
- How might riders be impacted in the long run?
- What solution might riders offer for the immediate future?

After groups have answered their questions and discussed and drafted their possible consequences and solutions, they reconvene as a class to present their positions for the remainder of the period.

4. For homework, students further explore the position they covered on the New York City M.T.A. strike during class.

   In a position paper, each suggests a resolution to the strike that would be considered beneficial, in some way, to all. They should be encouraged to follow any developments in the strike and incorporate them into their papers if possible.

**DISCUSSION:** What is your own personal opinion of the strike, why? Do you think timing the strike before the Christmas holiday impacted the city more than it might at other times during the year? Why or why not?

**EXTENSION:** Choose and profile another New York City mayor from the past century. What were some of the changes, policies, or important events associated with his administration? Write a short play about four strangers who meet in a New York City taxi during the public transportation strike. The article notes that New York’s "Taylor Law" bars and penalizes strikes by public employees. Where did this law originate, how long has it been in existence, and under what circumstances, if any, has it been implemented previously? Present your findings to your class.

ON THE ROAD AGAIN:
MOVING PEOPLE, PRODUCTS, IDEAS

TOPIC AREA: Trucking/Freight Systems
AGE LEVEL: 3rd - 5th Grade
DURATION: 2 hours
RESOURCES:
- About.com Cities and Transportation
- International Forum on Globalization
- National Geographic: MapMachine
- National Geographic: Xpeditions Activity—Lizzie’s Morning

MATERIALS:
- Blank outline maps of the world
- Marker, pencils, rulers
- World atlases
- "On the Road Again" scenario sheets

OBJECTIVE: In this lesson students learn to identify modes of transportation and communication for moving people, products, and ideas from place to place. Students also learn the advantages and disadvantages of different modes of transportation. This lesson investigates ways in which global interdependence is altering traditional trade patterns, and encourages students to speculate on future world economic development.

TASKS: Begin the lesson by asking the class to explain how a certain product, such as an apple, gets to the lunchroom. What about other products in the lunchroom or classroom? Did they arrive by the same mode of transportation as the apple? What about the route(s) they traveled?

Discuss and list transportation methods used in the past and today. Post this list on the board, then have the class create symbols to represent four major methods of shipping goods—rail, ship, plane, and truck.

Discuss the cost of transporting goods, especially over great distances. Usually the faster the service, the more costly it is. Call any "overnight" courier service to get a sample of rates for a package delivered the next day to several distant locations as compared to a later delivery.

Divide students into Transport Teams of four. Assign each student in a team one of the tasks below to complete during the lesson:

- Captain Geo—reads the student scenario to the group and reports to the class
- Spatial Cadet—locates cities in the scenario and helps with decision-making
- Measure Magician—measures distances between cities and records information on a map
- Super Symbolist—draws symbols for necessary mode(s) of transportation and places them on the map.

Give each group a world map, a scenario, markers, a ruler, an atlas, and the following instructions: "Your group’s task is to read the mission, then decide how to get your product to market. You must use the best method of transport, changing methods if there is a better way on certain legs of the journey. As you work through the scenario, measures distances and draw the necessary symbols for the modes of movement that you and your group find most efficient. (Use the symbols created by the class.) You must stop at all the cities included in your assignment, selecting the shortest route."
"On the Road Again" Scenarios:

Scenario 1: São Paulo, Brazil, is a leading exporter of oranges. Suppose that the Queen of England loves fresh orange juice each morning. Deliveries must be made to London, England, but the shipment must stop in Miami, Florida, so that several tons can be processed at a plant in Lake Wales, Florida. The exporter also promised oranges to Monrovia, Liberia, and the city of Bamako, Mali. You have been hired to deliver the oranges. Plan the shortest route, using four means of transport. Begin in São Paulo and end in London, England.

Scenario 2: A new style of running shoe is being advertised to the public. The manufacturer in Bangkok, Thailand, needs to get the shoes to a mall in Chicago, Illinois, as quickly as possible. But first, stops must be made in San Francisco, California, and in New York City. There is a possibility that shoes will be needed in Cleveland, Ohio, as well. Plan a route from Bangkok to Chicago, including all stops mentioned.

Scenario 3: Bauxite is an ore used in the manufacture of aluminum. The ore is mined in open pits and then sent out for processing. A bauxite mine in Australia’s interior is sending a large shipment of ore to the port in Sydney, Australia, where it will be loaded and shipped to several processing centers and eventually used in the manufacture of electronic goods. Processing plants in Seoul, Korea; Tokyo, Japan; and Gary, Indiana, have ordered a shipment of ore from the Australian mining company. Plan a route from Sydney, Australia, to Gary, Indiana.

Scenario 4: Icelandic fisheries catch cod, pollack, and other fish in the North Atlantic, freeze them, and export them to markets in the Western Hemisphere. The fisheries have negotiated a contract with a major seafood restaurant chain. Deliveries must be made to their distribution points in Halifax, Nova Scotia; Montreal, Quebec; Detroit, Michigan; Des Moines, Iowa; and St. Louis, Missouri. Plan the route to ensure deliveries from Reykjavik, Iceland, to St. Louis, Missouri.

Scenario 5: The city of Cairo, Georgia, is the site of a major manufacturer of precision ball bearings that are used in the construction of various automobiles. The machine that makes these ball bearings has broken down. The necessary part (manufactured in Berlin, Germany) has been ordered and will be shipped soon. Plan the route that the shipment will take from Berlin, Germany, to Cairo, Georgia. The company usually ships through Paris, France, to Baltimore, Maryland, then to Atlanta, Georgia, before sending ball bearings on to Cairo, Georgia. Plan the shortest route possible using four modes of transport.

Scenario 6: Suppose that marzipan, a candy made from almond paste and pressed into the shapes of little fruits, has been a favorite of Hillary Rodham Clinton since she first had some while in Rome, Italy. The mayor of Rome is sending her a five-pound (two-kilogram) box for her birthday. This particular type of marzipan is made by a woman in Naples, Italy. Plan the route that the candy will take if it is shipped from Naples to a shop in Rome, then mailed to Washington, D.C. Note that marzipan will keep for several weeks in a cool place.

After the groups complete the task, have them present their findings orally to the class.

Have the entire class list advantages and disadvantages of the four modes of movement. What routes were best for specific products?

DISCUSSION: Exchange world maps within the class and challenge groups to discover more efficient modes of transport for the same scenario.

EXTENSION: Have students go through the Xpeditions activity Lizzie’s Morning, reading the stories, looking at the photo galleries, and completing the activities.

SOURCE: Dany Ray of Washington Middle School in Cairo, NationalGeographic.com
TRANSPORTATION WITH A PURPOSE

TOPIC AREA: Multimodal
AGE LEVEL: Kindergarten-2nd Grade
DURATION: 1 hour
RESOURCES:
- http://www.abcteach.com/shapebooks/plane.htm
- Transporting Goods.ppt
- Transporting Goods Student Book.doc

MATERIALS:
- Tape
- Computer/powerpoint
- TV monitor
- Pencils
- Crayons
- Stapler
- Chart paper
- Marker
- Dry erase/chalkboard
- Marker/chalk

OBJECTIVE: Why do people need transportation? What kinds of vehicles are used to transport goods? What goods are transported by which vehicles? Are all goods used in the U.S. from the U.S.?

TASKS:

1. Introduce the lesson by asking the students to think about why people need transportation and allow them to respond. After students share their ideas, explain that there are two primary reasons why transportation is necessary: to move people from one place to another and to deliver goods (or things that people use) to where they need to go. Tell the students that today they will learn some different ways that goods are transported.

2. Elaborate on what a good is by telling the students that goods are items that a person can touch and that have worth. Offer some examples of goods that are transported from place to place so that people all around the world can have access to them such as food, clothing, and mail. Challenge the students to think of some more "things" from your own community that are transported and generate a list of these on the board or a sheet of chart paper. Discuss whether the item is imported or exported to another country to show students that not all of the things that we use in the U.S. come from our own country.

3. Tell the students that there are many different types of vehicles that are used to transport goods. Show the students the pictures of the vehicles that were printed from the above listed Web sites and tape them to the board. Then, challenge the students to think about some of the things that each of the vehicles transports and write them below the pictures.

4. Display the above listed PowerPoint presentation. While viewing the slides, have the students compare their ideas with those listed on the board.

5. As a final activity, distribute the booklet listed above and read the sentences to the students. Tell the students that they need to use phonetic spelling to fill in the blanks with an appropriate word and draw a picture to match the sentences. After the students have completed their books, allow them to color them and share them with the rest of the class.

SOURCE: Heather Thacker, LessonPlanet.com
CALIFORNIA AND THE SEA

TOPIC AREA: Aviation, Marine, Rail
AGE LEVEL: 3rd - 5th Grade
DURATION:
RESOURCES:

MATERIALS: • Variety of Bay area maps
• Copies of map layers
• Transparency film
• Colored markers
• Tracing paper
• Masking tape
• Overhead projector

OBJECTIVE: Students will explore the idea behind water as a means of moving people and things. The importance of the Bay system to the development of the region will be the primary focus.

BACKGROUND: The influence of water on human settlement in California goes back to the first peoples to inhabit the area. Native villages were concentrated on the coast and along most river courses. Many of our major metropolitan areas are built over the sites of Native settlements, and this coincidence is no accident. Direct access to a navigable water course was essential in the development of early European settlements. It is harder today to see this link because of the network of roads, railroads, and airports which give us relative independence from the sea.

TASKS: Students will create a layered map of the Bay area showing the distribution and the chronology of transportation and development. Students will discuss changes in transportation of the Bay region over time.

1. Locate a Bay area that shows major highways and bridges, railroads, ferry terminals, bays and rivers, and cities and towns. Make a copy of this map on transparency film for use with the overhead projector. Make enlarged copies of this map for students to trace.

2. Hand out a full set of maps and layers to each cooperative group. Assign a student to trace a different layer and a base map: one layer each for highways and bridges, railroads, ferry terminals, bays and rivers, and cities and towns. Students should tape the copy onto the table with masking tape. Have them tape the tracing paper securely over the copy. It is important that their work does not shift during the tracing. Be sure that students also trace the line-up target on the lower-left side.

3. Color the water on the base map with a light blue marker.

4. When all the layers are ready, place them in order on top of the base map making sure to align the targets. Tape each layer down securely.

DISCUSSION:

• How many of you have traveled to Sacramento? How did you get there? How else could you have gotten there? (look at the map) Make a list on the board of student responses.

• Fruits, vegetables, and hay are grown in the Central Valley in the area near Sacramento. How would you get these products to market in San Francisco? Make a second list of student responses.
• Using the chronology and timeline provided, remove a layer at a time and discuss some of the same questions as above. When only the cities and towns layer remains on the base map you will be looking at the Bay Area before 1850. Tell students about the importance of the bay and rivers as a way to move about. What were the obstacles when traveling by land? Forests, wetlands, and mountains made travel by land difficult. A well-worn network of trails existed for hundreds of years, used for foot travel as well as horse trips. Water travel could get around many of the barriers mentioned above, but it also posed some hazards. Wind, waves, and currents were the major factors when using the bays and rivers.

• Looking at a modern map, guess which communities would not exist (or were very small) before railroads and roads were around. Towns such as Davis and Vacaville are far from any river access and did not develop until a rail line was built through the area. Give students an opportunity to create imaginary trips between Bay Area communities.

• How would you transport a load of bricks from Santa Rosa to San Francisco in 1865? in 1900? Today?

**SOURCE:** LessonPlanet.com
# THE RAILROAD: SETTLEMENT IN THE WEST

**TOPIC AREA:** Aviation, Marine, Rail  
**MATERIALS:** Copies of:  
- The Homestead Act May 20, 1862  
- Pacific Railway Act July 1, 1862

**AGE LEVEL:** 6th - 8th Grade  
**DURATION:** 2.5 hours  
**RESOURCES:**  
- Archives of the West  
- The Northwest Ordinance  
- American Indian Nation Territories  
- U.S. 1860  
- U.S. 1870  
- Transcontinental Railroad

**OBJECTIVE:** Students will understand development following the Civil War and be aware of the role the completion of the transcontinental railroads played in the settlement of the American West.

**TASKS:** View a political map of the U.S. in 1860.

1. Ask the class to imagine that they are living in 1860 when a political map of the U.S. looked like this. Ask the class the following questions:
   - In 1860 did the U.S. encompass land from the Atlantic to the Pacific coasts?
   - How many states existed in 1860?
   - Was there any land which was owned by the U.S. government but which was not yet admitted into the Union as a state?
   - What is the difference between a state and a territory?
   - How did a territory become a state?
   - Why did so few Easterners settle in between the states fronting the Mississippi River and the states of California and Oregon?
   - Compare the maps from 1860 and 1870. What accounts for the differences?

2. Ask students to consider the following:
   - Were there good water sources on the plains?
   - If there were few trees, with what would settlers build? What would they use for fuel?
   - What means of transportation existed at this time to both transport settlers and goods onto the plains, or transport the goods they produced to markets elsewhere?
   - What means of communication existed to connect those settling the plains with people on either the eastern or western seaboards?
   - What American Indian tribes lived in these areas, and how might they have survived? (see map)

3. Now ask students the final two interrelated questions of this part of the lesson:
   - How could the government play a role in enticing people to settle the Great Plains? Many railroads existed in the North (fewer in the South) in 1860, but none reached across the Great Plains or linked the country coast to coast. How could railroad companies be encouraged by the government to build a railroad to service a part of the country where there were as yet no significant numbers of U.S.
citizens? Conversely, why should settlers come when there was no railroad?

4. As a class, answer the following questions about the Homestead Act of 1862:
   • What is the purpose of this act?
   • What is meant by the term "public domain"?
   • Who is entitled to secure a grant of land from the Federal Government? Can women secure such a grant in their own names, and if so, how?
   • What is the largest land amount a person can secure from the Federal government?
   • How would one go about applying for land under the act (filing the affidavit)?
   • How long would one have to wait in between filing an affidavit and securing final title to the land one settled? What did a settler need to do in the meantime?
   • How much per acre did land under the Homestead Act cost?
   • The Homestead Act was meant to insure that U.S. citizens who actually wanted to farm land were the recipients of the government's largess. Who else might have wanted to profit from this deal, and how? How is the law trying to prevent various abuses?

5. As a class, answer the following questions about the Pacific Railway Act of 1862:
   • What is the purpose of this act?
   • What is the Union Pacific Railroad Company empowered by this act to do?
   • Mark on a map the route that the transcontinental railroad will follow.
   • What will be the most difficult terrain on which to lay track?
   • What other difficulties do you foresee in terms of crews of men living and working in a variety of environments as they lay tracks?
   • Why did the government provide for telegraph poles along the length of the railroad?
   • The act gives the railroad the right of way on public lands. How much land on either side is included? What does the government promise to do if American Indians claim title to this land?
   • In Section 3, the act provides the railroad with more land than what is needed to give it a right of way. Why will this land fronting the railroad tracks be even more valuable than land given to homesteaders at a distance from the railway?
   • What method of financing the railway does the bill propose in Section 5?
   • Under what terms is the Central Pacific Railroad Co. of California authorized to build a railway headed east? Bonds will be awarded based on completed railway track mileage: which company would be awarded the most money? How does this set up a competition between two railways?
   • The Central Pacific Railroad had to lay track in the mountainous region of the Sierra Nevadas, one of the most difficult endeavors of the entire enterprise. This will obviously take much more time than laying tracks on the flat plains. How does the government plan to compensate the companies for the laying of track over mountainous terrain?

6. Divide the class into three groups and ask each group to do the following:
   • Railway owners As railway owners you will want to maximize your profits. Your lawyers are ready to look over both acts to see how your company can make the most money. As a group plan, whatever strategies you can to do so. (Be sure to include use of the land you will acquire.)
   • Land Speculators You are neither settlers nor railway owners, but people who want to buy land as cheaply as possible and then re-sell it at a much higher rate. Your lawyers will look at both these acts to
find as many loopholes as possible for ways in which you can purchase land for re-sale.

- **Settlers** You are people who want to purchase land for farming. The Homestead Act seems like the bonanza you have been waiting for. However, profiting from both these acts may be harder than you imagine. Discuss the various difficulties you may face in terms of staking your claim to land, holding on to it, and making it profitable.

7. Now have each group present their strategies to the class. Each group should answer the following questions in their presentation.

- What conflicts are evident?
- What problems do students foresee if any?

**DISCUSSION:** What impact did the railroad have on western development? What impact did the expansion of the railroad have on American Indian nations?

**SOURCE:** Heidi Alder, Scott Stucki, Russell Fullmer, LessonPlanet.com
U.S. TRADE AND TRANSPORT

TOPIC AREA: Trucking/Freight Systems
AGE LEVEL: 3rd - 5th Grade
DURATION: 1 - 2 hours
RESOURCES: • National Geographic: Xpeditions Activity—Lizzie’s Morning
• U.S. Guide to the Union Pacific Railroad

MATERIALS: • Road atlas
• Airplane timetable
• Map of railroad routes

OBJECTIVE: Students will:
• discuss major types of transportation used in trade;
• explain how specific products might get from place to place in the United States, referring to a map of major transportation networks;
• discuss what it would be like to operate a plane, train, or truck; and
• write stories or draw pictures showing themselves operating a plane, train, or truck across the U.S.

TASKS: Ask students to state the types of transportation they think would be used to get products from place to place within the United States. They will probably mention airplanes, trains, and trucks. Show students maps of the major transportation networks in the United States. Locate major interstates on a road atlas, major plane routes in an airline timetable, and railroad routes at the U.S. Guide to the Union Pacific Railroad. Have them explain how specific products might get from place to place. For example, ask them how:
• artichokes might get from central California to Chicago;
• pineapples might get from Hawaii to Seattle; and
• oranges might get from Florida to Texas.

Ask students to discuss and/or list what they think would be the best and worst things about each method of transportation. For example, an airplane is fast but can’t carry as much weight as a train.

DISCUSSION: Ask students to imagine that they’re in charge of transporting products from one point to another in the United States. What would it be like to operate a plane, train, or truck? What places would they like to go? Discuss their answers as a class. Have each student choose one method of transportation (plane, train, or truck). Ask them to write stories pretending they are in charge of transporting products from one point to another in the United States using this method of transportation. Where would they go? What would they carry? What would it be like to operate the plane, train, or truck?

To enhance their stories, help them figure out what types of products they might realistically transport to another part of the country. For example, the fruits and vegetables listed above, coal from Colorado, or cars from Michigan.

EXTENSION: Have the class read the story in the Lizzie’s Morning activity, or read it to them. Have students point out the places mentioned in this story on a class wall map and tape pieces of red construction paper onto each place so that the entire class can easily see all the places in the story. Or have students label these places on blank outline maps, available at the Xpeditions Atlas, as you or their classmates take turns pointing them out on the wall map.

SOURCE: NationalGeographic.com
TESTING CONCRETE

TOPIC AREA: Roadway Design/Structures
AGE LEVEL: 9th -12th Grade
DURATION: Overnight
RESOURCES: http://www.nasaexplores.com/show2_articlea.php?id=02-085

MATERIALS:
- Bag of cement
- Bag of sand
- Bag of gravel
- Water
- Egg cartons
- Bowls or buckets to mix concrete
- C-clamps
- Hammer
- Safety goggles

OBJECTIVE: To determine the relative strength of four types of concrete.

BACKGROUND: Concrete has many great uses: houses, roads, airports, parking lots, sports arenas, and playgrounds to name just a few. It has served many different purposes based on the task that needed to be accomplished. However, do you know the difference between cement and concrete? Your answer may be, “They are the same, so there is no difference.” If that were your answer, you would be incorrect. Let us look at what cement and concrete are, and see if we can figure out how they are different.

Cement is the main ingredient of concrete. Cement is an artificial stone. This powder is much easier to use and transport than natural rock. Since rock is so hard and heavy, it is difficult and expensive to make use of it in concrete production. Cement is processed into a fine powder. When water is added to this powder, it turns into a paste. When this paste dries, it is as hard as a rock. This cement powder can be taken anywhere, and the cement paste can be fashioned into any shape. Once it dries, you have concrete. Today’s concretes are a mixture of cement, sand, stones, and water. The additions of sand and stones give it more durability and density. This makes the new concrete better than the concrete used by the Romans and Egyptians.

Since concrete has so many uses, there are many different types of concrete to fit various tasks. Today’s lesson will give the students a chance to see what concrete is made of and to test how strong it is. Varying the amounts of the ingredients, students will determine the relative strengths of each type of concrete. From these tests, they can infer the best mixture of ingredients to make the strongest concrete possible.

TASKS:

Pre-Lesson:
- You will need to buy a bag of cement, sand, and gravel. You will not need huge bags; however, you will need enough for each of your groups to make four samples of concrete. Most bags of cement, sand, and gravel would be large enough that you would probably only need one of each. Alternately, you can make this a project that extends over several days, and have the students buy their own cement, sand, and gravel.
- You will need a place outdoors to test some of the concrete samples.
- You will need to designate a place for the concrete to dry overnight. If possible, start this on Friday to give the concrete plenty of time to dry over the weekend.
Lesson:

1. Read orally the 9-12 NASA explores article, "Paving the Way"
   http://www.nasaexplores.com/show2_articlea.php?id=02-085

2. Divide the class into groups of four.

3. Each group will be responsible for mixing up four different mixtures of concrete. They will vary the amount
   of ingredients used.

4. Each group will pour their mixtures into labeled egg cartons to dry overnight.

5. Each group will test their samples using various techniques.

From their tests, they will characterize each sample of concrete.

1. Your group will be responsible for mixing four different types of concrete. You will then test each mixture
to see which one is the strongest. Each type of concrete has to include cement, sand, gravel, and water. The
proportions of each are up to you.

2. The mixture chart has the four samples you will be testing. Each sample has been given a generic letter
designation. As a group, name each sample based on how well you think it will do, or how it looks, or how easy
it was to mix, etc. In each column, put the amount of cement, sand, gravel, and water. Due to the small
nature of each sample, make your measurements in very small increments (grams, ounces).

3. Record your data in the chart. Insert the proper units based on the measuring devices provided.

<table>
<thead>
<tr>
<th>Type</th>
<th>Name</th>
<th>Amount of</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Cement</td>
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<tr>
<td>B</td>
<td></td>
<td></td>
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<tr>
<td>C</td>
<td></td>
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<tr>
<td>D</td>
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</table>

4. Using the mixing bowl or cup, pour in the ingredients for your first sample. Mix it thoroughly, and pour it
into three compartments of the egg carton. Try to pour the same amount in each compartment. Be sure to
label each compartment.

5. Repeat steps 2-4 for the other three types of concrete. Be sure to label each one carefully.

6. When you are done, your egg carton should have three identical samples of four different types.

7. Place in the designated area to dry overnight.

8. When the samples are dry, you will test the strength of each one using three techniques.

9. You will use one sample from each type of concrete for each technique. Since you have only one sample per
test, be sure to read the instructions before you start and pay close attention to the results. Since each
sample has to dry overnight, you will not be able to repeat the test again.

10. Technique 1: drop the sample from a known height onto a paved surface (for example, parking lot, sidewalk,
etc.). The height should be above 3 feet (1 meter). During this technique, please wear safety goggles, since
pieces of the concrete could go flying.

11. Record your results in the table. Be sure to put what units you used. Put "Yes" or "No" under the Break
column. If you put "Yes," write down the number of pieces it broke into. Write down whether the sample is
hard or soft. If you wrote "hard," is it brittle? If you wrote "soft," is it mushy?

<table>
<thead>
<tr>
<th>Type</th>
<th>Name</th>
<th>Height</th>
<th>Break? (No. of Pieces)</th>
<th>Hard or Soft</th>
<th>Brittle or Mushy</th>
</tr>
</thead>
<tbody>
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<td>B</td>
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</table>
12. **Technique 2**: place the sample on a paved surface and hit it with a hammer. During this technique, all group members should wear safety goggles, since pieces of the concrete will go flying.

13. Record your results in the table. Record the number of hits with the hammer you used. Be consistent from one sample to the next one. Put "Yes" or "No" under the Break column. If you put "Yes," write down the number of pieces it broke into. Write down whether the sample is hard or soft. If you wrote "hard," is it brittle? If you wrote "soft," is it mushy?

<table>
<thead>
<tr>
<th>Type</th>
<th>Name</th>
<th>Height</th>
<th>Break? (No. of Pieces)</th>
<th>Hard or Soft</th>
<th>Brittle or Mushy</th>
</tr>
</thead>
<tbody>
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<td>A</td>
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<td>B</td>
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</tbody>
</table>

14. **Technique 3**: using the C-clamp, tighten it down onto the concrete sample. To make it easier, you might try placing the sample on the table with some cardboard around it to protect the table and C-clamp. Then, clamp the sample to the table until it is snug. Count the number of turns you can make until the concrete sample breaks or cracks (if you used cardboard to protect the table and C-clamp, you may not see the break or crack, but you should hear it).

15. Record your results in the table.

<table>
<thead>
<tr>
<th>Type</th>
<th>Name</th>
<th>Number of Turns before Crack or Break</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
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<tr>
<td>C</td>
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<tr>
<td>D</td>
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</tbody>
</table>

16. Answer the following questions:

a. Which was the strongest sample in technique 1?
b. Which was the strongest sample in technique 2?
c. Which was the strongest sample in technique 3?
d. Based on your results, which mixture was the strongest?
e. List the amount of each ingredient of that sample. Would you expect this one to be the strongest? Why or why not?
f. Was each test fair and objective (scientific)?
g. Analyze each technique. Rate it on how fair and objective (scientific) you think it is. Are there any improvements that you could make to each technique?

i. Technique 1:
ii. Technique 2:
iii. Technique 3:

**DISCUSSION**: Ask the students, “What is the difference between cement and concrete? Discuss the many uses of concrete. Ask the students, “Are there other ways you can test the strength of concrete?”

**SOURCE**: NASAexplores.com
TESTING CONCRETE

TOPIC AREA: Roadway Design/Structures
AGE LEVEL: 6th - 8th Grade
DURATION: 1 hour
RESOURCES: http://www.nasaexplores.com/show2_articlea.php?id=02-085

MATERIALS: Calculators, Rulers, Colored markers or pencils

OBJECTIVE: To contrast how changing the ingredients of concrete changes its properties. Students will calculate the ratios of ingredients, volume of the concrete used, amount of concrete needed in a particular job and will construct a bar graph of strength tests conducted on the different types of concrete.

BACKGROUND: Concrete has many great uses: houses, roads, airports, parking lots, sports arenas, and playgrounds, to name just a few. It has served many different purposes based on the task that needed to be accomplished. However, do you know the difference between cement and concrete? Your answer may be, “They are the same, so there is no difference.” If that were your answer, you would be incorrect. Let us look at what cement and concrete are, and see if we can figure out how they are different.

Cement is the main ingredient of concrete. Cement is an artificial stone. This powder is much easier to use and transport than natural rock. Since rock is so hard and heavy, it is difficult and expensive to make use of it in concrete production. Cement is processed into a fine powder. When water is added to this powder, it turns into a paste. When this paste dries, it is as hard as a rock. This cement powder can be taken anywhere, and the cement paste can be fashioned into any shape. Once it dries, you have concrete. Today’s concretes are a mixture of cement, sand, stones, and water. The additions of sand and stones give it more durability and density. This makes the new concrete better than the concrete used by the Romans and Egyptians.

TASKS: Read orally the 9-12 NASA explores article, “Paving the Way” http://www.nasaexplores.com/show2_articlea.php?id=02-085. Using the data given on various mixtures of cement, sand, gravel, and water, students should get a better understanding of concrete. By mixing the cement and other ingredients in different proportions, you can tailor your concrete to match whatever task you want it to perform. Have the students perform the following tasks:

1. Look at the chart below. The names of the types of concrete were changed. The unit “bag” is the same for each column. The exact bag size is not important for our activity.

<table>
<thead>
<tr>
<th>Type of concrete</th>
<th>Typical uses</th>
<th>Amount of:</th>
<th>Bags of cement/cubic meter of concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>cement (bags)</td>
<td>sand (bags)</td>
</tr>
<tr>
<td>Steelcrete</td>
<td>High strength</td>
<td>1</td>
<td>1.5</td>
</tr>
<tr>
<td>Liquid Stone</td>
<td>Sidewalks, driveways</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Roxx</td>
<td>Foundations</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Consand</td>
<td>General purpose, mortar</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>
2. Using the chart above, answer the following questions.
   - Which mixture contains the most water?
   - If one bag of cement is used, how much sand and gravel do you need if you are making a sidewalk?
   - If two bags of cement are used, how much sand and gravel do you need if you are making a patio?
   - Find the ratio of cement used in each type. Hint: add up all the ingredients and make a ratio to the cement used.
   - Using your ratios from the step above, which one uses the largest percentage of cement?
   - Your friend is concreting a driveway that is 20 meters long and 3 meters wide. If they make the driveway 10 centimeters deep, how many cubic meters of concrete will they need?
   - How many bags of cement will they need to make the driveway?
   - How many liters of water will he need?

3. Some of your classmates have made up four different mixtures of concrete. They put the mixtures in moulds and let them dry. Once they were completely dry, they tested the strength of each one using a simple pressure test until the concrete cracked or broke. This test involves turning a crank that presses on the concrete. The amount of pressure applied is measured in number of turns of the crank.

<table>
<thead>
<tr>
<th>Type of Concrete</th>
<th>Strength (number of turns)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steelcrete</td>
<td>1.7</td>
</tr>
<tr>
<td>Liquid Stone</td>
<td>1.3</td>
</tr>
<tr>
<td>Roxx</td>
<td>1.1</td>
</tr>
<tr>
<td>Consand</td>
<td>0.5</td>
</tr>
</tbody>
</table>

4. Using the chart above, answer the following questions:
   - Which one is the strongest? Does this make sense? Why or why not?
   - Construct a bar graph using the type of concrete and number of turns.

DISCUSSION: Ask the students, “What is the difference between cement and concrete?” Discuss the many uses of concrete. Discuss how you would test the strength of concrete.

SOURCE: NASAexplores.com
TOO MANY PEOPLE...TOO FAST

TOPIC AREA: Planning/Urban Development
AGE LEVEL: 6th - 8th Grade
DURATION: 
RESOURCES: "City of Joy" by Dominique Lapierre

MATERIALS: Beans or rice
Differently sized cups
Overhead projector

OBJECTIVE: This lesson is designed to show students what happens when a city's population grows too rapidly for the city to accommodate it. Students will look at and discuss examples of cities growing rapidly today, what problems occur with rapid growth, and ways to solve these problems. Students will also understand what it is like to live in a city where the infrastructure has broken down. After participating in this lesson, students will be able to

- list services that make their lives easier and comfortable,
- identify Zaire and Rwanda on a world map,
- generate problems that may arise in a community when too many people migrate into it, and
- develop possible solutions to public service problems arising from rapid population increases.

TASKS:

1. Discuss what kind of services that the students and their families have available to them for living in a town or city or rural area. List the services that the students generate on a flipchart (three separate lists). Discuss with the students which services that they might take for granted: telephone, running water, electricity, medicine, waste disposal... Then discuss what would happen to those services if the population of their town, city, and rural area suddenly doubled or tripled in a short period of time.

2. Explain to the students that they are about to do a demonstration of population growth. The rice represents people migrating to the city, and the cups represent the infrastructure of the city.

   - Divide the students into small groups of 2-4; give each group some rice and one cup of each size. One student in each group will begin by slowly pouring rice into the smallest cup they have.

   - When the cup gets full, the contents of that cup will be poured into the next largest cup by another student. But the student pouring the rice will not pause while the transfer is being done.

   - Students will continue in this fashion until the largest cup is full. The goal is to keep the cup (infrastructure) from overflowing without stopping the pouring rice (people migrating). e. Ask the students if there was much trouble with overflow of rice or if they were able to keep up with the person pouring the rice. Why were they able to keep up or not?

   - Tell students they are pouring the rice at a rate of 200 people per week. Have the students repeat the experiment increasing the rate to 400 per week, then 800 per week, then 1200 per week... until the cups can no longer keep up with the rice.

   - What would it be like in a city where 1500 people/week are entering? Lead the discussion to Goma, Zaire. What problems are going to arise? Make a list of the brainstorming ideas.

3. Each group is to then prioritize the problems to be solved, and then to develop possible solutions. Make certain students are aware of limitations such as lack of trucks to transport materials, lack of manpower, breakdown of airport runways, lack of living accommodations, lack of food, inappropriate waste disposal, inadequate clean water supply,... Remember, the solution to one problem may cause (three) more problems. Each group should prepare a brief presentation of how they prioritized and what their solutions were.

4. Introduce the book "City of Joy" to be read by the students over the following day.

SOURCE: Lucinda Bellah, Dayton High School, Oregon, LessonPlanet.com
NOISE POLLUTION

TOPIC AREA: Environment/Energy
AGE LEVEL: 3rd-5th Grade
DURATION:
RESOURCES: • Spreadsheet graphs step-by-step
http://www.quiet.org/faq.htm
• Ocean Noise http://www.nonoise.org/aboutno.htm

MATERIALS: • Sound meter
• Microphone connected to computer
• Tape recorder
• Excel

TASKS:

1. Brainstorm noise pollution. What is it? What are some sources of noise pollution in various environments of students - home, school, community?

2. Explore various means of recording noise pollution - sound meter, microphone connected to computer, tape recorder, distance from sound before can no longer hear it, etc.

3. Choose an environment. Collect noise level data from at least five sources of noise pollution, using a tally sheet to record the results.

4. Create a graph using the spreadsheet portion of AppleWorks.

5. Create three questions based on the information provided in your graph.

6. Share your graph and questions with a partner.

7. Answer your partners’ graph questions.

8. Revise/edit your original questions based on feedback from your partner.

9. Post the graphs on a bulletin board display. Post the questions and see if people can guess which graph the questions are based on.

10. Make three recommendations for decreasing noise pollution and protecting your hearing based on what you learned from the environment you explored.

11. Share each student’s recommendations in a newsletter to parents.

EXTENSION: Choose three sources of noise pollution. In your learning log, make a chart that lists the source of noise pollution, positive and negative aspects of the source, potential for hearing loss and safety procedures.

SOURCE: Elizabeth Tumblin, LessonPlanet.com
AIR POLLUTION

TOPIC AREA: Environment/Energy
AGE LEVEL: 3rd-5th Grade
DURATION: 2 weeks
RESOURCES: 

MATERIALS: 
- Air pollution fact sheet
- Flower seeds
- Potting soil
- Paper cups
- Marker, pencil, paper

OBJECTIVE: Air pollution is a growing problem today. This lesson plan is designed to teach students about the problem, its effects on our environment and health and the latest methods designed to combat air pollution.

- Define air pollution.
- Identify major causes of air pollution (e.g., automobiles, burning garbage, electric power plants emissions, industrial boilers and certain consumer products).
- Identify the effects of air pollution (health effects in humans, effects such as acid rain on the environment, effects on the ozone layer, ground level-smog).
- Identify programs in place to reduce air pollution (passage of The Clean Air Act, industry programs such as the development of reformulated gasoline).
- Identify personal methods of reducing air pollution (car-pooling, reduction in use of aerosol spray products, choosing biodegradable products).

TASKS:

1. Students should plant an identical amount of flower seeds in two separate paper cups. One cup should be placed in a heavy traffic zone (such as the place where school buses enter and exit). The other cup should be placed in a relatively clean air environment such as the class room.

2. The class should discuss and form a definition of air pollution and hypothesize its effects on their plants.

3. Students should observe the growth of the seeds over a 2-week period of time, during which the plants are watered on a regular basis with identical amounts of water. Students should observe the plants regularly and record growth activity.

4. At the end of 2-weeks, the students should plot the number of plants grown, the size of the plants, the color of the plants, and write a short conclusion about the effect of air pollution on growth.

DISCUSSION: Open the classroom discussion to a brief history of the industrial age and the advent of the automobile. Discuss how dependent our society is on the use of autos and the effect of automobiles on the level of air pollution. Discuss government (The Clean Air Act) versus industry (reformulated gasoline) versus individual (carpooling, walking, and biking) solutions to the air pollution problem. Ask the students to identify methods of reducing air pollution.

SOURCE: LessonPlanet.com
HIGHWAY TRANSPORTATION SYSTEM BREAKDOWNS

TOPIC AREA: Traffic Safety
AGE LEVEL: 9th - 12th Grade
DURATION:
OTHER RESOURCES:

MATERIALS: • Sticky note pads
• Poster board
• Pens
• Markers

OBJECTIVE: The student will be introduced to the highway transportation system (HTS) and informed of their role in the HTS. Students will also learn how to develop and gain the knowledge, attitudes, and skills that are pertinent for safe driving. Students will be able to:

• list and explain the three parts of the highway transportation system
• explain how the HTS is regulated
• provide examples of breakdowns in the HTS.

BACKGROUND: Provide the students with notes on the Highway Transportation System. Use a driver education textbook and handbook to supplement the notes given as a brief reading assignment. Tell the students that the HTS is broken down into three components: vehicles, people, and roadways.

TASKS:

1. Divide students into groups of 4 to 6 students
2. Give each group the required materials.
3. Ask groups to divide their poster board into three parts using a marker. Give each of the three sections one of the following headings: roadway, people, and vehicles.
4. Students are asked to write down as many factors that can contribute to the breakdown of the HTS on the sticky notes. (Only one factor per sticky note)
5. After a stated time limit, ask students to quickly take the numerous sticky notes and stick them to the poster board under the correct heading: people, roadways, or vehicles.
6. Have students display their board on the walls as various groups view each others work.

SOURCE: John P. McIntyre, LessonPlanet.com
WINTER STORMS: TRANSPORTATION AGENCIES KEEP YOU MOVING SAFELY

TOPIC AREA: Roadway Maintenance
AGE LEVEL: 6th - 8th Grade
DURATION: 
RESOURCES: • The Physical Properties of Two De-Icing Materials

• Conclusions
• Data Table
• instructions

MATERIALS: • Ice cubes

• Rock salt

• ICE BAN™

• Beakers

• Graduated cylinders

• Thermometers

• House plant

OBJECTIVE: Students learn about the organizational coordination and technical know-how necessary to respond to weather disasters. The small group activity explores the chemistry and environmental science behind innovative deicing products.

BACKGROUND: When a blizzard or ice storm strikes, the people who work for your state and local transportation agencies respond to battle the elements much as an army responds to an enemy attack. When the meteorologists tell us that a storm is threatening our area, we implement our Emergency Action Plans. These plans detail what needs to be done to keep people safe during the storm and to get us moving again as soon as possible after the storm passes.

Our Emergency Operations Center (EOC) uses the latest computer technology to help us decide what we need to do, when, and where. We have sensors on the roads that tell us road temperatures, whether the road is wet or dry, and information about snow, ice, and deicing chemicals on the roads. This information is set by telephone lines to a remote processing unit, and then to a central computer at the control center. We put the highway condition data into our winter storm mapping system, where it is visually displayed on a statewide map. Our maintenance engineers receive this information on their laptop computers and use it to determine when and where to send snowplows and deicing equipment.

During a storm a lot of people need information fast. We have closed circuit television cameras on the major roads in the region that feed pictures of traffic into the EOC. We can see right away when an accident occurs or a traffic back-up starts. In some areas, you can see these live video images on the Internet or on cable TV. The State Police work with us at the EOC to send help immediately to people who have accidents or get stuck on the road during the storm. We can redirect drivers away from a problem area by reprogramming the traffic signals, and by broadcasting warnings on our changeable message signs and highway advisory radio. We notify the television, radio, and newspaper reporters about road and traffic conditions, so they can tell people at home or in their offices or cars.

We work with meteorologists to advise your school officials about road safety. They have to decide by about four o’clock in the morning whether to tell the school bus drivers to come to work. Sometimes we aren’t sure at four o’clock what the weather is going to be like later in the day, so the schools delay opening for a few hours. If the weather clears, they won’t have lost the whole day. Sometimes the storm has passed, but school is delayed for a few hours or a half-day to give us more time to clear away the snow. The school officials have to base their decisions on the safety of everyone in their school district. Sometimes roads are safe where you live, but school is closed because some of your classmates live where the roads are not clear yet.

We have new weapons in our arsenal to combat snow and ice storms that are the products of scientific and technical research. Modern snowplows are designed to plow snow more efficiently. Some “Smart Plows” are equipped with “Global Positioning Systems”, which beam the plow’s location to a satellite, and back down to our EOC so our operations managers know exactly where the snowplows are all the time. This helps us get plows where they need to be more quickly.
We are using new deicing chemicals that are more effective and less harmful to the environment than road salt. Road salt is not biodegradable, and can harm plants when it stays in the soil. Sometimes it leaches through the soil to groundwater, and makes the water undrinkable. Road salt also is corrosive, causing the steel in bridges and in cars to rust. Furthermore, it doesn’t melt ice very effectively in temperatures below about 20 degrees Fahrenheit.

TASKS:

1. Order ICE BAN™ from manufacturer, ICE BAN™ America, 1-888-423-2261. The product is the residue created by processing corn, and is completely safe and biodegradable. It will wash out of clothes.

2. Xerox the handout (instructions), making one for each student. (Staple together “The Physical Properties of Two De-Icing Materials;” “Conclusions;” and “Data Table.”)

3. Set up the materials for each group:
   - One small beaker (50 ml) of ICE BAN™
   - One small beaker (50 ml) of table salt
   - Two 200 ml (or similar sized) beakers
   - One teaspoon
   - One graduated cylinder or measuring cup
   - One thermometer (optional)
   - Enough ice (ice cubes or crushed ice) for one 200 ml beaker per group

4. Tell the students to break up into activity groups (5-7 students) and give each student a handout (instructions). Instruct them to follow the steps under “Procedure.”

5. The activity should take the students about 15-20 minutes to complete.

6. After the students have completed the procedures and filled in the Data Table, have them sit back at their desks. Direct their attention to “Conclusions.” You may either ask each student to fill in their own answers and then discuss the answers as a group, or go directly to a group discussion

DISCUSSION: Most of you should have found that the temperature of the ICE BAN™/salt mixture was several degrees lower than the temperature of the ice water. That is why it works as a deicer. We like to put deicers on the roads just before a storm to prevent snow and ice from sticking to the road. We call that “pretreating.” We also put the deicers on after the storm, to help the snow and ice melt more quickly.

The manufacturer claims that ICE BAN™’s freezing point is -36 degrees Celsius, compared to the 0 degrees Celsius freezing point of water. Regular road salt works well as a deicer down to about -6 degrees Celsius. [Someone may ask why the activity did not compare the ICE BAN™/salt mixture with a salt water mixture. The reason is that the differences in freezing points might not be apparent in such a small sample.]

Now let’s talk about the conclusions. Most of you probably noticed that the salt water wasn’t clear. That was because not all of the salt had dissolved into the water.

The ICE BAN™ has a molasses-like consistency and a distinct smell. If we added the ICE BAN™ to a house plant, we wouldn’t expect any effect. Adding a salt water solution to a plant would probably kill it, or at least make it pretty sick. That’s one reason we are moving away from the use of road salt on the roads. It can harm plant life, and also leach into the soil and the groundwater supply.

If someone in your family needed an ambulance to go to the hospital during a bad winter storm, where the temperature was less than about 20 degrees Fahrenheit or -6 degrees Celsius, it might make a big difference whether we had treated the road with an alternative deicer. Those of us who work in the transportation industry take pride in doing our job well, so that you can travel safely.

SOURCE: This activity was developed by a public outreach partnership among the American Society of Civil Engineers, the FHWA, the Virginia Department of Transportation, and the Maryland Department of Transportation.
BOAT FLOAT

TOPIC AREA: Aviation, Marine, Rail
AGE LEVEL: Kindergarten - 2nd Grade
DURATION:

RESOURCES:

MATERIALS: • Aluminum foil
• Weights
• Water table

OBJECTIVE: Design a boat from the sheet of foil that will hold the most weight.

TASKS: The children can fold the foil into any shape and then see how much weight it will hold. When the boat sinks, they have added too much weight. Then they could redesign the boat using the same piece of foil and see if they could get the boat to hold more. Keep track on the chalkboard of which boat held the most weight. Then the children will have a goal to aim for.

Presentation
• Describe the role of boats in transportation, freight movement, etc.
• Introduce Bonus Contest - write down on a slip of paper your name and the number of containers that you think the largest container ships hold

Experiment
• Each group designs three boats, one boat at a time, using aluminum foil

Contest
• Boat buoyancy is tested using weights (marbles, metal nuts, etc.)
• Boat design that supports the greatest weight wins

DISCUSSION: The boats shaped similar to a barge will hold the most weight. Talk about the shapes that held the most weight. Relate this lesson to the use of container ships to move cargo.

• How big do you think boats can get?

Bonus Contest Results. The largest ships under construction now, called Super Containers, can hold as many as 6,600 containers!

• If boats keep getting bigger, what happens to the trains and the trucks?

SOURCE: Dena Tensa, Oregon, LessonPlanet.com and Montana State University ITE Student Chapter
### DESIGN A BICYCLE HELMET

**TOPIC AREA:** Pedestrians/Bicycles  
**AGE LEVEL:** Kindergarten - 2nd Grade  
**DURATION:** 
**RESOURCES:** 

**MATERIALS:**  
- Boiled eggs  
- PlayDoh™

**OBJECTIVE:** This demo is simple, fun, and rather illustrative of the use of modeling to help solve engineering problems.

**TASKS:**

1. Divide students into groups.
2. Give each group a boiled egg and a hunk of PlayDoh™.
3. Ask them to design bicycle safety helmets where the boiled egg models the bicycle rider's skull.
4. Designs are judged by simply dropping each construct on the floor from waist height and seeing which eggs break.

**SOURCE:** Victoria Heil, Arizona, LessonPlanet.com
TRANSPORTATION AROUND TOWN

TOPIC AREA:  Planning/Urban Development
AGE LEVEL:  9th - 12th Grade
DURATION:  
RESOURCES:  • The Grid Plan
• The Invention of the Steamboat
• The Erie Canal
• Shipping in New York
• The Black Ball Line

MATERIALS:

OBJECTIVE:  In this activity, students will learn how to take action to improve their town’s transportation routes -- and make a small but significant difference in their community. Students will first examine some of the different ways people get around your area (cars, public transportation, bikes, etc.). Then, either in a small group or as a class, students will identify a problem with a local transportation route, such as a pothole, a narrow bike path, a lack of a traffic signal at a busy intersection, and so on. Students then research what local agency, board or person has the authority to improve this situation. Working together, students develop a solution for addressing this problem and then present it, as a proposal, to local officials.

TASKS:  Begin by having your students read the articles above. Lead a class discussion about some of the different ways that people get around town. You may wish to discuss questions such as:

• What types of transportation do you, your family, and friends use each week?
• What are some ways that your community’s transportation systems could be improved?
• Do some groups of people (such as students or senior citizens) tend to use some types of transportation more than others?
• What changes in your local roads and street signs might help more people get around more safely and efficiently?

1. Ask students to brainstorm some problems with local transportation routes. Focus on specific, easily-fixable problems such as the lack of a streetlight at a busy intersection, confusing signs on the highway, no speed bumps near a low-speed zone, lack of bike paths, and so on.

If your students can’t think of any transportation problems, suggest they contact your local newspaper or TV news station and ask if they’ve done stories about traffic accidents at a particular location, complaints about unsafe roads, etc. Students can also speak with their parents about this matter.

2. Once students have identified a transportation problem they want to tackle, brainstorm some possible solutions. Then, help students research which government agency, board or person handles the transportation concern your students want to improve. For example, the Parks Department might be in charge of local bike routes. Students can also call their City or Town Hall to find the appropriate contact person.

3. Ask students to research the method for presenting their idea to this agency, board, or person. Are there regular public meetings? Is there a special hotline set up for such concerns? Are there certain forms which must be completed?
As a class, develop a convincing written proposal to address this transportation problem. Different students should work on different parts of the proposal. Collect facts and figures that show the effect of the problem. Gather or take photographs to support your argument. Students may wish to interview a sample of people from your area, or gather signatures on a petition.

4. Then, have students present their proposal to the appropriate board or individual. Remind students that the wheels of government can turn slowly, so they need to be persistent and creative. For example, if the local government says it doesn’t have money to fund your proposed change, students can ask if they can collect or raise money for this purpose and then donate it. TV news stations and newspapers are always looking for heartwarming stories about people (especially kids) going out of their way to make a difference in the local area. If your students’ first efforts are unsuccessful, you may wish to contact local news stations or newspapers for additional support and publicity for your cause.

5. Have your students share their struggles and successes by filling out the worksheet. Have them describe the problem you worked on, the solutions they proposed, the people they contacted, the actions they took, and any results.

SOURCE: LessonPlanet.com
CATCH THE UNIVERSITY SHUTTLE

TOPIC AREA: Buses/Public Transportation

AGE LEVEL: 3rd - 5th grade

DURATION: 45-60 minutes

RESOURCES:
- http://www.utexas.edu/parking/transportation/shuttle/calendar.html
- http://www.utexas.edu/parking/

MATERIALS:
- Internet access
- Paper, rulers, pencil
- Markers or crayons
- Highlighters

OBJECTIVE: Schedules are a part of our everyday life. They help add structure and organization so that things run efficiently. This lesson lets students use information to create a user friendly and creative display of the schedule for the University of Texas Shuttle Bus. Students will take real world information and use it to create a table and to solve problems involving time. Students will:

- measure to solve problems involving length, including perimeter, time, temperature, and area
- solve problems by collecting, organizing, displaying, and interpreting sets of data
- create an attractive and easy to read poster showing the schedule of the University of Texas Shuttle Bus.

TASKS:

Step 1: Ask students “What is a schedule?” Record answers as they brainstorm.

Step 2: Brainstorm and record where you might use or see a schedule.

Step 3: Lead the discussion to schedules in transportation (airplanes, trains, buses).

Step 4: Introduce the information on the University of Texas Shuttle System website located at http://www.utexas.edu/parking/transportation/shuttle/calendar.html.

Step 5: Help students to interpret the information given. Highlight important information.

Step 6: Students will use their elapsed time skills to create a schedule. (You may have to model to get the students started.)

Step 7: Students will create a chart for the Shuttle schedule including an advertisement to encourage students to use the shuttle system.

DISCUSSION: Review the usefulness of schedules.

SOURCE: Kathy Faulks, Buda Elementary. This lesson plan was developed with content located at the UT Parking and Transportation website http://www.utexas.edu/parking/.
TRAFFIC SAFETY JEOPARDY

TOPIC AREA: Traffic Safety
AGE LEVEL: 9th - 12th Grade
DURATION:
RESOURCES: Jeopardy questions

MATERIALS: • Poster/foam board
• 3x5 index cards
• Heavy stock paper/ poster board
• Paper clips
• Play money
• Glue/velcro

OBJECTIVE: To learn the laws of traffic safety.

TASKS:

Board Set Up:
• Use Velcro tabs or glue to attach category names across the top of the Board.
• Use Velcro tabs or glue to attach 5 pockets under each category. (Leave top opening for index cards.)
• Paper clip card with dollar amount on the top of each packet.

Play Jeopardy/Double Jeopardy
• Student chooses a category and dollar amount. Read the answer card. Have student respond in the form of a question. (Large groups can be divided into teams.)
• One DAILY DOUBLE can be played during-regular JEOPARDY and two DAILY DOUBLES can be played during DOUBLE JEOPARDY.

ELEMENTARY QUESTIONS:

SCHOOL BUS

$100 Something you always do when getting on or off the bus? What is hold the handrail?
$200 You must never, ever do this when getting off of the bus? What is walk behind the bus in the Danger Zone?
$300 Always do this when you ride the bus? What is sit quietly in your seat?
$400 At the bus stop you should always do this? What is staying at least two giant steps back from the side of the road?
$500 Be sure you can see the bus drivers face and he can see you? What is do this before crossing in front of the bus?

SCHOOL BUS DOUBLE JEOPARDY

$200 The area 10 feet or 10 giant steps around the bus? What is the Danger Zone?
$400 The Danger Zone is called this for a reason? What is because the driver cannot see you when you are this close to the bus?
$600 Look left, then right, then left again? What is the proper way to cross the street after getting off the bus?
$800 You practice these two times each year to know what to do in an emergency? What is an evacuation drill?
$1000 He or she is your friend and teacher on the bus? Who is the bus driver?
BONUS There are 8 of these on every school bus? What are flashing lights - 4 amber; 4 red?
UNDERAGE DRINKING

$10 Definition of impaired? What is to reduce/lessen your ability to perform?
$20 Performance (walking, sports, bike riding) is impaired by these? What are alcohol/other drugs?
$30 Two ways you can get out of riding in a car/vehicle with an impaired driver? What are sleep at a
friends house, find someone else to take you home, etc.?
$40 Signs that a driver has been drinking? What are smell of alcohol, talking strangely (slurred speech),
balance (not able to walk a straight line)?
$50 S. A. D. D.? What is Students Against Drunk Driving?

UNDERAGE DRINKING DOUBLE JEOPARDY

$20 If you must ride with an impaired driver, you will be safer if you do this? What is ride in the back
seat of the car and always wear a seat belt?
$40 Legally you cannot drink until you are what age? What is 21?
$60 The blood alcohol content legal limit in Pennsylvania if driving a motor vehicle? What is 0.10?
$80 The underage drinking penalty for a first offense for children who do not have a driver’s license?
What is a three month license suspension after you have successfully passed the Pennsylvania driver’s
test?
$100 The fine for adults who provide alcohol to anyone under the age of 21 (even their own child)?
What is $1000.00 for the first offense (child) and $2500.00 for each additional offense (child)?
BONUS The adult homeowner would receive this fine for a party in their house with 10 underage drinkers?
What is $23,500.00?

PEDESTRIAN

$100 Always stop at the curb? What you should do before entering the street or road?
$200 Stop, look left, look right, look left again? What is the correct way to cross the street?
$300 Don’t just LOOK for traffic, do this too? What is listen for traffic?
$400 The safest place to cross the street? What is the crosswalk/corner?
$500 Make eye contact? What is the way to be sure the driver making a right hand turn has seen you?

PEDESTRIAN DOUBLE JEOPARDY

$200 A specially marked path for pedestrians crossing a street? What is a crosswalk?
$400 This is where you should walk when there is no sidewalk? What is facing traffic as far to the left of
the road as possible?
$600 Wear bright colored clothing when walking during the day? What is to help drivers see you?
$800 Move to the edge of a parked vehicle (if no one is in the vehicle and the vehicle is not running)
and look left-right-left? What is the way to check for traffic if your vision/view is blocked?
$1000 The traffic signal that tells you to cross the street after you have checked for turning vehicles?
What is the “WALK” signal or “walking pedestrian”?
BONUS Continue walking and complete crossing the street? What is what you should do if the don’t walk
signal begins to flash once you have started to cross the street?

BICYCLE

$100 Made to protect your head in a bike crash? What is a bicycle helmet?
$200 Place your forearm along the top tube with the elbow touching the seat. Your fingertips should
just reach the handlebars. Then straddle the bike. There should be about an inch between the
top bar and your crotch. What are the two ways to measure a bike to assure correct fit?
$300 Bicyclists ride their bikes in this direction? What is the same direction, with flow of traffic?
$400 The way a bicyclists lets a car know he/she is turning? What are hand signals?
$500 Stopping at stop signs and yielding to pedestrians? What are traffic laws bicyclists must obey?
BICYCLE DOUBLE JEOPARDY

$200 Children should not ride in the roadway until they reach this age? What is nine years old?

$400 A skill cyclists should use to look and search ahead, back, and around for any traffic hazards? What is to scan?

$600 ANSI, ASTM, or SHELL certification? What to look for when buying a bicycle helmet?

$800 Always lock your bike when not in use; park your bike where it can easily be seen; take your bike indoors overnight; register your bike with the police dept. and record the serial number? What are ways to protect your bike from being stolen?

$1000 Yell "passing left" or "passing right" and pass on that side? What is the correct way to pass a pedestrian or bicyclist on a bike path?

BONUS Always wear a bicycle helmet; ride with traffic; signal all turns; obey all stop signs and traffic signals ? What are the best ways to be safe on a bike and be predictable in traffic?

SEAT BELTS

$100 The first thing you do when you get into a car/vehicle? What is BUCKLE UP?

$200 Across pelvic bone; low and snug across your hips? What is proper position for wearing a lap belt?

$300 The amount of time needed to buckle your seat belt? What is three seconds?

$400 This is equal to a fall from a three story building? What is the force in a 30 mph crash?

$500 You, your family, and friends? Who are the people who suffer the consequences if you are in a car crash and you do not use your safety belt?

SEAT BELTS DOUBLE JEOPARDY

$200 Across the shoulder and low and snug against the hips? What is the proper placement of a safety belt (shoulder/lap belt combination)?

$400 Every time you ride in a car/vehicle? What is how often you should wear your seat belt?

$600 Number of collisions in a crash? What is 3: when the car hits an object, when the passenger hits the inside of the car and when the internal organs hit the skeletal frame?

$800 In the middle position of the back seat, buckled in a safety belt? What is the safest place for children to be in a crash?

$1000 Your safety belt is your best defense against this kind of driver? What is a drunk driver?

BONUS The driver and all front seat passengers? Who is required to wear a seat belt by Pennsylvania Law?

SECONDARY QUESTIONS:

SCHOOL BUS

$100 The ten foot area around the bus? What is the Danger Zone?

$200 The Danger Zone is called this for this reason? What is because the driver cannot see children or small objects in this area?

$300 There are eight of these on every school bus? What are flashing lights - 4 amber; 4 red?

$400 Buses have one of these to attract motorist's attention? What is a stop arm?

$500 A school bus stops 10 feet from rail road tracks. To safely cross, the school bus must travel approximately what distance, in how much time, when starting from a dead stop? What is approximately 25 feet and 15 seconds?

SCHOOL BUS DOUBLE JEOPARDY

$200 As a motorist, meeting or overtaking a school bus with red flashing lights you must take what action? What is stop at least 10 feet away from the bus?

$400 Until all children reach a place of safety around a school bus the motorist may not do this? What is resume motion of the vehicle?

$600 The penalty for failure to stop for a school bus with red flashing lights? What is a 60 day license suspension, 5 points and a $100 Fine plus costs?
$800  The only exception to the rule that drivers must stop for a stopped school bus with flashing red lights? What is when a driver is on a separated roadway (physical barrier, cleared dividing section)

$1000  The total cost of the fine for passing a school bus with flashing red lights? What is $100 fine, $24.50 court costs, $10 EMS Fund, $50 CAT Fund and $1.50 administrative costs - total of $186.00?

BONUS  Concrete median, metal median, non-mountable curbs, concrete mountable curbs, trees or shrubs, rocks or boulders, grass? What are physical or clearly indicated dividers? (Singing divisors DO NOT create a separate roadway.)

UNDERAGE DRINKING

$10  Alcohol content in one 12-ounce can of beer is equal to these? What are one shot (1.5 ounces) of liquor, a 5 ounce glass of wine, and a 12 ounce wine cooler?

$20  The time it takes for one ounce of alcohol to leave the body? What is approximately one hour?

$30  The underage drinking penalty (Act 31) for a first offense? What is a three month license suspension and a fine of up to $300.00 plus court costs?

$40  The blood alcohol content legal limit in Pennsylvania if driving a motor vehicle? What is 0.10?

$50  A car straddling the center line, weaving, stopping in traffic without a cause? What are ways to spot a drunk driver?

UNDERAGE DRINKING DOUBLE JEOPARDY

$20  The fine for adults who provide alcohol to anyone under the age of 21 (even their own child)? What is $3000.00 for the first offense (child) and $2500.00 for each additional offense (child)?

$40  The first driving ability affected by alcohol? What is judgment/ability to think clearly?

$60  Percentage of total crashes that involve alcohol? What is 50%?

$80  Parental consent is not required for the police to conduct these tests, but parents will be notified? What are chemical tests of breath, blood, or urine to determine drug or alcohol content?

$100  The penalty for Driving under the Influence of Alcohol/Drugs? What is one year license suspension, sentenced to jail for a minimum of 48 hours, pay a fine no less than $300.00, required to participate in Alcohol Highway Safety classes, and if necessary, be ordered to undergo alcohol and drug rehabilitation treatment?

BONUS  The "Implied Consent" law states a licensed driver will take one or more chemical tests if arrested for driving under the influence of alcohol or drugs. Failure to do so results in this. What is the automatic suspension of your license for one year?

PEDESTRIAN

$100  The safest place to cross the street? What is the crosswalk/corner

$200  Stop, look left-right-left, and over your shoulder for turning traffic? What is the correct way to scan before crossing the street at an intersection?

$300  This is where you should walk when there is no sidewalk? What is facing traffic as far to the left of the road as possible?

$400  Make eye contact? What is the way to be sure the driver making a right hand turn has seen you?

$500  As a driver you must yield to pedestrians using these? What are crosswalks?

PEDESTRIAN DOUBLE JEOPARDY

$200  A way to make yourself more visible at night? What is to wear bright colored clothing, use retro reflective materials, and carry a flashlight?

$400  Stop, look for pedestrians and vehicles, and then turn when it is safe? What is the correct way to make a right turn on a red light?

$600  Crossing the street at any point other than a crosswalk? What is jay-walking?

$800  These "additives" can impair your ability to walk safely? What are drugs, including alcohol?
$1000 Failing to yield to a pedestrian in a crosswalk at an intersection that does not have a signal will result in this fine? What is $25.00 plus CAT fund, EMS, and court costs for a total of $91.00 plus 2 points?

BONUS Driveways, neighborhood streets, alleys, and parking lots? What are common vehicle-related places you may find children playing?

**BICYCLE**

$100 Bicycle is a vehicle and must follow these? What are all traffic signs and signals.

$200 Safety equipment required by law when riding at night? What are a front white headlight, a rear red reflector, and an amber reflector on each wheel.

$300 By law, bicyclists must ride on this side of the road? What is the right side, with traffic?

$400 Designed to cushion a blow to the head; it must meet special safety standards? What is a bicycle helmet?

$500 The way a bicyclists communicates with another driver? What is using hand signals?

**BICYCLE DOUBLE JEOPARDY**

$200 Helps the bicyclist to be seen by other drivers? What is to wear bright colored clothing and use reflective materials?

$400 The correct way to scan for traffic at an intersection? What is look left-right-left and over your shoulder for turning vehicles?

$600 ANSI, ASTM, or SHELL certification? What is the first thing to look for when buying a bicycle helmet?

$800 The only circumstance when a bicyclists can ride on the left side of the road? What is a one-way street?

**BONUS** The minimum fine for violating the bicycle law in Pennsylvania. What is $10.00 fine plus CAT fund, EMS, and court costs for a total of $76.00?

**SEAT BELTS**

$100 Please, Buckle Up? What is the first thing you should say to passengers in your car?

$200 The fine for not wearing a seat belt when sitting in the front seat of a vehicle/car? What is $10.00 plus CAT fund, EMS, and judicial costs for a total of $51.50?

$300 Across the shoulder and low and snug against the hips? What is the proper placement of a safety belt?

$400 Most occur within 25 miles of home and under 40 miles per hour? What is where most crashes occur?

$500 Only deploys in a frontal crash? What is an air bag?

**SEAT BELTS DOUBLE JEOPARDY**

$200 They are uncomfortable; I am a good driver; I only travel at low speeds; I only take short trips? What are excuses people give for not buckling up?

$400 The fine for failing to buckle up a child (4 years old or younger) riding in your car? What is $25.00 plus CAT fund, EMS, court costs, and administrative costs for a total of $91.00?

$600 Number of collisions in a crash? What are 3: the vehicle collision, the human collision, and the internal organ collision?

$800 Your safety belt is your best defense against this kind of driver? What is a drunk driver?

$1000 The number of crashes involving fire or submersion in water? What is less than, 1/2 of 1% of all traffic crashes?

**BONUS** Your chances are 25 times greater of being injured or killed if this happens? What is being thrown from the vehicle?

**SOURCE:** Pennsylvania Chapter, American Academy of Pediatrics, "Advocates For Children"
TOPIC AREA: Traffic Safety
AGE LEVEL: 9th - 12th Grade
DURATION: 
RESOURCES:

MATERIALS: • 2 buzzers/bells
• Question/answer cards
• Score card
• Prizes

OBJECTIVE: Learn the rules for highway safety.

TASKS: Prepare opening remarks that will provide highway safety information to aid in responding to the questions. Set up the room with two tables (one on either side in the front of the room). Place a chair for each contestant at the table. Put one buzzer/bell on each table.

To Play
Select 4 players for each team. Instruct the players to hit the buzzer/bell if they know the answer. The first team to ring the buzzer/bell will answer the question. If the answer is correct the team receives two points. If the answer is not correct the other team has the opportunity to answer the question. If the second team answers correctly they receive 1 point. The team with the most points at the end of the allotted time wins.

1. Q: Where is the School Bus Danger Zone? A: The 10 foot area around the bus.
2. Q: Why is the 10 foot area around the bus called the Danger Zone? A: Because the driver cannot see children in this area.
3. Q: How many flashing lights are on every school bus? A: There are eight - four amber and four red.
4. Q: Why do buses have STOP arms? A: To catch the motorists attention.
5. Q: A school bus stops 10 feet from rail road tracks. To safely cross, the bus must travel approximately what distance, and in how much time, when starting from a dead stop? A: A bus needs to travel 25 feet in 15 seconds.
6. Q: When the red lights on a school bus are flashing, how far away must a vehicle stop? A: A vehicle must stop 10 feet away.
7. Q: When can you resume driving after children leave the school bus? A: You must wait until all the children reach a place of safety.
8. Q: When can you pass a school bus with flashing red lights? A: The only exception is approaching the school bus on a divided highway.
9. Q: A bicycle is a vehicle; therefore it must follow all traffic signs and signals. True or False. A: True.
10. Q: What safety equipment is required on a bike when you ride at night? A: A front white headlight, red rear reflector, and amber reflectors on each side.
11. Q: Where should bicyclists position themselves on the roadway? A: Bicyclists must ride on the right in the same direction as traffic.
12. Q: When should you replace your helmet? A: Helmets must be replaced after a crash, even if there is no visible damage.
14. Q: How do bicyclists increase their visibility? A: Bicyclists are more easily seen when wearing bright colored clothing and use reflective material.
15. **Q:** What is the correct way to scan for traffic at an intersection? **A:** Look left-right-left and over your shoulder for turning vehicles.

16. **Q:** What is the first thing to look for when buying a bike helmet? **A:** The ANSI, ASTM, or SHELL certification.

17. **Q:** When can a bicyclist ride on the left side of the street? **A:** Bicyclist may ride on the left, with traffic, on a one street.

18. **Q:** Name 4 ways to be safe and predictable on a bike. **A:** Always wear a helmet, ride with traffic, obey traffic signs and signals, and signal all turns.

19. **Q:** What is the first thing you should say to passengers in your car? **A:** Please, Buckle Up.

20. **Q:** What is the proper placement of a safety belt? **A:** The proper placement is across the shoulder and low and snug on the hips.

21. **Q:** Where do most crashes occur? **A:** Most crashes occur within 25 miles of home and under 40 MPH.

22. **Q:** When will an air bag deploy? **A:** Air bags only deploy in frontal or near frontal crashes.

23. **Q:** How many collisions are there in a crash? **A:** There are 3 collisions: the vehicle collision, the human collision and the internal organ collision.

24. **Q:** What is your best defense against a drunk driver? **A:** The best defense against a drunk driver is to wear your safety belt.

25. **Q:** What percent of crashes involve fire or submersion? **A:** Less than 2 of 1% of all traffic crashes.

26. **Q:** Where is the safest place to cross the street? **A:** The safest place to cross the street is at the crosswalk.

27. **Q:** What is the correct way to scan before crossing the street? **A:** Stop, look left-right-left, and over your shoulder for turning traffic.

28. **Q:** When there is no sidewalk, where should you walk? **A:** Walk facing traffic, as far to the left of the road as possible.

29. **Q:** Drivers must yield to pedestrians in crosswalks. **A:** True.

30. **Q:** When walking, how can you make yourself more visible at night? **A:** Increase visibility by wearing bright colored clothing, reflective material, and carrying a flashlight.

31. **Q:** When making a right hand turn, you must only look for a safe traffic gap before turning. **A:** False.

32. **Q:** Which of the following have the same amount of alcohol: 1 shot (1.5 oz.) of alcohol; 5 oz. glass of wine; 12 oz. can of beer; 12 oz. wine cooler? **A:** All have the same amount of alcohol.

33. **Q:** How long does it take for 1 oz. of alcohol to leave the body? **A:** It takes approximately one hour.

34. **Q:** What are a few of the ways to spot a drunk driver? **A:** A car straddling the center line, weaving, stopping in traffic without a cause.

35. **Q:** What is the first driving ability to be affected by alcohol? **A:** The first driving ability to be affected is judgment / the ability to think clearly.

36. **Q:** What percentage of total crashes involves alcohol? **A:** The percentage of total crashes involving alcohol is 50%.

**SOURCE:** Traffic Injury Prevention Project, "Advocates For Children"
RIDE SAFE/WALK SMART
BINGO

TOPIC AREA: Traffic Safety
AGE LEVEL: 6th - 8th Grade
DURATION:
RESOURCES:

MATERIALS: • Bingo game cards
• Bingo chip markers
• Bingo question/tip sheets

OBJECTIVE: Learn the seat belt and walking safety rules.

TASKS:

1. Photocopy the question sheets using heavy stock paper. Cut question cards apart into 75 individual cards.

2. Place the question cards in a box or “fish bowl”, for random drawing.

3. Distribute Bingo game cards and Bingo chip markers.

4. **Seat Belt** - Participants may "Bingo" only on the diagonal and bottom horizontal line, the shape of a fastened seat belt. When playing with young children- you may consider accepting only the horizontal line, the shape of the lap belt. **Pedestrian** - Participants may "Bingo" only on the horizontal lines. This will remind them of crossing at a crosswalk or corner.

5. Participants will mark their Bingo card as needed.

Draw a question/tip card. Read the question/tip before reading the Bingo number. (Students will listen carefully to the question/tip as they are waiting to hear the Bingo number announced.) Continue drawing and reading the questions/tips until a student yells Bingo! Distribute prizes.

<table>
<thead>
<tr>
<th>Fact: Q. If shoulder belt fails to lock when pulled, is it working? A. Yes</th>
<th>Fact: Q. A lap and shoulder belt can cut my chances of being killed or seriously injured in a crash by 50% A. True</th>
<th>Fact: Q. Are most people more likely to use their safety belt on a long trip or a short trip? A. long trip</th>
<th>Fact: Q. What is the best defense against drunk drivers on the road? A. Safety belt</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>B2</td>
<td>B3</td>
<td>B4</td>
</tr>
<tr>
<td>Fact: Q. Would I need to wear my safety belt if I buy a car equipped with air bags? A. Yes</td>
<td>Fact: Q. If every state has a safety belt law, how many lives could be saved? A. 8,000 per year</td>
<td>Fact: Q. Three out of four car crashes happen within 25 miles of home. True or False? A. True</td>
<td>Fact: Q. How many injuries could be avoided if 80% of all Americans used safety belts? A. 319,000</td>
</tr>
<tr>
<td>B5</td>
<td>B6</td>
<td>B7</td>
<td>B8</td>
</tr>
<tr>
<td>Fact: Q. By using a safety belt, the driver has better control of the vehicle, True or False A. True</td>
<td>Fact: Q. How do safety belts help the driver of a vehicle? A. Keep driver from being thrown around, help maintain control of the car</td>
<td>Fact: Q. In a crash, what distributes/absorbs the impact force? A. Safety belts</td>
<td>Fact: Q. What’s the first thing you should say to passengers in your car A. Please, Buckle Up</td>
</tr>
<tr>
<td>B9</td>
<td>B10</td>
<td>B11</td>
<td>B12</td>
</tr>
</tbody>
</table>

* A RECRUITMENT TOOLBOX FOR TRANSPORTATION PROFESSIONALS
  * Sponsored in part by the Southwest Region University Transportation Center
| Fact: Q. Should a pregnant woman use a seat belt? A. Yes, and use it properly by positioning it as low as possible on the pelvic area. |
| Fact: Q. How often should you use a safety belt? A. Every time you ride in a car. |
| Fact: Q. What is the proper position for wearing a lap belt? A. Across the pelvic bone. |
| Fact: Q. If you crash and don’t use your safety belt, who suffers the consequences? A. You, your friends, and your family. |

| Driving Tip | Yield using marked or unmarked cross walks. |
| Driving Tip | Don’t overtake or pass drivers who have stopped for pedestrians. |
| Driving Tip | Right turn on red means Stop, Look for Pedestrians, and then turn when it is safe. |
| Driving Tip | Keep your windows fog and frost free. Pedestrians are less conspicuous than vehicles. |

| Driving Tip | Always reduce speed when passing children. |
| Driving Tip | Before backing up, always look for pedestrians in your path. |
| Walk Smart Tip | Always stop at the curb before entering the street or road. |
| Walk Smart Tip | Look left then right, then left again before crossing. |

| Driving Tip | Continue to look to the right and left as you are crossing the street. |
| Walk Smart Tip | Look over your shoulder for turning vehicles. |
| Walk Smart Tip | Walk to the edge of a parked car-to see traffic. |
| Walk Smart Tip | At traffic lights, wait until the light straight ahead turns green. |

| Walk Smart Tip | At intersections with walk and don’t walk signs, wait until the walk light is flashing. |
| Walk Smart Tip | A Flashing light “Don’t Walk” signal means DON’T WALK ACROSS THE STREET. |
| Walk Smart Tip | Q. What should you do if Walk light flashes and you are already in the street? A. Continue walking and complete the crossing. |
| Walk Smart Tip | Never cross in the middle of the block on busy streets. |

| Walk Smart Tip | Wear bright colored clothing when walking, even during the day. |
| Walk Smart Tip | Q. Where should I walk where there is no sidewalk? A. Walk facing traffic and as far left of the road. |
| Walk Smart Tip | Q. If walking at night, carry a lighted flashlight and wear a reflective arm band that glows in the dark. |
| Walk Smart Tip | Be alert to cars backing out of parking lots. |

| Walk Smart Tip | In residential areas be alert to cars coming in and out of driveways. |
| Walk Smart Tip | Alcohol and drugs can impair a person’s ability to walk safely. |
| Walk Smart Tip | Don’t walk outside unescorted when taking medications that cause dizziness or blurred Vision. |
| Walk Smart Tip | Never drink and drive and never drink and walk. |

| Walk Smart Tip | Q. How many people die in pedestrian crashes in the US each year? A. 8,000 |
| Walk Smart Tip | Its difficult for drivers to see in bad weather. Wear reflective clothing and carry a flashlight. |
| Walk Smart Tip | Drivers expect you to cross in crosswalks and intersections. |
| Walk Smart Tip | When no intersections are nearby, cross where drivers can easily see you. |
### Walk Smart Tips

<table>
<thead>
<tr>
<th>Walk Smart Tip</th>
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<th>Walk Smart Tip</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Ambulances, police cars, fire trucks may not stop at intersections. Wait before crossing.</td>
<td>If there is a pedestrian signal it is against the law to cross if the signal reads Don’t Walk.</td>
<td>Cross railroad tracks only at marked crossings.</td>
<td>If a railroad crossing gate is lowered or a red light is on, wait for train to pass before crossing the tracks.</td>
</tr>
<tr>
<td>Always use sidewalks - if they are available.</td>
<td>Wear bright colors during the day and reflective materials at night.</td>
<td>At the corner, look left and right then left again before you cross.</td>
<td>Be attentive while walking.</td>
</tr>
<tr>
<td>Don’t just look for traffic listen for traffic too.</td>
<td>Supervise young walkers until they show you that they are safe pedestrians.</td>
<td>Set a good example for our children by following safe walking rules yourself.</td>
<td>Make sure the &quot;coast is clear&quot; before crossing.</td>
</tr>
</tbody>
</table>

### Facts

<table>
<thead>
<tr>
<th>Fact:</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Approved child car seats have reduce deaths from 726 in 1978 to 425 in 1984. No other medical breakthrough saved as many children’s lives.</td>
<td>The chance of a crash on any trip is very low but the possibility of a crash on one of many trips in your lifetime is better than 30%</td>
<td>Some crashes are unsurvivable, but use of safety belts generally decreases the chance of death by 60% and chance of serious injury by 50%</td>
<td>Car seats are 65% effective when properly used.</td>
</tr>
<tr>
<td>Safety belts help to keep occupants from hitting into each other</td>
<td>Safety belts help keep you in place so that you can maintain control of the car.</td>
<td>Pedestrian crashes occur even on quiet pedestrian streets.</td>
<td>Law requires all drivers to have children 04 years properly buckled into approved safety seats.</td>
</tr>
<tr>
<td>The law exempts only those with verifiable medical or physical problems.</td>
<td>Knowledge is your best defense as a pedestrian. Walk Smart!</td>
<td>Recognize danger and react to it.</td>
<td>Car seat loaner programs are operating in our county. (Mention them)</td>
</tr>
<tr>
<td>Safety belts work! That’s a fact!</td>
<td>Use safety belts 11 times in a row to make it a habit!</td>
<td>Your life is in your hands. Buckle up!</td>
<td></td>
</tr>
</tbody>
</table>

**SOURCE:** PA Chapter, American Academy of Pediatrics, "Advocates For Children"
**BICYCLE DERBY STATIONS**

**TOPIC AREA:** Pedestrians/Bicycles  
**AGE LEVEL:** 3rd - 5th Grade  
**DURATION:** 
**RESOURCES:**

1. **REGISTRATION** - provide educational materials on use of helmets, helmet information, etc.

2. **BICYCLE MAINTENANCE CHECK** - Bike shops are a great resource for this station. Invite your local bike shop to come and provide bike inspection. Things to check for include: properly inflated tires, wheels that are true, spokes are straight and not broken, seat is tight and right height, handlebars tight, etc.

3. **BIKE REGISTRATION** - Check with your local police to see if they register bikes through their department. At this station you may provide engraving against theft. Place the parent’s license plate number on the main frame of the bike. This is the easiest way to trace ownership if the bike is stolen.

4. **EDUCATIONAL COMPONENT** - A uniformed officer or bike club member can provide information on correct street riding rules. Include bike reflectors, lights, bell/horn, hand signals, ride on the right, obey traffic signs and signals, courtesy techniques.

5. **SEE AND-BE SEEN** - Black Box Technique. Paint the inside and outside of a box with black paint. Place reflectors, white material, yellow material (or other bright color), black material (or other dark material). Put a small hole on the side of the box for a small flashlight to fit. Ask child to look in the box and shine flashlight for a second. Ask the child what he saw. Explain how it is easier to be seen when wearing reflective or bright clothing.

6. **DISPLAY DIFFERENT TYPES OF HELMETS** - Display a soft, thin, and hard shell helmet for parents/children to see the different types of helmets that are available. Be prepared to discuss ANSI/SNELL testing, fit, prices, helmet replacement, and wearing a helmet every time you ride a bike.

7. **HELMET FIT** - Have a selection of helmets available so that each child who plans on riding the derby course is wearing a helmet. Have sanitary caps available. In addition to fitting the loaner helmets check each child’s helmet for correct fit. (NOTE: Most helmets are not fitted correctly).

8. **DERBY COURSE** - Choose 4 or 5 basic skills you would like to test. They should be skills that are necessary for safe street riding. Suggested skills are:
   - A. Riding in a straight line slowly for approximately 60 feet. At about 30 feet the child should look over their left shoulder to check for traffic behind while maintaining a straight line.
   - B. Maneuvering and weaving. This skill test the child’s ability to change directions quickly.
   - C. Turning in a limited space - Following the line of a figure 8. This tests the bicyclist ability to turn around smoothly and easily.
   - D. Signaling - This skill tests the knowledge of hand signals and the ability to make a controlled stop.

9. **BICYCLE DRIVER’S LICENSE** - The school exchange photos are the right size to fit the license. If they are not available you can take use a Polaroid camera to take the picture. Have the child complete the information on the license and then laminate. Call 1-800 CAR BELT in advance to determine if the laminator and supplies are available for your derby.

10. **REFRESHMENTS** - At a minimum it is advisable to have water available, especially on warm days.

**SOURCE:** Traffic Injury Prevention Project, “Advocates For Children”
**RIGHT FAMILY, WRONG FAMILY**

<table>
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<th>TOPIC AREA:</th>
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<tr>
<td>AGE LEVEL:</td>
<td>3rd - 5th Grade</td>
</tr>
<tr>
<td>DURATION:</td>
<td></td>
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<tr>
<td>RESOURCES:</td>
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</table>

**MATERIALS:**
- Raw eggs
- Small plastic car
- Masking tape
- Ramp
- Newspaper
- 4 chairs
- 4 seatbelts
- Misc. clothing

**OBJECTIVE:** Wearing a seatbelt is the right decision to make.

**TASKS:**

1. Begin with an anticipatory set, i.e. seat belt in a box. Ask students to identify the sound of the seat belt clicking.

2. Next breakdown of WHO, WHAT, WHEN, WHERE, WHY, and HOW. Example: Who should wear a seat belt... everyone. One of the most important is HOW to wear a seat belt properly (low on the hips and low on shoulder).

3. Egg Demonstration - Use uncooked egg, small plastic car, masking tape, ramp and newspaper. Let egg go first with masking tape on, then without masking tape.

4. Role-playing
   - Materials Needed - 4 chairs, 4 seat belts, miscellaneous clothing, i.e. hats jackets, purses, etc.
   - Explain the Wrong Family’s actions; no seat belts, poor behavior, poor driving.
   - Explain the Right Family’s actions; always wear seat belts, always lock doors, etc.

5. Classroom reinforcement - Review and leave a word find or encourage a poster or essay contest.

6. Issue a Challenge
   - One fourth grade against another - or - fourth grade vs. fifth grade
   - Challenge the students to get their parents to buckle-up, have them make a reminder to put somewhere in the car.

**SOURCE:** Traffic Injury Prevention Project, "Advocates For Children"
EGGS AHoy!

TOPIC AREA: Aviation, Marine, Rail

AGE LEVEL: 3rd - 5th Grade

DURATION:

RESOURCES:

MATERIALS: Raw eggs
2 aluminum pie pans
2 plastic sandwich bags
1 meter of tape
Scissors
Large container filled w/ water

OBJECTIVE: Build a boat that will float while holding a raw egg.

TASKS: Describe the role of boats in transportation, freight movement, etc.

1. Boats can hold lots of things-people, cargo, even cars. Can you make a boat that can hold eggs?

2. You can use two aluminum pie pans, two plastic sandwich bags, and one meter of tape.

3. Once you’ve built your boat, try it out in a wide plastic container filled with water.

4. Introduce Bonus Contest - write down on a slip of paper your name and the number of containers that you think the largest container ships hold.

DISCUSSION: Relate this lesson to the use of container ships to move cargo.

• How big do you think boats can get?

  Bonus Contest Results. The largest ships under construction now, called Super Containers, can hold as many as 6,600 containers!

• If boats keep getting bigger, what happens to the trains and the trucks?

EXTENSION: How did you build your boat? How many eggs could it hold? Get together with some friends and have a contest to see whose boat can hold the most eggs without sinking. Relate this lesson to the use of container ships to move cargo.

SOURCE: PBSKids.org and Montana State University ITE Student Chapter
SPEED, EGGS, AND SLAM!

**TOPIC AREA:** Traffic Safety

**AGE LEVEL:** 3rd - 5th Grade

**DURATION:**

**RESOURCES:**

**MATERIALS:**
- Toy truck (big enough for an egg to fit into)
- Raw eggs
- Magic marker
- Ramp for truck (board propped up w/2 chairs)
- Garbage bag or plastic
- Sheet of paper
- Pencil
- String
- Rubber bands
- Cotton balls
- Tape
- Toothpicks
- Styrofoam cup

**OBJECTIVE:** Create a safety device to protect an egg ‘passenger’ in a car crash.

**BACKGROUND:** Newton’s First Law of Motion (or the Law of Inertia) states that objects tend to keep doing what they’re doing until a force stops (or starts) them. So a toy truck at rest wants to stay at rest until you push it, and a truck in motion will stay in motion until something stops it. The same goes for things riding in the truck. Friction holds the egg in the truck while it gradually speeds up or slows down. But if the truck stops suddenly, inertia overcomes friction and the egg keeps moving! Your challenge here is no different than an engineer who designs safety devices for people in cars finding an effective design for an affordable price.

**TASKS:** Set up your workspace so your ramp ends at the brick wall (be sure to put the plastic beneath the brick and part of the ramp). Draw a face on your egg, give it a name and personalize your passenger. Design a safety device for your passenger that fits in the truck keep in mind the price of each object as you build (see list below). Create a chart or list so you can keep track of how much you’re spending on each design.

**Item price list:**
- Styrofoam cup: $500
- Cotton Balls: $100 each
- String: $50 per meter
- Rubber Bands: $100 each
- Toothpicks: $100 each
- Tape: no charge

Test your safety device. Put your egg passenger inside the device, then place the truck at the top of the ramp and let it go so it 'crashes' against the brick. Note your results on your chart did your passenger survive? Did it fall out of the truck? Did it crack? Did it break? Analyze your results for both passenger safety and cost to build your design. The goal is to build affordably but keep your passenger safe! What is the least expensive design that protects your egg?

**DISCUSSION:** Encourage your child to come up with more than one design compare safety success as well as cost for your designs. What are the pros and cons for each design? Investigate real-life safety devices in cars, on airplanes, amusement park rides, etc. How are your egg device designs similar? How are they different?

**SOURCE:** National Science Center (Fort Discovery)
AIR POLLUTION: WHAT CAN YOU DO?

TOPIC AREA: Environment/Energy

AGE LEVEL: Kindergarten - 2nd Grade

DURATION:

RESOURCES: • “Air Pollution” by Gary Lopez

MATERIALS: • Journals

• Pens and pencils

• Air pollution vocabulary words

OBJECTIVE: This lesson is about air pollution awareness. It will help students to understand what air pollution is and how students can communicate their feelings about it.

TASKS:

1. Introduce the lesson by walking in with a bike and asking the students why they think the instructor rode to school on a bike.

2. Show the students pictures from the book "Air Pollution" and ask them to write words in their journals that describe how these pictures make them feel.

3. Have the students share, and together the class will come up with a definition for air pollution. This word will be first to be added to the word wall.

4. Introduce 3 more vocabulary words relating to air pollution. Have the students define the words and use them in a sentence.

5. After writing the words and definitions on the board, have the students write down 2 sentences in their journals. These sentences must contain at least 2 of the new vocabulary words in the appropriate context.

6. Now that the students have a general idea of what air pollution is, they can finish their daily entries with one new fact they learned about air pollution.

7. The lesson will be wrapped up by asking the students how they think they can help fight air pollution.

EXTENSION: Have students get into groups and create posters about air pollution using one of the new vocabulary words.

SOURCE: Jennyfer, Preschool Teacher, LessonPlanet.com
STOP THE BUS!
AMERICA WANTS A RIDE

TOPIC AREA: Environment/Energy
AGE LEVEL: 6th – 8th Grade
DURATION:
RESOURCES: Transportation Worksheet
MATERIALS: • Pictures of automobiles
• Fuel efficiency rates
• Emissions information
• Transportation survey

OBJECTIVE: Students will be able to: (1) identify major sources of air pollution associated with automobile emissions; (2) recognize that human lifestyles directly influence the degree of air pollution, (3) identify and describe specific actions to take to limit air pollution caused by automobiles, (4) compare various vehicles (cars, trucks, buses, and mass transit trains) for fuel efficiency, and (5) evaluate the use of carpooling or mass transit by observing the number of people riding in each vehicle as it passes a busy intersection.

TASKS:
1. Ask the students to make a list of advantages and disadvantages of personal automobile use versus carpooling or mass transit. Break up into small cooperative groups of three to four students to discuss the pros and cons of each mode of transportation. Assign roles such as reporter, recorder, etc. Ask the reporter to share the main ideas of the group with the class.
2. Spark a discussion of ways to conserve energy and alternatives to energy dependence.
3. Give the students the Transportation Survey sheet and have them survey their classmates, teachers, and staff at the school about their modes of transportation. Tally the results of the entire class on the board and have each student graph results (with a bar graph) on graph paper.
4. Take students to a busy intersection close to your school to observe traffic. If possible take different classes throughout the day to compare traffic patterns.
5. Divide the class into five large groups and assign each group a category. Have each group further subdivide. Each student will count a vehicle in their category with a different number of people in it. For example, one student in the group will only count cars with one person driving it while another person in the same group will count cars with one person driving and one person riding in it and so on. Each group will be responsible for counting all of the vehicles in their assigned category that cross the intersection from any direction.
6. Ask each group to graph and analyze the results. Encourage them to use statistics - average, median, and mode. After graphing and analyzing results, ask the students to formulate conclusions (reject or accept hypothesis) and answer the questions on the lab. Use the results and conclusions from this activity along with information gathered from the videos to spark a class debate on Mass Transit vs. Personal Automobile Usage.

DISCUSSION: What are the advantages and disadvantages of personal automobile use versus car pooling or mass transit? What are some ways to conserve energy and discuss alternatives to energy dependence? What are some of the positives and negatives of mass transit?

EXTENSION: Assign the students to write the Environmental Protection Agency to ask for information on emissions data on buses and cars (4, 6, and 8 cylinder engines). Include diesel-fueled vehicles. Compare the amount of exhaust emissions to the number of people the vehicle can carry. Invite a city planner to speak to the class about how cities cope with the increasing number of cars in the community. Ask him/her to bring along detailed drawings of roadways, greenways, and traffic patterns. Assign students to write questions to ask the city planner on the day of his/her visit.

SOURCE: Suzanne Asaturian and Cheryl Rulis, LessonPlanet.com
IT’S A CRASH TEST, DUMMY!

TOPIC AREA: Traffic Safety
AGE LEVEL: 6th – 8th Grade
DURATION: 1 hour
RESOURCES:
- Air Bag Study Guide
- It’s a Crash Test, Dummy
- Air Bags: A Hazard in Your Dashboard?

MATERIALS:
- Baking soda
- Vinegar
- Ziploc™ bags
- Tissues
- Egg holders (butter tubs or cardboard boxes)
- Tape
- Graduated cylinders
- Balances
- Meter sticks

OBJECTIVE: Students will research air bags on the Internet and use that information to design and test a version of an air bag, while also examining some of the safety concerns regarding airbags.

BACKGROUND: The engineers who design air bags are able to determine the exact quantity of chemicals needed to inflate the air bag to the proper volume, and in the correct amount of time. If the air bag is under inflated or inflates too quickly, the passenger will still be injured by the steering wheel. If the air bag over inflates or inflates too slowly, the passenger will hit the inflating airbag and be injured. It is critical to get just the right amount of gas in the air bag.

TASKS:

1. Distribute the student sheet entitled Air Bag Study Guide and have students go to Air Bags: A Hazard in Your Dashboard?. At this site, they will learn how an airbag inflates and is supposed to save the life of a passenger.

2. Distribute the student sheet entitled It’s a Crash Test, Dummy. Students should attempt to find the amount of sodium bicarbonate (baking soda) required to react with 2 ml of acetic acid (vinegar) so that the bag is inflated, with no appreciable quantity of either reactant left. This will allow students to develop some idea of a limiting reactant. It is important for students to realize that this is not exactly how an air bag works, but is a good analogy that allows them to simulate the inflation of a protective device in the classroom.

3. Place a plastic sheet be under the "drop zone" to assist in cleaning up. It is important to find a container for the egg drop that is the right size; three-pound butter tubs or small shoe boxes work well. Also be sure that students wash hands well after handling raw eggs.

DISCUSSION: Discuss the answers to the questions on the Air Bag Study Guide. This will lead into a discussion of the chemistry behind airbags.

SOURCE: www.sciencenetlinks.com
WHY USE SEAT BELTS?

TOPIC AREA: Traffic Safety

MATERIALS:
- Barbie™ or similar doll
- Seat and dash assembly

AGE LEVEL: 9th - 12th Grade

Teacher:
- Board .75 to 1.0 m long
- Dynamics cart
- Books (2)
- Clamp
- Plasticene (or modeling clay)
- Meter stick or ruler

DURATION: 1 hour

Student:
- Board .75 to 1.0 m long
- Dynamics cart
- Books (2)
- Clamp
- Plasticene (or modeling clay)
- Meter stick or ruler

OBJECTIVE: To show why seat belts are important and to encourage students to think about traffic safety.

TASKS: As a demonstration, put a Barbie doll on a block seat on a dynamics cart. Place the cart at the top of a ramp which is set with the top 30 cm above the table top. Clamp a book down as a barricade about 50 cm from the bottom of the ramp. Release the cart and observe where the doll lands after hitting the barricade.

Student Activity:
- Mark the ramp into 20 cm intervals. Raise one end of the ramp about 30 cm. Position an obstacle such as a book about 30 cm from the bottom of the ramp. Hold the obstacle stationary.
- Make a plasticene (modeling clay) cube “passenger” with sides about 2 cm long.
- Place the passenger on the front of a dynamics cart. Place the front of the dynamics cart at the 20 cm mark on the ramp. Release the cart. Observe the motion of the passenger during and after the collision. Measure the distance the passenger moves from the collision point to where it stops. Repeat this step several times and average the distance.
- Release the cart from several different distances up the incline to vary the speed. Observe the motion of the passenger and measure the distance as in the previous paragraph. Repeat this procedure several times for each measured 20 cm mark to average the distances.

DISCUSSION:
- Describe the motion of the passenger during and after the front-end collision.
- How did the speed just before the collision change as the cart was released further up the ramp?
- How did the distance the passenger rolled after the collision change as the cart was released further up the ramp?
- Describe the motion of an unbelted passenger in a car which collides with a stationary obstacle.
- Diagram the forces acting on the cart and on the passenger on the flat before and during collision.
- Seatbelts prevent a passenger from being thrown from the car. Why is it usually more dangerous to be thrown from the car than to remain in it?
- Newton’s First Law says (in essence), it takes an unbalanced force to change velocity. Explain how this applies to the motion of the passenger during the collision.

EXTENSIONS: Use ticker tape timers and attach ticker tape to each dummy as well as the car. This would provide a difference in time of movement as well as distance differences.

SOURCE: Larry Brandon, Thornwood High School Teacher, LessonPlanet.com
BUCKLE UP!

TOPIC AREA: Traffic Safety
AGE LEVEL: Kindergarten - 2nd Grade
DURATION: 10 - 30 minutes
RESOURCES:
- Buckle Up America
- Heading For A Bumpy Ride

MATERIALS:
- 2 Barbie™-sized dolls
- Large toy car
- Photographs of students
- Ribbon
- Glue
- Crayons

OBJECTIVE: To show why seat belts are important and to encourage students to think about traffic safety.

BACKGROUND: Newton’s First Law of Motion states that “An object at rest tends to stay at rest, and an object in motion tends to stay in motion with the same speed and in the same direction unless acted upon by an unbalanced force.” What this means is that objects tend to keep on doing what they’re doing. This tendency to resist changes in their state of motion is described as inertia. Seat belts are used to provide safety for passengers whose motion is governed by Newton’s laws. The seat belt provides the unbalanced force that brings you from a state of motion to a state of rest. Seatbelts prevent car passengers from flying through a windshield or hitting the dashboard when the car comes to an abrupt halt. At the moment of impact, unbelted occupants are still traveling at the vehicle’s original speed. When the person comes to a stop, the internal organs are still moving forward. These organs hit other organs or the skeletal system when the body comes to a halt. This third collision is what often causes serious or fatal injuries.

TASKS:
1. Read "Heading For A Bumpy Ride."
2. Discuss the reason the Aries plane is used.
3. Discuss the importance of staying safe while riding in the car. Ask students if they know ways they can stay safe in a car. (Buckle the seatbelt, lock the doors, sit in the back seat, etc.)
4. Ask students why seatbelts are used. Older students may be ready for an explanation of Newton’s First Law. Ask students, “Have you ever been riding in a car when the driver suddenly slammed on the brakes? How did your body move as the car stopped? You probably felt your body move forward. When you felt this happening, you experienced Newton’s First Law of Motion. In the car, your body was in motion, traveling at the same speed as the car. When the car stopped, your body stayed in motion. If you were not wearing a seatbelt and you were traveling very fast, your body could continue to move forward through the windshield!
5. Demonstrate why seatbelts are important: Place dolls in the car. Secure one doll to the car with a rubber band. Leave one doll unprotected. Push the car as hard as you can into a wall. The unprotected doll should fly out or fall forward into the dash.
6. Ask students to discuss the demonstration.
7. State, “It is important to wear safety belts every time you get into a car. We never know when an accident might happen.”
8. Discuss the importance of sitting in the back seat. Many cars have air bags that can hurt a child if they are too close to them. The back seat is higher, which will protect your neck if there is a crash. You will hit the padded front seat instead of the dash.

SOURCE: www.nasaexplores.com
GPS RECEIVER BASICS

TOPIC AREA: Transportation Technology
AGE LEVEL: 6th - 8th Grade
DURATION: 30 - 40 minutes

RESOURCES:

OBJECTIVE: GPS technology is becoming very popular in cars and buses, sporting goods, cell phones, and many other commercial and professional products. In this lesson, students will learn how to use a hand-held GPS receiver in a scavenger hunt to find nearby locations.

TASKS:

1. Go out into a large open field or park. Turn on the receivers and look at the satellite page. Have students follow along with instruction in worksheet.

2. Sketch the satellite visibility picture and point out the directions to the satellites in the sky. Notice any buildings or trees nearby that might block your view.

3. Try covering the top of the receiver with your hand and see that the signal strengths of all the satellites are lost.

4. Uncover the antenna and try moving closer to a building or bunch of trees. Describe what happens to the satellite signals. Can you predict which satellites will be blocked using the satellite display?

5. Estimate the direction along one edge of the field. Begin walking in that direction and watch your motion on the map page. Check your direction on the compass page. How well does the direction match what you estimated?

6. Check your speed on the compass page. How fast are you moving? What happens to the compass page if you stop or move slowly?

7. MARK a location and enter a name for this waypoint. Walk across the field and MARK a second waypoint.

8. Use the GOTO function to tell you how to get from waypoint 2 to waypoint 1. How good were the directions?

9. Now stand still with the receiver. Every once in a while mark your location. Go back and look at your waypoints. How much are they changing even though you are not moving?

DISCUSSION: How accurate do you think the GPS you are using are? What is the minimum number of satellites needed for the GPS to work? (Answer: Four.) How good were the directions given by the receiver to get to your waypoint? (Answer: probably pretty good if the points are far apart, but not very reliable if they are very close together.) Discuss how GPS is used in transportation and the implications of its accuracy.

SOURCE: The Institute of Navigation
Worksheet 1
GPS Receiver Basics

1. Turn on the GPS receiver and look at the satellite page. Sketch the satellite visibility picture below and label the direction to the satellites in the sky.

2. Cover the receiver with your hand. Does the reception change for the better or the worse?

3. Uncover the receiver and move close to a building or a tree. Describe what happens to the satellite signals as you move closer to the building or tree.

4. Are you able to predict which satellite signals get blocked by the obstacle? Try moving back and forth to various obstacles. Can you predict them now? Why or why not?

5. Use a compass to determine the direction of one side of the field. Write the direction from the compass here:

6. Now, use the GPS receiver. Walk along the edge of the field. Record the direction from the GPS receiver here:

7. How well do the GPS receiver and the compass match? Which is more accurate?

8. Check your speed on the compass page. How fast are you moving when you walk at a normal pace? How fast are you moving when you run along the edge of the field? What happens to the compass page if you stop repeatedly or walk really slowly? Why?

9. Time how long it takes you to walk the length of the field or room that you are in, then calculate your speed by using the following formula:
   \[ \text{Speed} = \frac{\text{Distance}}{\text{Time}} \]
   What is your speed? How does it compare to what the GPS calculated? (Note: 1 foot/sec = 0.3 m/s = 0.68 mph = 1.1 kph)

10. Mark a location in the GPS receiver. Label this waypoint with the first four letters of your name. Walk across the field and label another waypoint with the first four letters of your last name.

11. Use the GOTO function to tell you how to get from waypoint 1 to waypoint 2. Are the directions good? Why or why not?

12. Stand in one spot with your receiver. Mark your location- in the SAME spot- on your receiver every three minutes. Does the waypoint change at all? Why?
SAFETY DRIVING

TOPIC AREA: Traffic Safety

AGE LEVEL: 9th - 12th Grade

DURATION: 2 hours

RESOURCES:
- Safety Fact Sheets
- Drive Now, Talk Later!
- Driver Fatigue
- Drive Home Safe: For Teens

MATERIALS:
- Newsprint
- Internet access
- Poster board
- Markers
- Color printer
- Video cameras
- Tape recorder

OBJECTIVE: This lesson seeks to make students aware of safe driving practices and to familiarize students with the potential dangers associated with driving unsafely.

BACKGROUND: According to the National Highway Traffic Safety Administration, motor vehicle crashes are the leading cause of death among Americans up to 34 years old. Factors such as alcohol consumption, high-speed driving, and other dangerous behaviors contribute to these crashes. Most accidents could be avoided by following common safety practices. The focus of this lesson is to learn about safe practices and laws designed to prevent accidents.

TASKS:

10. On a piece of paper, draw two columns for the "dos and don'ts" of driving. Ask students to brainstorm about items for both lists. Their answers may include the following:

   **Do**
   - Wear your seat belt
   - Pay attention
   - Obey traffic laws
   - Drive at the speed limit
   - Signal before turning or changing lanes
   - Reduce speed at night, in bad weather, in heavy traffic

   **Don't**
   - Drive under the influence of drugs or alcohol
   - Drive above the speed limit
   - Pass a stopped school bus
   - Drive through a stop sign or light without stopping
   - Pass a car unless there's plenty of room
   - Drive if you are sleepy

11. Divide students into five groups, and assign one of the following topics to each group:

   - Impaired driving (DUI/DWI)
   - Seat belts
   - Speeding
   - Distracted driving (such as driving while eating or talking on a cell phone)
   - Drowsy driving

3. Have the students in each group research their particular safety issues. Encourage them to take notes about dangers, risks, and statistics. Make sure students include examples of trauma that may occur when safety practices are not followed.

4. Have each group develop a public service announcement such as a poster, mock television or radio commercial, Web site, or brochure for high school students. Encourage them to use statistics and specific state laws from their research and anecdotes or stories from personal experiences. Students should include descriptions about the injuries that can occur as a result of unsafe driving.

5. After each group has presented its public service announcement, discuss the issues as a class. Which statistics did they find most surprising? How do they think their driving will change after what they've learned?

A RECRUITMENT TOOLBOX FOR TRANSPORTATION PROFESSIONALS

Sponsored in part by the Southwest Region University Transportation Center
DISCUSSION:

- Imagine a friend has had a few beers and is about to drive home from a party. What would you say to persuade him or her not to drive?

- Your friend has just bought a new car and wants to take you for a ride. He or she is driving through your neighborhood 20 miles over the speed limit. What would you say?

- A defensive driver anticipates danger to avoid accidents. Give examples of defensive driving.

EXTENSION: Traffic Laws in Your State. Have students visit the Web site for your state’s motor vehicle department. (Links for all states are available at Teen Driving Info.) As a class, review important facts such as the following:

- What is required to get a driver’s license?

- What are your state’s laws regarding seat belts and child restraints?

- What are your state’s laws on driving and alcohol, passing school buses, stopping for pedestrians, and emergency vehicles?

SOURCE: www.discoveryschool.com
## DESIGN/CONSTRUCT
## A ROAD SIGN SUPPORT

**TOPIC AREA:** Roadway Design/Structures  
**AGE LEVEL:** 6th - 8th Grade  
**DURATION:** Four 50-minute sessions  
**RESOURCES:**  
- What Is the Design Process?  
- Road Signs Gallery  
- Train Truss Animation  
- Firth of Forth Cantilever Bridge  
- Shapes Lab  
- Triangles: Designing a Straw Bridge

**MATERIALS:**  
- Thick spaghetti noodles (uncooked) or drinking straws  
- Small paper cups  
- String  
- Glue  
- Rulers  
- File folders  
- Scissors  
- Index cards  
- Newspaper  
- Small weights (marbles, coins)  
- Fan or hair dryer  
- Clay or cellophane tape

**OBJECTIVES:** Understand the engineering design process (define challenge, research and brainstorm solutions, choose solution that fits within constraints, design and build solution, test solution, evaluate and redesign if necessary). Recognize the benefit of using triangular shapes in construction.

**TASKS:**

### Part I: Defining the Challenge

1. Tell students that they will be designing, building, and testing models of the structures that support overhead highway signs. Start with a discussion about the steps they will need to follow. Make a list of these steps, either together as a class or in small groups. Show them the What Is the Design Process? video. Compare and contrast the steps that students came up with to the steps in the video.

2. Have students view the Road Signs Gallery still images and encourage them to notice the structures used to support the signs.

3. Have students observe sign support structures on their way home from school for next day discussion.

### Part II: More Brainstorming and Research

13. The next time the class meets, discuss the following: (a) What type of sign support structures did you see? (b) Did they cross the road completely or overhang just part of it? (c) What do you think keeps them from collapsing or falling over?

14. Show students the Train Truss Animation video and the Firth of Forth Cantilever Bridge video, and encourage them to look for similarities in design between the bridges and sign support structures. Ask students: (a) Which types of bridges are similar in design to sign support structures? (b) What design element do they have in common, and why do you think it is used?

15. To help the students understand the strength of triangles, have them explore the Shapes Lab interactive activity.
16. To review the engineering design process, show the Triangles: Designing a Straw Bridge video. Ask students: (a) What steps of the design process did the ZOOM cast use to build their straw bridge? (b) How do you think the information on the video will help you when you build your sign support structures?

17. Divide the class into small groups and have them draw pictures of the sign support structures that they want to build. Give them the following design specifications: road width = 40 cm; maximum truck height = 15 cm; number of signs = 1 large or 2 small. Have each group review their designs and choose one to build.

Part III: Construction

18. The structure should be built by gluing the material to the 1 cm squares. See example: Straw Structure Diagram. This allows for easy cross-member attachment. The index cards are to be used as the signs.

Part IV: Testing/Evaluation

19. Test the structures, as follows:

Wind load test: Set up the sign support structure, holding it in place by anchoring the column(s) in clay or taping them to a desk and blow air at the sign(s). (If possible, use a fan or a hair dryer on the lowest setting.)

Weighted load test: Set up the sign support structure again. Select a location farthest from the structure’s vertical support(s) and attach a small paper cup by a string, so that the cup hangs straight down but does not touch the ”ground.” Load the cup with weights (marbles or coins), one by one.

DISCUSSION:

• Were some steps in the engineering design process more important than others? Explain.

• What are the steps in the engineering design process?

• Much can be learned from structures that fail. What did you learn from your test results?

• How was your design similar to or different from the other designs in the class?

• What would you do next time to make your structure stronger or lighter?

SOURCE: WGBH Educational Foundation
GOING-TO-THE-SUN ROAD: A Model of Landscape Engineering

TOPIC AREA: Roadway Design/Structures
AGE LEVEL: 6th - 8th Grade
DURATION: 45 minutes - 1 hour
RESOURCES: Going to The Sun Road

MATERIALS: • Internet access
• Two maps
• Three readings
• Six photographs
• One drawing

OBJECTIVES:

• To identify the problems encountered in designing and building Going-to-the-Sun Road.

• To analyze the role of Frank A. Kittredge in planning Going-to-the-Sun Road.

• To describe and evaluate arguments for building roads to provide access to Glacier National Park and other backcountry and wilderness regions.

• To identify an important highway or parkway in their own community and describe the work that went into its construction.

BACKGROUND: Before the Sun Road was constructed, only a small number of people could enjoy the spectacular scenery of Glacier National Park. The construction of the Going-to-the-Sun Road, dedicated in 1933, made this splendid experience available to the hundreds of thousands of visitors who come to the park by car. Building this trans-mountain road, which was literally carved out of the precipitous mountainside for 12 of its 50-mile length, was a challenging and dangerous task. Its designers and builders learned valuable lessons that were applied to many such scenic roads to follow.

TASKS: Have students go to Getting Started: an Introductory Question and use the continue button on the lower left corner to take them through the lesson.

SOURCE: Marilyn Harper and Teaching with Historic Places (TwHP)
# CHOCOLATE ASPHALT COOKIES

**TOPIC AREA:** Roadway Design/Structures  
**MATERIALS:**  
- **Supplies:**  
  - Medium (2 qt.) pot  
  - Crock pot  
  - Extension cord  
  - Large wooden spoon  
  - Ladle  
  - ¼ measuring cup  
  - ⅛ measuring cup  
  - Tablespoon measure  
  - Paper towels  
- **Each Student:**  
  - Steep sided bowls  
  - Sturdy spoons  
  - Wax paper in 12" squares  
  - 16 oz. Sealed can or rolling pin  

**AGE LEVEL:** 6th – 8th Grade  
**DURATION:** 1 hour  
**RESOURCES:**  
- Pictures of asphalt construction materials  
- Background information  
- Asphalt Close-Up  

**Ingredients:**  
- ⅓ c. Cocoa powder or carob  
- ½ c. Milk  
- ⅛ lb. Butter  
- 2 c. Sugar  
- 8 tbs chopped walnuts  
- 8 tbs. Shredded coconut  
- 1 c. Old fashion oats  
- 1 c. Quick cooking oats

**OBJECTIVE:** Students will learn how asphalt is made and used in paving roads.

**BACKGROUND:** When asphalt is heated it changes from a solid to a sticky liquid. Small rocks are mixed into the asphalt. As the mixture cools the asphalt hardens. This asphalt and rock mixture is much stronger than the original solid asphalt and can be used for paving roads. Like the asphalt, the chocolate you use in this recipe becomes a liquid when heated. As you mix other tasty ingredients into your "chocolate asphalt" you'll observe the cookies harden and become stronger as they cool.

**TASKS:** Prepare the "chocolate asphalt" in advance. In a medium pot combine the cocoa powder, milk, butter and sugar. Heat, stirring frequently until mixture boils for 2 minutes. Pour into the crock pot set at highest temperature. Yields 2 cups (8 ¼ cup portions). Double or triple as needed. Review the information in the background section. Check out the photo gallery for this lesson!

1. Measure the following ingredients and pour them into your mixing bowl or paper cup: 1/8 cup old fashion oats, 1/8 cup quick oats, 1 tablespoon walnuts and 1 tablespoon coconut

2. **Compare the edible construction materials to the pictures of the actual asphalt construction materials.**  
   List the similarities and differences between the edible and real construction materials. Consider weight, roughness, thickness, overall size, porosity.

3. Look at the liquid form of the chocolate asphalt in the crock pot. When asphalt binder is heated to 300° F, it is also a liquid. Using the ladle, spoon and measure ¼ cup chocolate asphalt into the materials mixture.
4. Look at the picture of the drum mixer from the asphalt plant. It tumbles all of the construction materials until they are well coated with the asphalt binder. The tumbler works like a clothes dryer. Mixing the ingredients in the bowls is similar. Stir until all of the materials are well coated. Notice - the mixture cools while you stir it, becomes stiffer and starts to stick together. Asphalt behaves the same way.

5. In the field, the pavement is spread with a paver and then rolled into a thin mat with a roller. The roller is very heavy and pushes all of the air out of the pavement. This helps make the asphalt very strong. Use a can or rolling pin to roll your cookie mixture 1/4"-1/3" thick. Can you still identify the different materials in the cookies? Place your hand over the top of the cookie. Do you feel the heat? When asphalt pavement is first rolled out it is still very hot. Just like the asphalt, the cookies will harden as they cool. (Do you think that the cookies would be as strong if you use less edible materials? More edible materials?) When the cookies have cooled and hardened (20-30 minutes), you can peel off the wax paper and eat.

**SOURCE:** The Society of Women Engineers
**TRANSPORTATION TYPES**

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<th>TOPIC AREA:</th>
<th>Multimodal</th>
<th>MATERIALS:</th>
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<tbody>
<tr>
<td>AGE LEVEL:</td>
<td>Kindergarten - 2nd Grade</td>
<td>• Marker</td>
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<td>DURATION:</td>
<td>1 hour</td>
<td>• Chart paper</td>
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<td>RESOURCES:</td>
<td>&quot;The Wheels on the Bus&quot; Lyrics</td>
<td>• Pictures of modes of transportation</td>
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<td>• Transportation Types Checklist</td>
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<td>• Book, &quot;Road Roller Saves the Day&quot; by J. Kanabe</td>
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**OBJECTIVE:** Describe modes of transportation (e.g., horse, boat, train, car, and airplane) and recognize the role that these modes of transportation play in transporting people and goods.

**TASKS:**

1. Students should come to the group singing "The Wheels on the Bus."

2. Introduce the word transportation. Give definition and examples. Discuss what kinds of transportation that students are already familiar with. Display pictures of various modes of transportation. As each one is shown, ask the children to tell whether it is land, air, or water transportation.

3. Record the students' responses.

4. Teacher will write a story dictated by the students about the modes of transportation discussed in the web on the chart. Allow children to make a collage by sorting the pictures of land, air, and water transportation from the pictures used in step 2.

5. Read and discuss "Road Roller Saves the Day" by Junkichi Kanabe. Other books about transportation that would be good if this one isn’t available are: "Two Little Trains" by Margaret Wise Brown, "Truck Jam" by Paul Strickland, "Richard Scarry’s Cars and Trucks and Things That Go" by Richard Scarry.

**SOURCE:** Georgia Learning Connections
SIMCITY AND POWERPOINT

TOPIC AREA: Planning/Urban Development
AGE LEVEL: 6th - 8th Grade
DURATION: 2 weeks
RESOURCES: • SimCity
• Microsoft PowerPoint Tutorials

MATERIALS: • Internet access
• SimCity (or SimTown)
• Microsoft PowerPoint
• Digital camera (optional)

OBJECTIVES:

1. Students will be able to use SimCity to create a "functioning" city.
2. Students will be able to use PowerPoint to create a 7-slide election campaign presentation.

TASKS:

1. Introduce students to SimCity, a city simulation program. Use the first class session to instruct students on the "basics" for setting up a city (transportation, water pipes, power plants, residential and industrial zones, etc.). During the next 3-5 class sessions, students form their own SimCity.

2. When all of the cities have been constructed, introduce the class to the basic components of PowerPoint (this may take 1-2 class sessions). Focus on how to create a new slide, how to format backgrounds, how to add clip art and animation, and how to incorporate sound effects and transitions. Students should have 7 slides in their slide show. As for content, students may want to consider the following questions when creating their slide show:
   - What qualities do you have that would make you a good mayor?
   - What have you done for your town in the past? (students can make this up)
   - What will you plan to do in the future?

3. Once all of the PowerPoint presentations are finished, students can share their slide shows with the rest of the class. Students can share their feedback on what they liked about the slide shows -- both the technical aspects and the campaign content.

DISCUSSION: Discuss important elements in a functioning city. Consider how transportation services affect mobility, quality of life, environment, public opinion, city budgets, etc. What happens if you change the characteristics of the transportation services (i.e., implement a public transit system)?

SOURCE: Staci Nazareth, LessonPlanet.com
TRAFFIC LIGHT PROBABILITY

TOPIC AREA: Traffic Markings, Signs, Signals
AGE LEVEL: 6th-8th Grade
DURATION: 

MATERIALS: • Overhead, transparency, marker
• Pencils and lapboards/clipboards
• Whiteboard, marker
• Probability Record Sheet
• Data Collection Sheet
• Probability Journal Self-Assessment

OBJECTIVE: Traffic Light Probability engages the class in a probability experiment on the way to a local state park for a class field trip.

TASKS:

1. Several days prior to a field trip, the teacher leads a class discussion of the traffic lights that the class may encounter on the trip. Students brainstorm a class list of all possible traffic signals that will be encountered.

2. Teacher distributes copies of Traffic Light Probability Record Sheet to students. Students work cooperatively to complete their individual record sheets.

3. On the day of the trip, the teacher distributes copies of Traffic Light Data Collection Sheet to the class. Students collect and record data on their way to the park. Teacher collects data sheets for later collaboration.

4. The day after the trip, the teacher distributes the completed Traffic Light Data Collection and Traffic Light Probability Record Sheets to students for discussion. The teacher asks the students to then write a paragraph in their Probability Journals comparing their predictions to their actual data; additionally, students are asked to respond in their journals to: "What is the probability of these results occurring again?" for their homework assignment.

5. Students use the Traffic Light Probability Journal Entry Self-Assessment to evaluate their work

SOURCE: Christy Clanton, Bay District Schools, Florida, LessonPlanet.com
SIGNS OF THE TIMES

TOPIC AREA: Traffic Markings, Signs, Signals
AGE LEVEL: 9th - 12th Grade
DURATION: Three 50-minute sessions
RESOURCES:
- Department of Transportation

MATERIALS:
- Internet access
- Colored pencils/markers
- Bulletin board supplies
- Portfolio
- Digital camera
- Printer

OBJECTIVES:
- State the meaning of the shapes and colors used for traffic signs.
- Explain how signs help you when driving.
- Become proficient in the use of internet searches.
- Use a digital camera to reproduce images.

TASKS:
1. Research a variety of signs and their meanings (www.trafficsign.us) using the Internet.
2. Students will pair up for the group activity.
3. Students will take digital pictures of signs located in their area.
4. Create replicas of signs found at Department of Transportation and label their use.
5. Display created signs on a bulletin board.

EXTENSION: Discuss how state departments of transportation or local traffic engineers determine the need for roadway signs.

SOURCES: Odell Dingess, Mildred Napier, Debra Browning, LessonPlanet.com
BICYCLE SAFETY: OBSTACLE COURSE

TOPIC AREA: Pedestrians/Bicycles
AGE LEVEL: 3rd - 5th Grade
DURATION: 
RESOURCES: Bicycle Helmet Safety Institute

MATERIALS: • Cones
• Road blocks
• Traffic signs/ stop lights
• Flags
• Pretend pedestrians/ bikers

OBJECTIVE: This activity may be used with students of all levels and bike riding experience. This lesson will teach the students about proper bike riding procedures, bike safety, and traffic signs.

Using the instructions and information given in class, the students will be able to complete the obstacle course in less than ten minutes, following all of the rules, obeying all of the traffic signs, and demonstrating proper bike riding. Using the knowledge taught in class, the students will be able to respond correctly to any dilemma that may occur while riding through the obstacle course.

TASKS:

1. Make sure all of the students are physically capable of riding a bike. If there are any complications, make sure they are resolved before you continue.

2. Teach and demonstrate the proper way to ride a bike and go over rules and safety tips.

3. Teach the students the meanings and responses to common traffic signs that they may need to know for riding a bike.

4. Make sure that the obstacle course is set up and ready. Some good places for a course may be a parking lot, a hard top playground, or a dead end street. Of course, all would be blocked from other traffic. Make sure that all of the students are equipped with bikes, helmets, and pads. If everyone is not equipped, they can share or use extras.

5. Have all the students line up on their bikes at the starting line, you will send one student at a time through with a five minute delay between each student.

6. While waiting or when finished, the students may watch and observe the other students that are going through the obstacle course.

DISCUSSION:

1. Ask the students how hard it was for them to follow the bike safety rules.

2. Ask the students if it was easy for them to follow and obey the traffic signs.

3. Ask the students how difficult it was for them to finish the obstacle course in ten minutes or less.

SOURCE: Michelle A. Zenk, LessonPlanet.com
WHAT'S YOUR SIGN?

**TOPIC AREA:** Traffic Markings, Signs, Signals  
**MATERIALS:**  
• "What’s Your Sign?” worksheet  
• Crayons

**AGE LEVEL:** Kindergarten - 2nd Grade  
**DURATION:** 25 minutes

**RESOURCES:** What’s Your Sign

**OBJECTIVES:**

- To recognize common traffic signs and signals.
- To understand the importance of obeying traffic signs and signals.

**TASKS:**

1. Ask the children to imagine they are riding in the car with one of their parents. Ask them what the adult should do if they come to this sign (display the Stop sign). Next hold up a traffic signal with the green light colored in and ask them what the driver should do now.

2. Discuss with the children what might happen if drivers did not obey traffic signs and signals.

3. As a group, brainstorm ways that children get to school, to a friend’s house, or to the park. Be sure to include walking, biking, in-line skating, and skateboarding. For example, ask: When you go by yourself or with friends somewhere by biking or in-line skating, do you think you need to follow the traffic signs and signals like cars do? Why or why not?

4. Display each of the safety signs and signals you have made using the "What’s Your Sign?” worksheet. Discuss what each one means. Have volunteers pretend to be biking or in-line skating and hold up the various signs for the children to demonstrate what to do when you come to each one.

5. Pass out a copy of the "What’s Your Sign?” worksheet to each child. Explain that the children should look at the shape of each sign and draw what goes inside.

6. When the children have finished, pair them with a partner to discuss their signs worksheet and explain to their partner what each one means.

**SOURCE:** National Crime Prevention Council
PEDESTRIAN SAFETY

TOPIC AREA: Pedestrians/Bicycles
AGE LEVEL: Kindergarten - 2nd Grade
DURATION: 1 hour

MATERIALS:
• (1) 23’ x 40’ canvas with painted roads and walkways
• (6) battery powered cars w/extra batteries, chargers, and assorted traffic signs
• (6) colored boxes or blocks
• (1) booklet "When I Cross The Street"

RESOURCES:

OBJECTIVE: Students will learn pedestrian and traffic safety practices.

TASKS:

1. Place traffic signs in the appropriate locations and place colored boxes on the matching colored patches; three on each side of the center street is recommended.

2. Introduce and define the vocabulary word "pedestrian".

3. Discuss ways to be safe when walking to school. Ask what drivers need to do so pedestrians are safe.

4. Review each traffic sign, discussing what it means to both drivers and pedestrians.

5. Review how to cross the street correctly. (Look both ways. Step onto the road; look to the left again and continue across the street walking quickly. Do not run.)

6. Assign six students to be drivers. Assign six more to be delivery persons of the colored boxes or blocks. Explain that it will be their job to walk to the first building, where their color-coordinated box is sitting, and pick it up. Then they must deliver their "package" across the center street to the second building of the same color and return safely back to their starting point (off the canvas).

7. The students should practice what they have just learned about interacting as pedestrians and drivers. When all deliveries have been safely made, rotate the students (i.e. drivers sit on sidelines, delivery people become drivers, 6 new students become delivery people) until all have had an opportunity in each position.

8. Someone may act as police officer; ticketing children who break traffic/pedestrian rules (jay walking).

9. Change the car batteries as soon as a car starts going slower than the others. Each battery should last about 1-1/2 hours. Please be sure to hook dead batteries up to the chargers so they will be completely charged for the next event.

DISCUSSION:

1. Present all the traffic signs to the children and ask them what they mean.

2. Review traffic and pedestrian laws.
3. Ask why we have laws to regulate auto and pedestrian traffic.

4. Ask children to pronounce and define pedestrian.

EXTENSION:

This requires an additional adult (student teacher, parent volunteer, etc) and a location apart from the driving activity. A stage or far corner of the gym/cafeteria is suitable. This activity is designed to meaningfully occupy those children who are otherwise on the sidelines. It consists of a picture/story booklet presentation which reinforces the brief safety practices review presented in tasks items 2-5 above. The teacher who has no assistant may use this presentation for the entire class in connection with items 2-5.

1. Assemble students in the identified location.

2. Announce the picture/story booklet presentation as a story of a girl named Mary who has learned how to be safe when walking in the streets.

3. Display the booklet "When I Cross The Street". Read the story page by page while displaying each picture. If they are able, invite various students to read the text as you turn the pages.

4. Stimulate student interaction with questions, examples, and personal experiences.

SOURCE: Junior Engineering, Utah State University
HOUSTON
REAL-TIME TRAFFIC REPORT

TOPIC AREA: Transportation Technology
AGE LEVEL: 9th - 12th Grade
DURATION: Introduction: 45 minutes
Weekly: 3-5 minutes
RESOURCES:
• Houston Transtar
• Houston’s Real-Time Traffic Map
• Houston’s Real-Time Traffic Report

OBJECTIVE: This is an ongoing project where students will collect real-time traffic data for the purpose of studying traffic patterns at various times of the day. Students will also calculate the time needed to travel a certain distance given a certain rate of speed, which will be obtained from the data.

TASKS:

1. Assign each student a partner for this project. They will be asked to monitor traffic flow in the Greater Houston area.

2. Give an introductory lesson calculating the time it would take to travel a given distance using the speed from the traffic maps.

3. After completing the questions at the end of this assignment, discuss the reasoning behind the TEMC research.

4. Students will collect data daily on traffic flow on three major freeways (exact locations of freeways will need to be assigned--teacher discretion). This data will be posted on a chart or other suitable area in the classroom.

5. Results will be discussed at the end of one-week, one month, and each semester. Students will be asked to keep a journal of their data and at the end of the project, students will be asked to use this data and write a summary of the results accumulated over the period of the project.

DISCUSSION:

1. What was the average speed of vehicles traveling on: Interstate-10(west), Interstate-59(south) and Interstate-45(north)?

2. How long would it take a vehicle to travel 12 miles beginning at the 610 loop and traveling west on Interstate-10?

3. If your school was located at the intersection of Interstate-59 and the 610 Loop, and you had to travel 11 miles north on Loop 610 and then took highway 290 for 13 miles traveling west, if you left now, when would you arrive at your destination? (be sure to record your time of departure.)

SOURCE: Susan Boone, Rice University, Department of Computer Science
DEER SAVERS

TOPIC AREA: Traffic Safety

AGE LEVEL: 9th - 12th grades

DURATION: One semester

RESOURCES:

MATERIALS: • GPS Equipment

OBJECTIVE: Students will gather data regarding deer/car collisions from the State Department of Motor Vehicle (DMV) data files, local police/trooper reports, by surveying community members (local PTA, Kiwanis, Lions Club, Rotary Club, Chambers of Commerce, Scouting groups, 4H, Cooperative Extension, etc.). Based on interviews with community members (hunters, naturalists, hikers, joggers, etc.), students will map active deer trails near local high use roadways using GPS receivers. Using the collected data, students will utilize GIS software to create maps to educate all community members about high risk deer collision areas on local roadways. Students will present their findings to local town boards, county officials, and highway departments with recommendations for deer crossing signs.

TASKS:

Key Planning Activities

1. Teacher will contact potential community member partners.
2. Students will complete introductory activities to become familiar with the GPS units and the GIS software capabilities.

Key Service Activities

1. Students will meet with community organizations to both describe their project and elicit help.
2. Students will mark sites where car/deer collisions occurred with GPS units and then make overlays with county maps using ArcView.
3. Students will download community data from various sources into ArcView and compile maps from this data.
4. Students will present information to government officials and propose where deer crossing signs should be located.

Key Reflection Activities

1. Right after the project is presented to students, the students will be given a pre-project online survey which will elicit information on what the students perceive will be the outcome of the project.
2. Interviews will be conducted with students at the approximate mid point of the project to reinforce goals, support outcomes, and determine the students’ level of comfort with the project.
3. Students will complete evaluation forms at the end of the project to see if goals were achieved (lives were saved)

SOURCE: The Graduate Center, Institution of the City University of New York
TOPIC AREA: Planning/Urban Development
AGE LEVEL: 6th – 8th Grade
DURATION: 1 hour

RESOURCES: Plain drawing paper, Coloring pens/pencils

OBJECTIVE: Students will be able to create a mental map of their home town and identify areas that are cultural, historical, political and economic. Students will analyze their maps and specify transportation improvements that could enhance the livability of their town.

TASKS:

1. Have students draw a Venn Diagram and label one circle TOWN and the other CITY. They are to jot down similarities and differences between the two. Next, share their results with their group and get a group consensus that will be shared with the larger class.

   ![Venn Diagram](image)
   
   Town: Cultural Areas, Historical Areas, Political Areas, Economic Areas
   
   City: Cultural Areas, Historical Areas, Political Areas, Economic Areas

   These sites should be pointed out as a similarity (degree and quantity maybe a difference).
   
   * Brainstorm examples for each area.

2. Students will identify their hometown and on a blank 8-1/2 X 11 sheet of paper, create a map of the main street or intersection that defines the center of their town. They will need to include a title and key for their map.

3. They will need to orient their map by indicating north as well as other important directions.

4. When identifying points of interest, the following should be taken into consideration - Cultural, Historical, Political, Economic Areas. Class should brainstorm examples for each area to develop consistency and understanding.

5. There should be a rough scale to indicate distances in town (1” = 50 yards). Students may need parental assistance with this part.

6. After completing their map, students will write a brief description of their town (population size, diversity of residents, traffic patterns, etc.). They will be asked to assess the overall livability. What factors make their town unique, a gathering place for residents/visitors, where people want to come? On the other hand, what are areas of concern - could relate to traffic congestion, safety, aesthetic, etc.?

EXTENSIONS: Students could take on the role of urban planners and design projects for improving the community. They may have to prioritize projects as high (occurring within the next year), medium (within next two to five years), and low (within next ten years) and provide a rationale for high priority projects.

SOURCE: Laurie Seto, The University of Hawaii
AIRPORT DESIGN

TOPIC AREA: Aviation, Marine, Rail
AGE LEVEL: 3rd - 5th Grade
DURATION: 1.5 - 2 hours
RESOURCES: NASA Science Files

OBJECTIVE: To design and build an airport.

TASKS:

1. Discuss airports and what they include. Be sure to mention runways, taxiways, wind socks, terminal building, hangar (service, maintenance, and storage), beacon tower, control tower, tarmac, fuel center, parking lots, airplanes, cars, trucks, and any others that you would like to include.

2. Brainstorm for ideas about various layouts for the airport and choose one.

3. Optional: Using grid paper, determine a scale for each grid and lay out the design you have chosen for your airport.

4. Use the bulletin board paper to cut out runways, taxiways, and the tarmac. According to your design, place them on the large, flat surface area.

5. Place airplanes on the runways or taxiways.

6. Cover the boxes with construction paper and color or cut out windows and other features of the buildings they will represent.

7. Label each building or write a business name on the building.

8. Construct and place the hangars used for airplane service, maintenance, and storage. Label each.

9. Provide a facility at the airport to fuel airplanes.

10. Provide a place on the airport grounds to park the cars and trucks that bring people to the airport. Place model cars and trucks in the parking lot.

11. Add any other additional buildings or roadways that you have designed.

12. Name your airport.

13. Role-play the manager of the new model airport, providing a tour of the facility to a group of citizens. Use correct terminology to describe the airport, its buildings, and their functions.
EXTENSIONS:

1. Ask five or more students to take off from the airport with their model airplanes. Have them "fly" to a destination in the classroom and return to the airport for landing. Ask student observers to describe what method the pilots used to avoid hitting each other. Discuss reasons why real airports designate flight patterns for pilots to use. Why is it important that pilots communicate with each other during a flight?

2. Have a student be an air traffic controller and direct flight operations at the model airport.

3. Make a wind sock and add it to your airport. Place a small electric fan on the table to test the wind sock. Use the information from the wind sock to decide which runway to use, remembering that airplanes must always try to take off and land into the wind.

4. Visit a local airport with the students or invite an airport manager to your class.

SOURCE: NASA Official, Dr. Thomas E. Pinelli
TRAFFIC FATALITIES

TOPIC AREA: Traffic Safety
AGE LEVEL: 9th - 12th Grade
DURATION: 1 hour
RESOURCES: Activity Worksheet
http://www-fars.nhtsa.dot.gov

MATERIALS: Internet access
Spreadsheet
Statistics software or graphing calculator

OBJECTIVES: Students will:
- use the Internet to find up-to-date data about traffic accidents
- generate random numbers in order to take a random sample from a population
- compute the mean, median and standard deviation of data given by a frequency table
- learn about the four different sampling methods - simple, systematic, stratified, and cluster
- use cluster sampling to estimate a population mean
- compare a sample mean to a population mean.

BACKGROUND: Traffic accidents account for a large number of deaths in the U.S. Unfortunately, many of these victims are young people, of high school or college age. In this project students will find information about the age distribution of fatal accident victims in a particular state.

TASKS:
1. Students should access the Activity Worksheet for this exercise and follow the procedures.
2. Students should open their spreadsheet or statistics software package and generate five odd random numbers. These numbers represent the county codes for the counties in the state chosen to obtain the data.
3. Next students should access the Fatality Analysis Reporting System (FARS) web site http://www-fars.nhtsa.dot.gov. They will obtain fatality data by age for each of their selected counties. They can then complete Part I of the Activity Sheet.
4. In Part II, students will estimate the mean age of all fatality victims by using all the data from their five counties. Examples of different kinds of random sampling (simple, systematic, stratified, cluster) can be found in the hand-out “Random Sampling Methods”.
5. Students may then complete Part II of the Activity Sheet.

EXTENSIONS:
- Students could study other variables besides age from the FARS site and answer other questions they may be interested in.
- Students may estimate the mean age of the population using a different sampling method. They will need to select data randomly from the FARS site in a different way.
- The class can share their estimates of the population mean and discuss the variation in their estimates.
- If students are acquainted with confidence intervals, they could use their county data to compute a confidence interval for the population mean.

SOURCE: University of Wisconsin - La Crosse
COMMUNITY DESIGN GAME

TOPIC AREA: Planning/Urban Development
AGE LEVEL: 3rd - 5th Grade
DURATION: 2 - 3 hours
RESOURCES:

MATERIALS:
• Community maps: 8 1/2 x 11 in. and 30 x 36 in.
• Colored paper or foam core board
• Cameras (optional)

OBJECTIVES: Students will:
• learn about the physical design and composition of their community
• learn to work cooperatively, building group problem-solving skills
• analyze current conditions, future possibilities, and formulate recommendations for the improvement of the community
• practice their public speaking and presentation skills.

BACKGROUND: The community design game consists of a number of hands-on activities first used as one component of a larger downtown revitalization project in the village of Oregon. A team of University of Wisconsin Urban and Regional Planning students led 22 summer school students ranging from 2nd- to 7th-grade levels in the activity one afternoon. After completing the community design game, the students presented their ideas to community leaders. Their ideas were incorporated into the downtown revitalization project.

TASKS:

1. Determine an area where students will work: a neighborhood, a downtown area, or other area of interest.
2. Create a map of the area, identifying major buildings, landmarks, and streets. You can obtain maps from your local planning office or city or county. You will need two sizes of maps: 8 1/2- by 11-inch to guide students as they walk through the area, and 30- by 36-inch for the design game board.
3. Mark routes on smaller maps for groups of students to walk. Identify about four points of interest for the groups to stop, observe, and answer questions.
4. Create a list of questions that the students will take and respond to as they walk the route. The idea is to help the students experience the area with four of their five senses.
5. Create game pieces to accompany the design game board, or larger map. Game pieces are colored paper pieces, or foam core board, marked with names of various elements that could be included in a community.
6. Recruit adult volunteers to supervise groups of three to four students.
7. If Polaroid cameras and film are available, give one to each group to help them capture their observations on film. If conducted over two days, students walk and record observations one day, and spend the second day reviewing their written responses and/or photos, and doing the map design activity.
8. During the walking tour, organize students and volunteers into groups, making sure that each student has a packet of questions with sufficient space to record answers and a writing instrument. If students do bring cameras, instruct them to write a sentence or two describing why they chose to take a particular picture.
9. After the walking tour, have students reconvene in the classroom. In their groups, ask students to share their observations and responses with each other.

10. To help keep students focused, ask each group to identify the busiest street or area, their favorite building, establishment, or area, and explain why.

11. Begin working on the map by giving each group one game board (the large-size map) and a set of game pieces. Colored markers are also good to have.

12. Encourage the students to look through the game pieces and to discuss the various elements, identifying the existing elements that they value and would like to keep, those they would like to improve, and those they would add to benefit the community.

13. Ask students to summarize their maps and present their findings.

SOURCE: Connie Bodeen, University of Wisconsin-Marathon County
PEOPLE MOVERS

TOPIC AREA: Buses/Public Transportation
AGE LEVEL: 6th - 8th Grade
DURATION: 2 hours
RESOURCES:
• Activity Web page
• People Movers Worksheet
• “Reaching for the Sky”
• “The Great Stations of Yesteryear”
• “Subways”

MATERIALS:
• Colored pens/pencils
• Large sheets of paper
• Maps of the community

OBJECTIVE: This activity asks students to think about rapid transit systems and to design one for the kids in their own community. It starts off with a discussion of the New York City subway system: why it was built, how it was built, how it changed the city.

TASKS:
Although this activity could be done as an individual exercise, it is probably best to divide the class into design teams.


2. As noted above, this activity is ideal for a group exercise. Take a look at the list of considerations for a Rapid Transit System for Kids listed in Step 2 of the Activity Web page. Have the students break up into design teams. You might want them to divide up the different considerations among them: traffic patterns, population density, cost, physical environment, and environmental issues. Each can study the community with an eye for one of these things. Then, they can hash these things over amongst themselves as they come up with their own Rapid Transit System for Kids (RTSK).

3. As the students begin to design their system, you might want to supply them with the items they will need: different colored pens, large sheets of paper, maps of the community (both street and mass transit), photocopies of the maps, etc...

4. Finally, you might want to offer a place for the kids to put up their maps. Perhaps they can put up a preliminary version and have other students offer comments. Then, the design teams can go back and add these new elements.

DISCUSSION:

• Why do people need transport?

• Why do they need transport within the city?

• What is the difference between long-distance and metropolitan transport systems?

• What are the different kinds of mass transit systems?

SOURCE: Educational Broadcasting Corporation
WHAT IS TRANSPORTATION?

**TOPIC AREA:** Multimodal  
**AGE LEVEL:** Kindergarten - 2nd Grade  
**DURATION:** All Day  
**RESOURCES:**  
- Videos:  
  - The Big Plane Trip  
  - The Big Submarine  
  - The Big Aircraft Carrier  
  - Cars, Planes, Trucks and Trains  
- Books:  
  - "Going To School" by Joy Cowley  
  - "Trucks" by Rebel Williams  
  - "Wheels" by Jill Cutting  
- Websites:  
  - Choo Choo Train Poem  
  - How Do I Get From Here To There Poem

**MATERIALS:**  
- Plastic models of different transport  
- Boxes for box construction of vehicles  
- Magazines for cutting out pictures of different transport  
- Art supplies for making a driver's license: tag board, clear contact paper, photo of the child, scale, and meter stick.  
- Collection of library and student books relating to different forms of transportation.

**OBJECTIVES:** On completion of this thematic unit, students will:  
- identify and name at least six different kinds of transportation  
- sort and classify different kinds of transport according to similar and/or different characteristics  
- identify the purpose of different types of transportation.

**TASKS:**

1. Read the book "Wheels", and make into a wall story.
2. Provide students with a photocopy of 12 types of transportation. Have students cut out the examples and sort and classify according to characteristics (wheels, no wheels, wings, items with four tires, what do the vehicles carry etc.)
3. Look at model cars and have students identify specific body parts, for example, door, wheels, lights, windshield wipers, exhaust pipe, etc.
4. Guessing game- "What vehicle would I use?" Describe a situation to the children requiring the use of a vehicle. Ask them what vehicle they might pick for the job and why. Provide models for children to consider and from which to choose.
5. Bring in as many examples of tickets for transportation as possible. Discuss why and how we use them (bus, train, airplane, subway, boat, etc.)
6. Watch the video Cars, Planes, Trucks and Trains and teach children the words to "Wheels on the Bus" with motions.
7. Illustrate a big classroom book using words from "Wheels on the Bus."

8. Make vehicles out of boxes. Include the body parts mentioned in activity 3.

9. Introduce map skills by creating a map of the classroom. Draw outlines corresponding to the furniture and equipment and label each item. Plot a course for the children to follow using a toy vehicle, and encourage them to get to a specified location using the map.

10. Give each pair of children a photo card of a form of transportation. Provide each pair with a list of questions to answer, based on the photocard. Questions are: What is the vehicle called? What color is it? What other color could it be? What makes this vehicle move? How many people could this vehicle carry? What else could this vehicle carry? Draw a picture of your vehicle. Have children report their information back to the group.

11. Have each child make their own driver's license. Information on the driver's license could include:

   My name is___________.
   My birthday is_________.
   I am a girl/boy (circle one.)
   My hair color is________.
   My weight is___________.
   My height is___________.

SOURCE: Amy Coquillard, LessonPlanet.com
COMMERCE
IN THE INDIAN OCEAN

TOPIC AREA: Aviation, Marine, Rail
AGE LEVEL: 6th – 8th Grade
DURATION: 1 hour
RESOURCES: • Blank map of Asia
• Indian Ocean Map
• Age of Discovery Maps

MATERIALS: • Internet access

OBJECTIVES: Students will

• describe geographic features of the Indian Ocean;
• describe the influence of the monsoon on maritime trading patterns in the Indian Ocean before 1500;
• assess the desirability of certain areas as trading ports;
• assess the role and importance of cultural factors in attracting trade; and
• explore contemporary maritime trading patterns.

TASKS:

1. Have students examine maps of the Indian Ocean. Ask students the following questions in a class discussion:
   • What information do you need in order to determine the pattern of maritime trade when ships were powered solely by the wind?
   • How important is knowledge of who controls the areas bordering the Indian Ocean?
   • How important is knowledge of what commodities were available in the various countries and which of those were in demand?
   • Do you think most of the trade would have been local or long distance?

   After the discussion, have students draw possible routes of maritime trade between ports in the Far East and ports in the Near East. Pair students to compare their maps.

2. Ask students what kinds of weather patterns might impact maritime trade routes (hurricanes, powerful storms, etc.). Explain that common occurrences in Southeast Asia are monsoons, which are caused by a particular weather pattern that brings high winds and heavy rain. Have students read about monsoons in the National Geographic MapMachine Student Edition. Explain that there are three main circuits of seasonal monsoons: Arabia to India; India to Southeast Asia; and Southeast Asia to China. Have students draw the directions of the winds on a blank map of Asia.

3. Have students draw logical trade routes on their blank map of Asia and speculate where ports might have developed and why.
4. Keeping monsoons in mind, help students identify some of the major Indian Ocean trading ports that flourished before the year 1500. The list might include ports such as 'Aden (Aden), Yemen; Masqat (Muscat), Oman; Kozhikode (Calicut), India; Quilon (Kollam), India; Kanchipuram, India; Palembang, Indonesia; Malacca, Malaysia; Sulawesi (Celebes), Indonesia; and Hangzhou, China. Have students note these locations on their maps. Divide the students into small groups. Assign each group one of the ports. Have each group collectively research the answers to the following questions:

- What were the advantages of your port?
- How might the monsoons have affected it?
- Would it have been easy to defend?
- Why might boats have passed by it?
- Did it have the potential to control a strategic point along the route (such as the Straits of Malacca)?
- What products were produced near this port or were traded from this port? (For example, which had valuable spices, raw materials, Cowrie shells, or silk or cotton textiles?)
- Was your port a major importer of products? If so, which ones?
- Did your port serve as a “rest stop” for ships involved in long-distance trade? If so, to which areas?

5. After the research is completed, have students share the information about their ports, and then ask the class to indicate what they think were logical maritime trade routes that flourished before 1500. Compare these to maps from the Age of Discovery and have students determine how their ideas of a logical trade route compared with the real routes used during that time.

SOURCE: www.nationalgeographic.com
CLASSIFYING TRANSPORTATION OBJECTS

TOPIC AREA: Multimodal
AGE LEVEL: Kindergarten - 2nd Grade
DURATION: 30 minutes
RESOURCES:

MATERIALS:
• Large, varied, assortment of transportation items
• 3x5 index cards for labeling
• Pencils or markers
• Substantial open floor area
• Chart paper and markers

OBJECTIVES: Students will:
• be exposed to the concept of recognizing attributes
• sort and classify objects by various attributes.

TASKS:
The children should be divided into smaller groups, or "centers", of 5-6 students. This lesson should be teacher facilitated, with the students working cooperatively in this small group. They should be allowed to work together to reach their own conclusions as the lesson progresses. The children will sit in a circle, and the teacher should empty the tub of objects onto the floor in the middle of the circle of students. Spread the objects out so that they can all be seen by the group.

Begin the lesson by simply asking the children how the objects in the middle are alike. Following some verbal answers, ask how the objects are different. Then ask the students to name some ways that they could sort, or classify the objects into groups. You will need to modify your guidance of the students, depending on how much prior exposure the class has had to classifying. You may even need to give them an example or two at the beginning of the lesson until they understand this concept. Some ways the students can sort are by:

• color
• size
• number of wheels
• composition material (metal, plastic, wood, etc.)
• goes on land, water, air
• floats, does not float
• number of windows, doors
• contains people, no people

As the students sort the items into groups, they must label the groups by attribute. They need to "sound out" and write labels on the cards, and then label each group. The teacher should observe, and contribute, as needed. Be sure to ask open ended questions, and serve only as a facilitator. After completing the small group center work, gather the class and refer back to the brainstorming list which was completed earlier. Beside each mode of transportation listed there, ask the group to help you to list some attributes of each.

SOURCE: Luada Skaggs, www.learnNC.org
# TRANSPORTATION IN EVERYDAY LIFE

**TOPIC AREA:** Multimodal  
**AGE LEVEL:** 3rd - 5th Grade  
**DURATION:** 1 hour  
**RESOURCES:**

**MATERIALS:**
- Construction paper
- Coat hangers
- Index cards
- Crayons or markers
- Pencils
- Scissors
- Yarn
- Glue

**OBJECTIVES:** Students will:

- learn how the post office transports mail
- learn how importing and exporting is accomplished
- discuss other ways transportation is used everyday (business trips, going to the store, etc.)
- make a mobile with the different modes of transportation and their uses.

**BACKGROUND:** Transportation is used everyday in every aspect of our lives. It is important that students are aware of these various forms of transportation. Two uses of transportation will be discussed in detail: importing and exporting and the path of a letter through the postal service. The teacher can discuss any other uses that they feel is necessary, such as riding commercial transportation.

**TASKS:**

1. Discuss the steps the post office takes in getting a letter to the students' mailboxes.
2. Discuss how certain products that the students use get to the United States, either by boat, plane, etc.
3. Discuss the ways we use transportation: going to grocery store, school, etc.
4. Make a mobile of various modes of transportation and their uses. (Students write facts on the back of pictures or on index cards. They then attach the work to the hanger with yarn or string.)

**EXTENSION:**

1. Take a trip to the post office to see how our mail gets to us.
2. Watch a video on importing and exporting.
3. Learn how to take a ride on commercial transportation and take the students on a field trip using the commercial transportation.

**SOURCE:** Tina M. Bucholtz and Jennifer R. Capps, LessonPlanet.com
CALCULATE YOUR CONTRIBUTION

**TOPIC AREA:** Environment/Energy
**AGE LEVEL:** 6th - 8th Grade
**DURATION:** 1 week

**OBJECTIVE:** Students will be able to calculate the impact of their personal and collective transportation habits on air quality.

**BACKGROUND:** Vehicle emissions are a major component of air pollution, which contributes to both human health problems and the deterioration of the Chesapeake Bay. Maryland’s most persistent air pollution problem remains ground-level ozone from vehicle emissions and smokestacks. This "bad" ozone can cause shortness of breath, coughing, wheezing, headaches, nausea and eye and throat irritation. Moreover, air pollution contributes to the development and severity of asthma. Nationwide, asthma is the main reason for emergency room visits, and the number one reason why kids miss school. Asthma mostly affects the very young, very old, and very poor, and it is rapidly becoming more common. Air pollution also contributes to worsening water quality. Scientists studying the Chesapeake Bay estimate that a quarter of the total nitrogen load to the Bay comes from atmospheric deposition. In addition, increased emissions of carbon dioxide and other "greenhouse" gases are contributing to global warming, expected to have significant impacts on our climate in the coming decades.

**TASKS:** Tail Pipe Tally. Keep a diary of your transportation behavior for one week (including the weekend). Include mileage, form of transportation, make and year of car traveled in, and note how many people were in the car. Include all trips, whether they were by car, transit, foot, bicycle, or any other mode of transportation. Use this information to calculate yearly emissions, using the Tailpipe Tally website. Calculate annual emissions for your class. For school bus emissions, check with your school system to get information on fuel efficiency. Then extrapolate emissions based on the car emissions information in Tailpipe Tally and divide by the number of riders.

**DISCUSSION:**
Evaluate your transportation behavior and identify ways that you can change your behavior.

- Combine or eliminate trips?
- Carpool?
- Use alternative transportation (e.g. bicycle, walk, or mass transit)?
- Choose alternative destinations (e.g. closer stores for shopping)?
- Other options?

Estimate the reduction you could achieve in miles traveled, and re-calculate yearly emissions.

**SOURCE:** Maryland State Department of Natural Resources
GROWTH OF THE INTERSTATE HIGHWAY SYSTEM

TOPIC AREA: Planning/Urban Development
AGE LEVEL: 9th - 12th Grade
DURATION: 90 minutes
RESOURCES:

MATERIALS: • Large map of U.S. Interstate Highway System
• Internet access
• Flip chart paper

OBJECTIVES: Students will:

• understand the effect of the growth and development of the interstate highway system on transportation and the economy in general

• be able to identify the geographic influences related to the interstate highway system

• be able to demonstrate specific changes in the transportation system characteristics between two major cities from the mid 19th century to the mid 20th century

TASKS:

1. Students will be divided into groups of three. Each group will choose two major cities in the state of their choice.

2. Utilizing the internet students will research to try and determine differences, if any, in travel between these two cities in 1890 and 1990.

3. Students will then produce on flip chart paper, three charts or graphs illustrating the differences in ease of travel, time of travel, and amounts of people and goods being transported between 1890 and 1990.

EXTENSION: For extra credit, students may conduct an oral interview of local people about the impact that the local interstate has made on their life.

SOURCES: Gary King, Jill James, and Bill Powers, Braxton County High, West Virginia
ALL ABOARD!

TOPIC AREA: Multimodal
AGE LEVEL: Kindergarten - 2nd Grade
DURATION: 30 - 40 minutes
RESOURCES:

MATERIALS:
• Large sheet of butcher paper
• Pictures of transportation modes from magazines/books
• One piece of 4" x 3" construction paper for each student

OBJECTIVES: The student will:
• recognize basic vehicle, transportation safety practices
• classify various forms of transportation under given headings
• graph the results of data collected by class
• analyze data using bar or pictograph
• explain why tracks are for trains only.

TASKS:
1. Motivate students by displaying pictures of various forms of transportation.
2. Write the following on the board or large sheet of paper: WATER, AIR, TRACKS, SIDEWALK, HIGHWAY, NEIGHBORHOOD STREET.
3. Work with students to list every vehicle or safe mode of transportation that they can think of under each category. Remember to stress the safety aspect of the lesson. For example: A tricycle can be ridden down the street, but should it be?
4. After recording all student responses, point out and discuss the fact that the only form of transportation listed under TRACKS is train. (You may have different types of trains: freight trains, passenger trains, subway, etc.)
5. Give each student a piece of 4" x 3" construction paper and assign each a mode of transportation of the previous list. Students will illustrate their assigned vehicle on the piece of paper.
6. When completed, have students place their illustration under the correct heading on a graph using a large sheet of butcher paper.
7. Discuss the results of the graph. Note that the TRACKS column is the shortest. Thus we find the answer to our question: Are Tracks For Trains Only?

EXTENSIONS:
• Participate in a class discussion about transportation safety.
• Create a class pictograph depicting the results of data collected by the class.
• Analyze data presented in graph using class discussion.

SOURCE: Becky Cunningham, Elk Elementary Center

A RECRUITMENT TOOLBOX FOR TRANSPORTATION PROFESSIONALS
Sponsored in part by the Southwest Region University Transportation Center
# TRANSPORTATION MODES

<table>
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<tr>
<th>TOPIC AREA</th>
<th>Multimodal</th>
<th>MATERIALS:</th>
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<tbody>
<tr>
<td>AGE LEVEL</td>
<td>Kindergarten - 2nd Grade</td>
<td>• Overhead projector</td>
</tr>
<tr>
<td>DURATION</td>
<td>45 minutes</td>
<td>• Transportation and non-transportation objects:</td>
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<tr>
<td></td>
<td></td>
<td>• transparencies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• cutouts (15-20)</td>
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<td></td>
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<td>• Construction paper</td>
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</tbody>
</table>

**OBJECTIVE:** The students will compare and contrast modes of land, air, and water transportation.

**TASKS:**

**Step 1:** (5 minutes) Explain to the students that they are going to assume the role of detectives during today’s lesson. Tell them you are thinking of an idea and that it is their job to solve the mystery that is your idea. Using an overhead projector, show students the first image, an example of a non-transportation object. Tell students that the object is not an example of your idea, don’t mention transportation yet. Show students the remaining three images and tell whether they are "yes" examples or "no" examples. Note: All "yes" images are examples of transportation, an object that can be moved from one place to another under power other than its own. This information will not yet, however, be revealed to students.

**Step 2:** (15 - 20 minutes) Ask students to share the similarities between the "yes" examples as well as how they differ from the "no" examples. Check for logical reasoning rather than accurate answers at this point. Distribute a large 12 x 8 sheet of construction paper to each student and have them fold it in half lengthwise. In the left column, ask students to write a "Yes" caption at the top. Students will create a "No" caption at the top of the right side. Next, distribute copies of the attached document to each student. Students will cut apart the pictures and place each one under what they feel is the appropriate heading. Gluing is not necessary, as students will need to be able to make revisions during the class discussion which follows. Give students approximately ten minutes to arrange their pictures.

**Step 3:** (15 minutes) Hold a classroom discussion in which students defend their pictorial arrangement. Lead students to the understanding that all the "yes" examples are modes of transportation and all the "no" examples are not. Give the definition of transportation, movement of an object from one place to another under power other than its own. The term transportation also denotes transporting an object or objects from one place to another. Ensure that students understand why an elephant or bird is not considered an example of transportation. Monitor students as they revise the placement of their pictures, then provide students with the correct arrangement.

**Step 4:** (10 minutes) Once students have finished placing their pictures correctly, explain that all examples of transportation can be classified according to whether they are land, air, or water modes of transportation. Call on students to give examples, using their pictures as necessary, of each of the three types of transportation.

**SOURCE:** http://lessonplans.fundingfactory.com
ADVANCEMENTS IN TRANSPORTATION

TOPIC AREA: Multimodal
AGE LEVEL: 6th - 8th Grade
DURATION: One week
RESOURCES:

OBJECTIVES: Students will:

• describe the impact of transportation technologies on individual lifestyles
• describe the contribution of transportation technologies to the evolution of world travel and communication
• describe the interrelationships between society, technology, and transportation systems
• outline the scientific and technological changes that have taken place in transportation over time

TASKS:

• Conduct a survey to find out the distances that students live from school, their methods of transportation, and how much time they would require to walk to school. Ask them to consider costs, benefits, and time factors in alternative methods of transportation.
• Have groups of students research the scientific and technological development of the car.
• Have students examine the historical relationships between transportation and global commerce.
• Have students consider the pros and cons of alternatives to the car.
• Have students research different kinds of engines (e.g., electric, diesel, rotary, piston) and different sources of energy and discuss the reasons that industry may be reluctant to replace the gas-fired, piston-driven engine.
• Discuss public-transport, rapid-transit systems. Have students compare and contrast their country's systems with systems in other countries.
• Have students consider the aspects of mass transportation that create vulnerabilities for society in terms of breakdowns, strikes, or terrorism.
• Have students research and compare the types of tests for automobiles used by consumer groups and manufacturers.

SOURCE: Ministry of Education, Government of British Colombia
WAYS TO GET FROM HERE TO THERE

TOPIC AREA: Buses/Public Transportation
AGE LEVEL: Kindergarten – 2nd Grade
DURATION: One hour
RESOURCES:

MATERIALS: • Bus (or other mode) schedule
• Money (real or play) to figure cost of purchasing a ticket
• Bus - actually take a bus trip and determine cost of the trip

OBJECTIVE: Students will learn the rules of the different forms of transportation, such as the public bus, learn how to read the public transportation schedule, and recognize the different modes of transportation.

TASKS: The teacher will teach the rules of using many different types of transportation, teach the children what is free to ride, and which of the items you must pay to travel on. The children will learn different ways to get from one place to another, and can also recognize places they are familiar with in their neighborhood. It should be pointed out that transportation does not only have to consist of riding in a motor vehicle, but it can also be in the form of walking or riding a bike.

DISCUSSION: Ask the students to name different forms of transportation, and what a person would have to do to use that particular type of transportation. For example, teaching them the rules about bike riding, such as wearing a helmet, and where you are and are not allowed to ride your bike.

SOURCE: Amy Kuklis, Indiana University of Pennsylvania,
TRANSPORTATION IN THE COMMUNITY

TOPIC AREA: Multimodal
AGE LEVEL: Kindergarten - 2nd Grade
DURATION: One hour
RESOURCES: Book: "This is the Way We Go to School"

MATERIALS:
- Felt board
- Air, water, land transportation pieces with velcro
- Sheets of paper with picture of bus, car, or van
- Crayons

OBJECTIVE: The students will discuss and identify modes of transportation in the community and others found throughout the world.

TASKS:

A. Motivation
1. Ask "Does anyone know what the word transportation means?" and "Do you know any types of transportation?" and "How do you get to school each day?"
2. Go over the meaning with the class and introduce the book.
3. Read the book aloud to the class. Stop periodically and ask questions such as, "Do you see any differences in the way these children go to school?"

B. Instructional Procedures
1. After reading the book, have children identify the different forms of land, water, and air transportation. Next, ask them to come up with other modes of transportation the book didn't mention. Show them the pictures of kinds of transportation.
2. Have the students place these modes of transportation on the felt board under each category: water, air, and land.
3. Discuss the modes and have children explain their reasons for placing it in the particular category.

DISCUSSION:
1. Ask the students to compare and contrast the different modes of transportation.
2. Have the students go back to their seats. Give them each either a bus, car, or van. Have them color the one that they travel to school in each day. Make a graph in order to visually display the results.

EVALUATION:
1. Listen to the students' answers during the story for comprehension.
2. Observe children as they place different modes of transportation on the felt board.
3. Observe the student's ability to visually display the mode of transportation they use to get to school each morning.

SOURCE: Rachel Fayard, www.lessonplanspage.com
SAFETY FIRST

TOPIC AREA: Traffic Safety
AGE LEVEL: 6th - 8th grades
DURATION: 1 hour
RESOURCES:

MATERIALS: • Student journals
            • Pens/pencils
            • Paper
            • Classroom blackboard
            • Poster board or large piece of paper (at least one per group)
            • Markers and colored pencils
            • Reference materials about transportation safety, technology

OBJECTIVE: In this lesson, students explore safety issues/challenges related to various modes of transportation. They create blueprints for technological methods to make those transportation modes safer.

TASKS:

1. WARM-UP/DO NOW: Students respond to the following prompt in their journals, written on the board prior to class: “What does the word ‘invention’ mean to you?” After a few minutes, allow students to share their responses. Then, on the board, brainstorm a list of inventions that are directly related to safety. Ask students to help you organize these ideas in a generalized timeline format, in which the oldest invention is listed in the leftmost position, the newest is listed in the rightmost position, and the others are placed as chronologically as possible in between.

2. Divide students into six groups, and assign each a different transportation method: trains, automobiles, watercrafts, motorcycles, bicycles and skating equipment (including roller blades, skateboards and scooters). Explain that each group will be acting as a team of engineers to design an advanced sensing and navigation system for their assigned mode of transportation similar to the systems addressed in the article for airplanes.

Using all available research materials, each group begins by investigating and discussing the different means of transportation within each category, focusing on the following questions (copied on the board or in a handout for easier student access):

- What types of vehicles exist in each class of this vehicle?
- For what are each of these vehicles used?
- What are some common safety hazards associated with each type?

Next, based on this initial research, ask groups to choose one type of vehicle and one specific hazard as their focus, and then to probe a bit deeper into the problem they want to address:

- Who uses this specific transportation system?
- What are some of the common routes traveled?
- What kinds of accidents are associated with hazard that you identified?
- Where do these accidents occur?
- What are some of the common results of those accidents?
Finally, each group "invents" an advanced safety system that would prevent a particular accident from occurring and creates an annotated blueprint of their invention. During the design process, the group should divide the problem into parts, assigning each member of the group a different task to address. Some of the questions to consider for breaking the problem down might include:

- What is the problem from the victim's perspective?
- What issues affect the vehicle operator?
- What are some human errors that might arise?
- How does the proposed technological solution affect the operation of the vehicle?
- How could the system be sabotaged? What could be done to prevent this?
- How reliable will the device be in the long run? What are some ways to maintain its continued operation?

3. WRAP-UP/HOMEWORK: Each group researches the regulatory agency or agencies that monitor safety for their assigned transportation category. Students should identify who the agency monitors, what some of the safety compliance requirements are for vehicles in this category, and how this agency investigates accidents. Then, adopting the perspective of the appropriate agency, each student writes a brief "design assessment" for their invention, which includes a list of questions that a review board considering the use of this invention might ask. In a future class, students should present their blueprints to the rest of their class as if they were presenting it to an agency review board. Alternately, students might review and write design assessments for other groups' inventions.

DISCUSSION:

1. What are some examples of tasks for which a computer is better suited than a human? What are some tasks for which a human might be better suited? As a general rule, can it be said that one is more fallible than the other? Why or why not?

2. How does one go about "measuring" a safety risk?

3. In your experience, is simpler always better? Why or why not?

4. Are there some situations in which a very complex solution might be worth finding, no matter what it might cost? What kind of situation would this be?

EVALUATION:

1. Based on information gleaned from the research, choose one of the following technology systems and create a "How It Works" poster, using the transportation mode you studied in class as an example: inertial navigation, restrictive navigation, fly-by-wire, global positioning system.

2. Investigate one or more airplane accidents, train accidents, or school bus accidents. Then, write a report describing some technological innovations that might have prevented these accidents. What caused each accident? What are some of the technological solutions that might already exist to avert such crashes? Would any of the solutions invented in class address a solution? If so, what information can you add to your classmates' engineering design?

**LET’S GO!**

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<tr>
<th>TOPIC AREA:</th>
<th>Multimodal</th>
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<tbody>
<tr>
<td>AGE LEVEL:</td>
<td>Kindergarten - 2nd Grade</td>
</tr>
<tr>
<td>DURATION:</td>
<td></td>
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</tbody>
</table>
| RESOURCES   | • Pictures of Land Vehicles  
             | • Pictures of Sea Vehicles  
             | • Pictures of Air Vehicles  
             | • "My Blue Suitcase"        |

**OBJECTIVE:** Students will learn about each mode of transportation: Land, Air, Sea, and Space

**BACKGROUND:** The Scenario: You and your own blue suitcase are going on a trip! You will need to decide where you are going to go, how you will get there, and what you will need to take with you. Who are you going to see? How long will you stay? How will you return? You will need to gather some information about transportation to help you make good decisions. “Let’s go!”

**TASKS:** Begin by reading and re-reading "My Blue Suitcase" by Sharon Katz. "My Blue Suitcase" uses all the basic forms of transportation and “Then comes back to me.” It will form the outline that we will use to learn about the various forms of transportation. During our study we will want to find out what we need to know in order to go on an imaginary trip.

- What do we already know?
- What do we need to find out?
- Where can we find this information?
- Who can help us?
- How can we do all this?

We will:

- gather: books, magazines, maps, brochures, audio-visual materials.
- explore: Internet resources.
- discuss: Each kind of transportation, the length of our stay, the distance from where we live, the climate at our destination, the money we will need, and where we will get food.
- list: Vehicle words, location words, travel words, and map words.

**DISCUSSION:** Ask Children:

- What did you learn about transportation? (Cars, trucks, ships, planes or rockets.)
- What surprised you?
- Is it easy to plan a trip?
- Did you have enough of everything you need?
- Where would you like to go next time?

**SOURCE:** http://score.rims.k12.ca.us/activity/letsgo/
FORMS OF TRANSPORTATION

TOPIC AREA: Multimodal
AGE LEVEL: Kindergarten - 2nd Grade
DURATION: 1 hour
RESOURCES:
- Directions for making paper boat
- Directions for making paper airplanes

MATERIALS:
- Crayons
- Paper
- Bulletin board
- Tempera paint
- Old license plates

OBJECTIVES: The idea is to introduce and discuss different modes of transportation and in the end, create one or more transportation art-i-facts.

TASKS: After discussing how people and products get from place to place, students can create drawings and paintings of various modes of transportation on thick paper. The pictures can be painted or decorated with markers or crayons. Once complete, the pictures can be cut out and put together in a mobile ... by punching holes in the pictures and hanging them from a coat hanger that has been wrapped with yarn or raffia. Have your students write facts on the back. (i.e., trucks deliver newspapers; people travel on airplanes etc.)

- BULLETIN BOARD ACTIVITY: Students can collect images of different types of transportation and add them to a bulletin board that has been divided into Land, Sea and Air.
- TRANSPORTATION MURAL: Students can work together to create a transportation mural (one for land, one for sea and one for air).
- SOUND PICTURES: What sounds do the various modes of transportation make? (train whistle, truck horn, police car siren) How would these sounds appear if we were to draw them? Provide crayons and paper for students to experiment with the colors and shapes of transportation sounds.
- TOY CAR PRINTMAKING: Using old toy cars and tempera paint, allow students to dip the cars into paint and "drive" them across paper to see what kinds of marks the tires make.
- LICENSE PLATE RUBBINGS: Using old license plates (or plate on cars in the parking lot) allow students to do rubbings of the plates. Provide paper and crayons for the rubbings.
- SHAPE VEHICLES: See how many types of transportation vehicles can be created using the basic geometric shapes (triangles, squares, circles, rectangles). Have students cut their shapes out of construction paper and arrange them to create vehicles.
- PAPER BOATS AND AIRPLANES: Make paper boats and airplanes using the directions above. Decorate them with bright crayon colors.
- TRANSPORTATION MOBILE: What You Need: String or yarn; coat hangers; thick paper; paint; brushes; scissors; hole punch; markers or crayons.
- TAKE A TRIP ON A ZEBRA: Have students consider what life would be like without cars or trucks. What if we traveled by riding animals? Not just any animals: elephants, zebras, tigers, ducks etc. Students can draw or paint their ideas on paper.

DISCUSSION: Discuss different modes of transportation on land, sea and in the air. Talk about how people get to where they are going (school bus, ferry boat, car etc.). Incorporate field trips wherever possible. Take a trip on a school bus, walk around the school parking lot to look at cars, visit the airport, bus station or train station. Watch videos that show different forms of transportation. Look at travel magazines. Ask if anyone has been on a plane ... a train ... a horse ... etc. Ask how students get to school everyday. How do kids in other countries travel? Leave lots of time for discussion. Make sure to review safety rules (seatbelts in cars, obeying traffic signals, walk and don’t walk signs). Don’t forget to discuss how products are delivered ... couriers with trucks, airplanes etc. How does the mail travel?

SOURCE: www.kinderart.com

A RECRUITMENT TOOLBOX FOR TRANSPORTATION PROFESSIONALS
Sponsored in part by the Southwest Region University Transportation Center
TOPIC AREA: Multimodal
AGE LEVEL: 3rd - 5th Grade
DURATION: 1 hour
RESOURCES:
• Transportation Web.doc
• Transportation Through History.doc
• http://www.yahooligans.com/Around_the_World/Transportation/

MATERIALS:
• Student reproducibles
• Drawing paper
• Crayons

OBJECTIVE: Students will explore these questions: (1) What are some forms of transportation? (2) How has transportation changed throughout the years?

TASKS:

Step 1 (Duration: 5 min.) Take a survey and ask students how they got to school that morning. Write the possible choices on the board (car, bus, walking, bike) and put tally marks beside each option to represent how each student was transported.

Step 2 (Duration: 15 min.) Tell students that transportation means to move goods or people from one community to the next. Ask students to think of other forms of transportation. Have them work with a partner to brainstorm as many forms of transportation as they can using the basic web found on the following attachment. Then write the following code on the board:

^=Mountain *=Desert #= Coast

Tell students to think about different types of transportation needed in different communities/environments. Have students put a ^ symbol in the circle if that type of transportation would be effective in the mountains. Have them repeat with the other symbols. Some forms of transportation may have more than one symbol.

Step 3 (Duration: 10 min.) Ask students to think about how transportation has changed throughout the years. Explain that hundreds of years ago, covered wagons were the transportation that most people used to get from community to community. Now most of us use cars and other vehicles to get around. Ask students to think of some other forms of transportation used in the past. Give each student one of the attached timelines and discuss as a class.

Step 4 (Duration: 30 min.) Now assign each student an event from the timeline. Allow them to illustrate the event using KidPix and write the date and event along with the illustration. If computer lab time is not available, students can illustrate the events on a piece of drawing paper. Print students’ pictures and statements and assemble them into a book in chronological order. Read the book aloud to the class and allow each student to share his/her page.

EXTENSION: Allow students to use the Internet to research different types of transportation. Have students determine the date and inventor as well as how that mode of transportation is used.

SOURCE: Anne Bosarge, Georgia Learning Connections
TOPIC AREA: Planning/Urban Development

AGE LEVEL: 6th - 8th Grade

DURATION: 2 to 4 weeks

RESOURCES:
• "The Grid Plan"
• "The Invention of the Steamboat"
• "The Erie Canal"
• "Shipping in New York"
• "The Black Ball Line"

MATERIALS:
• Paving the Way Worksheet

OBJECTIVE: In this activity, students will learn how to take action to improve their town’s transportation routes -- and make a small but significant difference in their community. Students will first examine some of the different ways people get around your area (cars, public transportation, bikes, etc.). Then, either in a small group or as a class, students will identify a problem with a local transportation route, such as a pothole, a narrow bike path, a lack of a traffic signal at a busy intersection, and so on. Students then research what local agency, board or person has the authority to improve this situation. Working together, students develop a solution for addressing this problem and then present it, as a proposal, to local officials.

TASKS:

1. Begin by having your students read the articles "The Grid Plan," "The Invention of the Steamboat," "The Erie Canal," "Shipping in New York," and "The Black Ball Line." Lead a class discussion about some of the different ways that people get around town. You may wish to discuss questions such as:
   • What types of transportation do you, your family, and friends use each week?
   • What are some ways that your community’s transportation systems could be improved?
   • Do some groups of people (such as students or senior citizens) tend to use some types of transportation more than others?
   • What changes in local road and street signs might help people get around more safely and efficiently?

2. Ask students to brainstorm some problems with local transportation routes. Focus on specific, easily-fixable problems such as the lack of a streetlight at a busy intersection, confusing signs on the highway, no speed bumps near a low-speed zone, lack of bike paths, and so on. If your students can’t think of any transportation problems, suggest they contact your local newspaper or TV news station and ask if they’ve done stories about traffic accidents at a particular location, complaints about unsafe roads, etc. Students can also speak with their parents about this matter.

3. Once students have identified a transportation problem they want to tackle, brainstorm some possible solutions. Then, help students research which government agency, board or person handles the transportation concern your students want to improve. For example, the Parks Department might be in charge of local bike routes. Students can also call their City or Town Hall to find the appropriate contact person.
4. Ask students to research the method for presenting their idea to this agency, board, or person. Are there regular public meetings? Is there a special hotline set up for such concerns? Are there certain forms which must be completed? As a class, develop a convincing written proposal to address this transportation problem. Different students should work on different parts of the proposal. Collect facts and figures that show the effect of the problem. Gather or take photographs to support your argument. Students may wish to interview a sample of people from your area, or gather signatures on a petition.

5. Then, have students present their proposal to the appropriate board or individual. Remind students that the wheels of government can turn slowly, so they need to be persistent and creative. For example, if the local government says it doesn’t have money to fund your proposed change, students can ask if they can collect or raise money for this purpose and then donate it. TV news stations and newspapers are always looking for heartwarming stories about people (especially kids) going out of their way to make a difference in the local area. If your students’ first efforts are unsuccessful, you may wish to contact local news stations or newspapers for additional support and publicity for your cause.

6. Have your students share their struggles and successes by filling out the worksheet. Have them describe the problem you worked on, the solutions they proposed, the people they contacted, the actions they took, and any results.

DISCUSSION: In this activity, you have learned that when citizens in a community join forces for a common cause, they can improve the daily lives for many people. After identifying and studying a local transportation problem, you came up with a viable solution and formally presented it to local officials. With persistence, forethought and creativity, you were hopefully able to get the results you wanted and “pave the way” for your city’s future.

SOURCE: Educational Broadcasting Corporation
HOW FAST CAN YOU REACT?

TOPIC AREA: Traffic Safety
AGE LEVEL: 3rd - 5th Grade
DURATION:
RESOURCES:

MATERIALS: • A friend

OBJECTIVE: To understand reaction time and relate its importance in traffic safety.

BACKGROUND: Reaction time is the time it takes your body to respond to a signal, like when you saw the paper drop. Reaction time depends on how quickly a signal travels. In this case the signal travels from the eye to the brain, and from the brain to the muscles that need to respond. When you see the paper drop, you respond by catching it. The faster your reaction time, the sooner you catch the paper. A signal could also travel from your ear. If you close your eyes, and your friend says, "Catch!" when she drops the paper, you are testing how long it takes to react to a signal you hear.

TASKS:
1. Ask your friend to hold out one arm.
2. Hold this sheet so it hangs just above your friend's hand. Make sure the bottom edge is between your friend's thumb and finger.
3. Drop the sheet and let your friend catch it as quickly as possible.
4. Look at the number nearest to where your friend caught the sheet. This is how many seconds passed before your friend caught it. Record the time. Repeat the test two more times.

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<tr>
<th>Name</th>
<th>Age</th>
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<th>Trial 2</th>
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<th>Best Time</th>
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5. Switch roles and test your own reaction time.
6. Then test other people, like family members and friends. Who has the fastest reaction time?

DISCUSSION:
• What happens if you close your eyes and your friend says "Catch!" as the paper drops?
• What happens if you try to catch the paper with your other hand?
• What happens if you test people of different ages?

Relate these observed reaction time differences to the challenge of designing a safe transportation system (i.e., traffic signal timing plans, pedestrian safety, etc.)

SOURCE: pbskids.org/zoom
PERIPHERAL VISION

TOPIC AREA: Traffic Safety
AGE LEVEL: 3rd - 5th Grade
DURATION:
RESOURCES:

MATERIALS: • 2 friends
• Colored paper
• Scissors
• Newspaper
• Markers

OBJECTIVE: To understand peripheral vision and relate its importance in traffic safety.

BACKGROUND: Peripheral vision is when you can see something out of the corner of your eye while you’re looking straight ahead.

TASKS:

1. Choose one friend to be the recorder and one to be the mover.
2. Cut different shapes out of colored paper. Each shape should be about 4 to 6 inches wide. On each shape write a letter of the alphabet.
3. Put the newspaper on the ground in front of you and stand so that your toes touch the edge. Have the recorder draw a semicircle on the newspaper.
4. Stare straight ahead. Don’t move your eyes from side to side.
5. Have the mover pick a shape and hold it up at arm’s length. Then the mover should stand at your left side, slightly behind you. Have the mover slowly walk around you holding the shape above the line on the newspaper.
6. Say, “Stop!” when you first notice movement of the object or its shape, color, or letter. Have the recorder mark where the mover is standing on the newspaper.
7. Remember to keep looking straight ahead!
8. Switch roles with your friends and test their peripheral vision.

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DISCUSSION: Look at your data chart. Which did you notice first: motion, color, shape, or the letter? Did everyone notice them in the same order? Most people see motion first. When your friend is standing next to you and starts moving, you can see your friend move out of the corner of your eye. In the back of your eye, there are different parts called rods and cones. Near the side of your eye, there are some rods but hardly any cones. The rods help you see motion, but not color, shape, or the letter. When your friend moves towards the center of your vision, you can now see color. That is because the middle of your eye has many cones, and cones help you see color. When you are using the center of your eye to look, it is packed with rods and cones, and you can see the shape and the letter.

- What happens if your friend starts on your right rather than your left?
- What happens if you try this experiment in a room with little light?

Relate these observed peripheral vision differences to the challenge of designing a safe transportation system (i.e., changing lanes, passing another car or truck, pedestrian safety, etc.)

SOURCE: pbskids.org/zoom
LYING LIGHTLY ON THE LAND

TOPIC AREA: Roadway Design/Structures
AGE LEVEL: 6th - 8th Grade
DURATION: 
RESOURCES: http://www.efl.fhwa.dot.gov/nbme/design1.htm

MATERIALS: • Internet access

OBJECTIVE: To introduce the technique of design visualization in roadway design. This allows engineers to display a design on the computer as if it were already constructed.

TASKS: Have students access the activities at the following website: http://www.efl.fhwa.dot.gov/nbme/design1.htm. Make selections by clicking the left mouse button on the blue underlined text and follow the instructions to navigate the displays. There are several selections that will allow you to "design" a roadway feature or features. Once you select the various design options you will be able to view the design with the design options you selected. Now you take a turn at "Lying Lightly on the Land..."

SOURCE: Eastern Federal Lands Highway Division
BUILD A BRIDGE

TOPIC AREA: Roadway Design/Structures
AGE LEVEL: 6th - 8th Grade
DURATION:
RESOURCES http://www.pbs.org/wgbh/nova/bridge/build.html

MATERIALS: • Internet access
• Cardboard strips, 1" x 11"
• Several books (for weights)
• Flat eraser or sponge
• String
• Rope, 5’ and 6’ long

OBJECTIVE: To understand when and why different bridge structures are used in roadway design.

TASKS: Have students access the activities at the following website: http://www.pbs.org/wgbh/nova/bridge/build.html. Make selections by clicking the left mouse button on the blue underlined text and follow the instructions to navigate the displays. Have students progress through all three steps and ask them to report on their success at playing the “Build a Bridge” game. Were they able to select the right bridge type for the different site conditions?

SOURCE: Nova Online
ECO TRAVEL LOG

TOPIC AREA: Environment/Energy
AGE LEVEL: 6th - 8th Grade
DURATION: 2 - 4 weeks
RESOURCES:

MATERIALS:
• Journal or a notebook
• Pens or pencils
• Bike route and transit maps of the area with distance key

OBJECTIVE: Students will keep a record over time, analyze the data collected and use the information to identify ways in which they can change their behavior to benefit their health and the environment.

TASKS: Students record their travel patterns over a four week period. In a journal or a notebook they record the mode of travel, how far they went and how long it took. After two weeks students review their diaries and identify trips that could have been made differently, either replaced by human powered travel or transit, combined with other trips or could have been a car-pool or ride share. For the second two week period students record their travel patterns with a goal of making changes in the ways they get around.

Relate a personal experience (commitment to human powered transportation, choosing to live close to work, buying locally grown and made food and goods to reduce the pollution generated by shipping).

1. Does anybody in the class already make an effort to be less dependent on their parent’s car? How? What are other benefits of being less dependent on the car (personal freedom, greater mobility, more time with friends, exercise benefits, saves time, chance to enjoy fresh air and sunshine, more fun...)?

2. Explain that students will be recording all of their trips over a two week period. This should take no more than a few minutes daily during regular homework time and can be recorded in an existing notebook or on scratch loose leaf paper and kept in a binder. Define a “trip” as every time you travel from place to place (home to school or the store, school to soccer practice, home to a friend’s house...)

3. The data we are after is:
• the distance of the trip (calculated by looking at the cars odometer or estimated from the map)
• the time it takes to get where you’re going and
• the mode used. The key for recording modes is: a=private automobile b=bike, w=walking, c=carpool, t=transit, cp=carpool, o=other

4. At the end of two weeks review the record and identify:
• the private automobile trips that were under five minutes (or approximately 2.5 miles). Could any of these trips be replaced in the future by walking or biking?
• any trips that were on the bus, ferry, Caltrain or BART route. Was transit an option?
• any trips which were repetitive. Do we go to the store several times a week when we could have combined errands?
• any trips that could have been carpooled or shared. Why don’t we make more of an effort to get together to share rides?

5. For the next two weeks make an attempt to change your travel patterns by focusing on the trips identified as short, along transit lines, could have been combined or shared.

After the final two weeks compare travel patterns with the first two weeks. Were students able to make changes on their own? Were they able to impact their families? What was easy to do? What was challenging? How could alternatives to the car be made more effective/apppealing?
DISCUSSION: Acknowledge that kids may not have a lot of control over how they get around, but that this is an exercise which is designed to empower them to take control of their own transportation. Getting around on their own is a valuable life skill which will help them develop decision making and problem solving skills, increase their sense of responsibility and build confidence, as well as expand their world and afford them new freedoms. Remind them that they have a lot of influence with their parents and have a responsibility within the family to make sure everyone is working together to live in such a way that our personal, community and environmental health and safety are protected.

- Have you (or your parents) ever changed the way you do something in order to "save the planet"? (recycling, buying recycled products, car pooling, buying a hybrid car…)
- Why do we need to "save the planet"? What's happening now that's never happened before? (We're running out of natural resources, global warming, the holes in the ozone...)
- What natural resources are we running out of? (water, fossil fuel, land for construction, agricultural land, forest products, plant and animal species...)
- Can any of these things be replaced/restored once they are gone? (land can be restored in some instances, otherwise once a plant or animal is extinct it is gone forever)
- Won't science/technology invent a solution? (In some areas better technology already exists, we must choose to us to use it. One example would be the choice to buy a Hybrid vehicle instead of an SUV or build a home with a solar heating system. Many of our smaller purchases and practices concerning technology, particularly chemical technology also matter, such as buying paper made from recycled products and not using pesticides in our gardens.)
- What will life be like in the future if we continue to use and pollute the way we do? (climate change, rising ocean levels resulting in the loss of islands and coastlines, sickness resulting from air and water quality, food and housing will become very expensive, we will lose our open spaces)
- What kinds of things can we do to help the situation? (have student brainstorm, ideas include: human powered transportation and transit, recycling and buying recycled and reusable products, turning off lights, turning down the thermostat, using small fans instead of air conditioners and clotheslines instead of dryers)
- One dangerous emission produced by cars is carbon dioxide (CO2). This greenhouse gas is released in direct proportion to the gallons of gasoline consumed. The amount of carbon dioxide American cars emit into the atmosphere has been steadily increasing, from 1970 to 1999, the amount increased by 56%, culminating in an estimated 300 million metric tons of carbon being released last year.
- We also know that a five minute car trip is about 2.5 miles and would take about 30-45 minutes by foot or about 10-20 minutes by bike. Compare this to one hour of walking in the mall which covers about 5-6 miles. Many car trips are short errands (grocery store, post office...) which could be replaced by biking or walking, saving many tons of CO2 pollution.

SOURCE: Safe Routes to Schools Program
TRADITIONAL TOWNS
AND MODERN SUBURBS

TOPIC AREA: Planning/Urban Development
AGE LEVEL: Kindergarten - 2nd Grade
DURATION: 3 hours
RESOURCES: • National Geographic Magazine: The American Dream—Urban Sprawl
• National Geographic: Virtual World—The New Suburb?
• Suburban Sprawl Slide Show

MATERIALS: • Internet access
• Map of a major metropolitan area, showing city and suburbs
• Projector to display Websites to the entire class (optional)

OBJECTIVE: This lesson introduces students to the differences between traditional towns and modern suburbs. Students will visit a virtual community and view aerial photographs to compare and contrast these two types of towns. They will conclude by drawing two mental maps.

Students will
• draw pictures of their town;
• discuss the things that are important for a town to have;
• identify a city and its suburbs on a map;
• hypothesize and list the good and not-so-good things about living in a city and in the suburbs;
• take a tour of a virtual town and compare it to scenes of suburban sprawl;
• view aerial photographs of suburban sprawl and hypothesize the impacts of sprawl on the environment;
• draw mental maps of traditional towns and modern suburbs; and
• write sentences describing their maps.

TASKS:
1. Ask students to draw pictures of their town. This should be a "free drawing," so you don’t need to give them any specific directions on what to draw. Discuss students' pictures. What features of the town did most kids draw? What are some of the more unusual things kids have noticed? What features does everyone agree are very important to the town? Why did they include some features and leave others out?

2. Make a two-column chart on the board or on a large piece of paper that the whole class can see. Label one column "New Urbanism" and the other "Sprawl." [Note: "New urbanism" refers to a recent movement to design towns based on traditional town models; you can just tell students that these are pictures of traditional town or city scenes. Likewise, if you don’t want to introduce the word "sprawl" right now, you can tell students that these pictures are typical of new suburbs.]

3. Ask students if they know the difference between a city and a suburb. Do they live in a city, a suburb, or another type of place (e.g., a small town or a rural area)?

4. Show students a map of a major metropolitan area, such as Chicago or San Francisco. The map should clearly show the city and its suburbs. If you would like to make a map on the computer, use MapMachine or MapQuest.
5. As students look at the map, have them identify the city and some of its suburbs. Explain that the suburbs closest to the city are usually older than the suburbs farther from the city, although the more remote suburbs are frequently older small towns that have spread outward into the surrounding countryside.

6. Ask students to list the good things about living in the city and the suburbs. Then ask them to list the things they think would not be so good about living in each place. Write their ideas in the class chart.

7. Have students go to National Geographic's Virtual World—The New Suburb? feature, or use a projection device to show this page to the entire class. Explain that this feature shows pictures of a town that is designed to look like a traditional ("old-fashioned") town or city center rather than a modern suburb.

8. Have students click on the following features:
   - The light-rail train
   - The parked car
   - Ted's Pizza Parlor (they will need to "move right" to see it)
   - The mixed housing ("move right" one frame from Ted's Pizza Parlor; it's the middle row house)

9. At each "stop," ask students to click on the tabs to learn about the careful planning of new urbanism versus the disorganized growth of sprawl.

10. At each "stop," pause to discuss the differences between the two pictures. Help students understand what the pictures show. Add words and phrases to the class chart.

11. Explain that as more new suburbs are built, many people are concerned that too much land is being used up. This is one of the reasons that some people would like new suburbs to be modeled after more old-fashioned towns, similar to the virtual suburb they have just visited.

12. Have students look at some aerial photographs of sprawl by going to the following Web pages:
   - National Geographic Magazine: The American Dream—Urban Sprawl
   - Suburban Sprawl Slide Show

13. Ask them to think about how this type of suburban design might impact animals, plants, air, and water. Add their ideas to the chart, and share with the class some of your own knowledge of the effects of sprawl. (You can get information on this subject from the "Resources and Links" section of the New Suburb feature.)

**DISCUSSION:** Discuss the class chart, asking students to summarize the main differences between a traditional town/new urbanist suburb and a modern suburb affected by sprawl.

- Ask students to describe the type of town they would most like to live in. They will probably have different answers. Ask them to state whether they would like to live in the suburbs, the city, or another type of place.
- Ask students to draw two maps: one of a traditional town and one of a modern suburb. They should draw these maps from memory, based on what they have learned in this lesson.
- Ask older students to write at least four sentences describing each of their maps.

**EXTENSION:** Have students draw maps of their ideal towns. They should incorporate concepts they have learned in this lesson and recorded in the class chart. Their maps should show residential and commercial areas and methods of transportation.

Have students share their maps with the class, describing the town and what they like about these places.

**SOURCE:** NationalGeographic.com
DESIGN YOUR OWN SUBURB

TOPIC AREA: Planning/Urban Development
AGE LEVEL: 3rd - 5th Grade
DURATION: Four hours
RESOURCES:
- Congress for the New Urbanism
- National Geographic Magazine: The American Dream—Urban Sprawl
- National Geographic: Geography Action! 2003—Habitats
- National Geographic: Virtual World—The New Suburb?
- Sierra Club: Sprawl Campaign
- Suburban Sprawl Slide Show

MATERIALS:
- Internet access
- Large pieces of white construction paper
- Regular and colored pencils

OBJECTIVE: This lesson asks students to think about their own perceptions of cities and suburbs and consider the features that exist in a typical urban and suburban area. They will also learn about sprawl and some problems associated with rapid suburban growth. They will conclude by designing their own suburbs.

Students will
- view and discuss urban and suburban scenes;
- list the features of their ideal town and discuss whether these can be found in cities and suburbs;
- draw mental maps of a city and a suburb;
- brainstorm and list the possible effects of sprawl on the environment, adults’/kids’ daily lives,
- visit a virtual New Urbanist suburb, and list differences between this and a sprawling suburb; and
- design their own new suburbs, taking into account the things they have learned about sprawl.

TASKS:

1. Write the words "City" and "Suburb" on the board, and ask students to contribute words that come to their minds when they think of each one. List their ideas on the board.

2. Ask students to list some of the things they would want to have in their ideal town. To guide this activity, you may want to pose these questions:
   - What conveniences would you want your town to have (e.g., accessible bus routes or plenty of parks and open space)?
   - What types of homes and businesses would you want there to be?
   - How would you prefer to get around your town? Would you like to be able to walk or take public transportation (or perhaps even skateboard), or would you prefer to be driven around?

Discuss student lists as a class. Can they find these conveniences in a city? What about in the suburbs? In their own town?

3. Read these two scenarios to the class, asking them to form pictures in their minds as you read (you may also want to print the scenarios and have students read them in class):
Marcie is running late for school. She runs out the front door, forgetting her lunch. Darn! She has missed the school bus, so she’ll have to take the public bus. She walks two blocks and pays one dollar to get on the next bus. She looks out the bus window and notices that Vinnie’s Pizza is having a special on pepperoni. A block later, the bus stops to pick up some more kids who missed the school bus. The traffic isn’t bad, but they have to stop at all the red lights and bus stops. She gets to school just in time for the bell. Because she got an A on her book report, her teacher takes her and a few other kids to the pizza place next to the school—it’s not Vinnie’s, but it’s almost as good!

Josh is running late for school. He knows he’s already missed the bus, so what’s the use in running down the street for it now? Thank goodness his mom is still home—otherwise he’d have to call around and see if a neighbor could drive him to school. His mom agrees to drop him off at school on her way to work. They’re in a hurry, but they have to slow down for children and speed bumps. Once they get to the main boulevard, they hit two red lights. Even worse, Josh realizes he has forgotten his lunch. He gets to school on time, but he has to share his best friend’s soggy sandwich; the school cafeteria is closed today, and the nearest place to buy food is in the mall three miles away.

Ask students to describe the type of setting where each person lives. They may notice that Marcie lives in a city and Josh lives in a suburb. What evidence do students see in each scenario that is "typical” city or "typical” suburb? Do they think these scenarios are accurate?

Have students sketch two maps that illustrate their own perceptions of what cities and suburbs are like. Their maps (one of a city and one of a suburb) should show examples of transportation routes, housing, and businesses. Allow about fifteen minutes for this activity; these should be rough sketches rather than highly detailed drawings. As students go through this mental mapping exercise, make sure they understand that they should draw the maps based on their own ideas and impressions of cities and suburbs. If they have little or no experience in one or both of these settings, that’s okay. Discuss students’ mental maps as a class. Ask them to describe the types of transportation they drew and the other features they included to show their impressions of a “typical” city and suburb.

Write the word "sprawl" on the board, and ask students to define this word. They might say that a person can "sprawl” out on the couch, or they might be familiar with the word as it pertains to suburban development. Explain that many people are very concerned about the way the suburbs have been growing over the past few decades. As more and more people move away from the cities seeking their own homes and some fresh air, developers build houses and malls on land that was once farmland or even desert. Since homes are kept in separate areas from businesses and there’s not generally much public transportation, the people who move into these houses have to drive a lot. Tell the class that this phenomenon is called "sprawl.” Ask the class if they have seen any examples of sprawl in their own area.

Have students look at the pictures of sprawl at the National Geographic magazine Urban Sprawl article and at the Suburban Sprawl Slide Show. Discuss what the pictures show.

Divide the class into small groups, and ask them to brainstorm the possible effects of sprawl on the environment, adults’ daily lives, and kids’ daily lives. Have them list their ideas.

Have groups go to National Geographic’s Virtual World—The New Suburb? Ask them to read the introduction, and make sure they understand that the term “New Urbanism” refers to a type of town design that tries to make new towns and suburbs more like old-fashioned city centers and small towns. Ask them to locate and scroll over at least six items in this virtual town and list the features that are different from a typical sprawling suburb. Make sure they know that when they scroll over an object...
and see a plus sign, they can click on the object to see pictures of the New Urbanist versus the sprawl design. Discuss students' findings as a class.

**DISCUSSION:** Discuss as a class the possible effects of sprawl on the environment, adults' daily lives, and kids' daily lives. What things did they notice in the New Urbanist suburb that might be better for the environment and that might be more pleasing to adults and kids than sprawl? Alternatively, are there some ways in which sprawl might be better than the New Urbanist model?

Ask students, either in groups or individually, to design a new suburb. They can imagine that it will be developed near their town or in another part of the country. First ask them to consider the features they would like their suburb to have. Some of the questions for them to consider will be:

- What types of transportation would you like to make available?
- What types of housing do you want?
- What types of businesses do you want?
- Do you want mixed-use neighborhoods where businesses and homes can be together?

Have them draw their suburbs on large pieces of construction paper. They should include streets, neighborhoods, business districts, and major transportation routes such as rail lines, bus routes, highways, or large "feeder" roads. Ask students to label their maps to show the important features they have included. They should label at least six features. Have students share their maps with the class.

**EXTENSION:** Have students locate their state on the Sierra Club’s Fall 2000 Sprawl Report. Be sure to point out that this page is sponsored by the Sierra Club, an environmental organization that is waging an anti-sprawl campaign. Ask them to use the Internet or print resources to find additional information about the "good" and "bad" developments mentioned for their state. Have students write brochures to educate other people in their state about the "good" and "bad" sprawl examples they have researched.

**SOURCE:** NationalGeographic.com
WHAT TO DO ABOUT SPRAWL?

TOPIC AREA: Planning/Urban Development
AGE LEVEL: 6th - 8th Grade
DURATION: Four to five hours
RESOURCES: • Congress for the New Urbanism
           • National Geographic Magazine: The American Dream—Urban Sprawl
           • National Geographic: Geography Action! 2003—Habitats
           • National Geographic: Virtual World—The New Suburb?
           • Sierra Club: Sprawl Campaign
           • Sprawl Guide
           • Sprawl Watch
           • Suburban Sprawl Slide Show
           • Vermont Forum on Sprawl

OBJECTIVE: Students may already be familiar with old cities and new suburbs. This lesson asks them to consider their own perceptions of cities and suburbs and has them learn about sprawl and related issues. They will read an article excerpt about sprawl and visit a virtual suburb to compare and contrast sprawl with “New Urbanism.” Students will conclude by analyzing the evidence for sprawl in an Atlanta suburb and making recommendations for how that town can minimize sprawl’s impact.

Students will
• draw mental maps of a city and a suburb;
• read and discuss an article excerpt about sprawl;
• visit a virtual New Urbanist suburb and discuss differences between this and a sprawling suburb;
• analyze a map and text about a suburb that has experienced sprawl; and
• write reports to this suburb’s City Council recommending how it can reduce or prevent.

TASKS:
1. Read these two scenarios to the class:
   • Jennifer is running late for work. She grabs her briefcase and runs two blocks to the bus stop. Luckily, the bus arrives in one minute. As she sits on the bus, she looks out the window and notices that Vinnie’s Pizza is going out of business and, one block later, that St. Joseph’s Elementary School is having a carnival on Saturday. A block later she sees a “For rent” sign on a building and decides that maybe she should think about moving. She gets to work just on time for her big day-long meeting. At the end of the day, Jennifer walks eight blocks to meet a friend for dinner. The friend brags about her new car, and Jennifer says, "There’s no way I would ever get a car. What a hassle!"
   • Kyle is running late for work. He opens the garage door and speeds down the driveway. As he goes down his street, he has to slow down for children and speed bumps. Once he gets to the main boulevard, he hits two red lights. On the freeway, it’s bumper-to-bumper. Never mind—he can get some work done on his cell phone and comb his hair in the process. He makes it to work just in time for his big meeting. His presentation goes so well that he gets to leave work early. The traffic isn’t too bad yet, as it’s only 2:00. He stops at the mall and then goes home to enjoy some peace, quiet, and fresh air.

   Ask students to describe the type of setting where each person lives. They will likely notice that Jennifer lives in a city and Kyle lives in a suburb. What evidence do students notice in each scenario that is “typical” city or “typical” suburb?

2. Have students sketch two maps that illustrate their own perceptions of what cities and suburbs are like.
Their maps (one of a city and one of a suburb) should show examples of transportation routes, housing, and businesses. Allow about fifteen minutes for this activity; these should be rough sketches rather than highly detailed drawings. As students go through this mental mapping exercise, make sure they understand that they should draw the maps based on their own ideas and impressions of cities and suburbs. If they have little experience in one or both of these settings, that's okay. They will be learning more about typical urban and suburban locations later in the lesson. Discuss students’ mental maps as a class. Ask them to describe the types of transportation they included and the other features they have added to show their impressions of a “typical” city and suburb.

3. Discuss the purposes of suburbs. Why do people live in the suburbs? What are the advantages and disadvantages of living in the suburbs versus in the city? Explain that suburbs have been around for a long time. Some suburbs, particularly around Eastern and Midwestern cities in the United States, began as small villages that took several days to get to from the city. As transportation improved, these villages attracted more residents and became “bedroom communities” where people who worked in the city could live. Explain that some suburbs are much newer than these older suburbs. Many new suburbs have been developed in the U.S. since World War II, and some very new suburbs did not exist at all—not even as small villages—until the past ten years or so. Can students think of examples of newer and older suburbs?

4. Have students read the excerpt from the National Geographic magazine article about urban sprawl. Discuss Tom Spellmire’s concerns. Pose these questions to the class to help them focus on the issues raised in this excerpt:

- What does the author mean when he says that the new suburban homes “for half a century have signified fulfillment of the American dream?”
- What has happened to most of the land Spellmire used to farm?
- Why do real estate investors like to go to Warren County?
- Why do you think so many people have moved into the new houses in Warren County? What do they like about this area?

Write the word “sprawl” on the board. Explain that many people, including Tom Spellmire, are very concerned about the way the suburbs have been growing over the past few decades. Sprawling suburban areas differ from traditional cities in a number of important ways.

5. Present these definitions of sprawl versus traditional cities and villages, and discuss their meanings with the class. Have students noticed any evidence of sprawl in their own community or elsewhere? (The lists below are paraphrased from “Sprawl Defined”):

<table>
<thead>
<tr>
<th>Sprawl</th>
<th>Traditional urban centers and towns</th>
</tr>
</thead>
<tbody>
<tr>
<td>uses more land than necessary;</td>
<td>have higher population density than surrounding areas</td>
</tr>
<tr>
<td>has lower population density than traditional cities/towns (fewer people in larger houses)</td>
<td>offer mixed use buildings (businesses/homes on same block or within walking distance)</td>
</tr>
<tr>
<td>creates dependence on cars for everything</td>
<td>pedestrian-friendly</td>
</tr>
<tr>
<td>results in fragmented open spaces, wide gaps between development, a scattered appearance</td>
<td>served by public facilities, services, spaces (e.g., public transit or community centers)</td>
</tr>
<tr>
<td>separates uses into distinct areas (no store, movie theater within walking distance from home)</td>
<td>consist of different types of housing and businesses</td>
</tr>
<tr>
<td>characterized by repetitive one-story commercial buildings surrounded by acres of parking</td>
<td>have centers for community activities</td>
</tr>
<tr>
<td>lacks public spaces and community centers.</td>
<td>surrounded by open spaces, including productive farm and forest land.</td>
</tr>
</tbody>
</table>
6. Have students make charts with two columns. Ask them to label the first column "Sprawl" and the second column "Traditional." Have students take a tour through the "New Suburb" to see examples of sprawl and what modern planners call "New Urbanism." Explain that New Urbanism is a movement to develop modern suburbs that resemble older city centers and towns. As students go through the virtual neighborhood, ask them to fill in their charts with the differences between sprawl and traditional (New Urbanist) town design.

7. Have students link to the first picture under "Zoom In" on the left side of the screen at the National Geographic magazine article about urban sprawl. This is a picture of a cul-de-sac in Alpharetta, Georgia, a suburb of Atlanta. Ask students to read the caption. Have students use MapMachine to create a map of Alpharetta. They should enter "Alpharetta" in the Find a Place box. Then, have them select "Street Maps" on the left side of the page, and zoom in and out on the Atlanta metro area to find the location and the relative position of Alpharetta. They can choose other types of maps from the menu to learn more. [Note: To save time, you can create the map for them, print it out, and make copies for the class.] Have students gather additional information on the town of Alpharetta’s home page. In particular, they should look for the information about how quickly the town has grown and why so many people are moving to this town. Ask students to look carefully at this map and other information and list the evidence they see that Alpharetta has indeed experienced sprawl. They should base their assessment of the map on the things they have learned about sprawl and, in particular, on the notes in their charts. [Note: Feel free to substitute another suburb of your choice for Alpharetta.]

8. Ask students to imagine that they live in Alpharetta (perhaps they do!) and have been invited to a meeting of the town’s City Council. The City Council has asked for their feedback on how they can reduce the effects of sprawl on their community and plan for the future so that sprawl doesn’t become a bigger issue than it already is. Have students write reports providing their recommendations to the City Council. Students’ reports should contain at least four recommendations, based on things they have learned in this lesson. [Note: Feel free to substitute another suburb of your choice for Alpharetta.]

DISCUSSION:
Discuss students’ charts as a class. In particular, discuss these questions:

- How do street design and layout affect a town?
- How might sprawl affect the environment (e.g., animals, plants, and air and water quality)?
- How might sprawl affect people’s interactions with their neighbors? (Hint: Think about how long it takes people to get to and from work and the consequences of having a big garage rather than a front porch.)
- What are some things that town planners can do to combat sprawl?
- What are some of the benefits of living in a sprawl area? (After all, your students might live in a sprawling suburb—what things do they appreciate about this place?).

EXTENSION: Have students locate their state on the Sierra Club’s Fall 2000 Sprawl Report. Be sure to point out that this page is sponsored by the Sierra Club, an environmental organization that is waging an anti-sprawl campaign. Ask them to conduct further research on the “good” and “bad” developments mentioned for their state. Their research should focus on the evidence that sprawl is indeed a problem in this location and the potential consequences for that sprawl. Have students write brochures to educate other people in their state about the “good” and “bad” sprawl examples they have researched.

SOURCE: NationalGeographic.com
SPRAWL: THE NATIONAL AND LOCAL SITUATION

TOPIC AREA: Planning/Urban Development
AGE LEVEL: 9th - 12th Grade
DURATION: Three to five hours

MATERIALS: • Internet access
            • Writing and drawing materials

RESOURCES: • Congress for the New Urbanism
            • National Geographic Magazine: The American Dream—Urban Sprawl
            • National Geographic: Virtual World—The New Suburb?
            • Sierra Club Sprawl Campaign
            • Sprawl Guide
            • Sprawl Watch
            • Suburban Sprawl Slide Show
            • Vermont Forum on Sprawl

OBJECTIVE: In this lesson, students will investigate how urban sprawl impacts the environment, people’s daily lives, and the local/regional economy. Students will draw mental maps to illustrate their impressions of modern suburbs, and view maps/aerial photos of a nineteenth century town that has recently become a modern suburb. They will conclude by researching and reporting on the sprawl situation in a nearby metropolitan area.

Students will
• read and discuss an article excerpt about sprawl;
• draw mental maps of a fictitious sprawling suburb;
• analyze pictures and text about a suburb that has experienced sprawl;
• visit a virtual New Urbanist suburb and list and discuss the ways that this suburb and its sprawling counterpart affect the environment, people’s daily lives, and the local and regional economy; and
• research and write reports on the sprawl situation in their own area.

TASKS:
1. Have students read the excerpt from the National Geographic magazine article about urban sprawl. Discuss the issues that arise in this excerpt. In particular, pose these questions to the class:
   • Why does Spellmire lease his land?
   • What does Spellmire say is wrong with Warren County’s zoning codes?
   • What irony does Spellmire observe in the new residents’ attitudes toward his farm?
   Ask students if they are familiar with the word "sprawl" as it relates to urban and suburban development. If so, what do they think the word means? What examples of sprawl have they seen?

2. Have students read the characteristics of sprawl and traditional urban centers and villages, under the headings "Sprawl is typically characterized by..." and "Sprawl is distinct from..." Discuss these characteristics; have students seen examples of them?

3. Ask students to imagine this scenario:
   A small town was established in the late 19th century. It was located about twenty-five miles from a major city. Since the trip to the city was too long for people to make on a daily basis, the town was self-sufficient and did not consider itself a suburb. With the opening of a freeway between this town and the city in the 1960s, some people began to use the town as a “bedroom community.” Within the last decade, the town has experienced a huge influx of people from the central city and other suburbs. Many new subdivisions have been developed, along with shopping malls and “business parks.”
Ask students to sketch maps of this town as they think it would look today. Their maps should show street patterns and types of available transportation (e.g., bus routes, light rail tracks, or major “feeder roads”). Discuss students’ mental maps as a class. In what ways do they reflect the characteristics of sprawl students have read about?

4. Have students use MapMachine to create maps of Louisville, Colorado. They should enter “Louisville, CO” in the Find a Place box. Then, have them select “Street Maps” on the left side of the page, and zoom in and out on the Denver metro area to find the location and the relative position of Louisville, as well as its basic layout. They can also choose other types of maps to learn more. [Note: To save time, you can download this street map for them, print it out, and make copies for the class.] What do students notice about this town’s street pattern? They should notice that it has a central grid pattern surrounded by streets that twist and wind. Many of these outer streets end up in cul-de-sacs. They will also notice several large roads which surround most of the town but divide parts of the outermost areas. Explain that Louisville is an older town on the eastern slope of the Rocky Mountains. It was incorporated in 1882. Over the past few years, a good deal of land in this area along the road between Denver and Boulder has been developed into new suburban residential areas, “business parks,” and shopping malls. Thus, the older grid pattern is surrounded by the twisting and winding residential cul-de-sacs that have become popular places to live. Ask students to compare what they have seen in the Louisville maps to the mental maps they created. Did they have an accurate idea of what an older town that’s become a sprawling suburb looks like? Discuss as a class the possible impacts of sprawl on the environment, people’s daily lives, and the local and regional economy. What do they think might be the impacts of recent suburban developments on these factors?

5. Have students make charts with three columns and four rows. Ask them to label the second column “Sprawl” and the third column “Traditional.” Ask them to label the second through fourth rows “Environment,” “Daily Lives,” and “Economy.” Have students take a tour through National Geographic’s “New Suburb” to see examples of sprawl and what modern planners call “New Urbanism.” Explain that New Urbanism is a movement to develop modern suburbs that resemble older city centers and towns. As students go through this online feature, ask them to fill in their charts to show the impacts of sprawl versus traditional (or New Urbanist) town design on the environment, people’s daily lives, and the economy. Discuss students’ charts as a class. You might want to have them compare the things they have found in the New Suburb to this list of the impacts of sprawl.

DISCUSSION: Ask students, in groups or individually, to research the sprawl situation in their metropolitan area or in a metropolitan area in their part of the country. They should also research the national sprawl situation to find out more about the issue in general. Students should take notes to answer these questions:

- What are the primary economic, political, environmental, and social arguments against sprawl?
- What is New Urbanism? How effective has it been so far?
- Which parts of your metropolitan area (or your study area) provide examples of sprawl?
- Why has sprawl occurred in these areas?
- What have been some of the impacts of sprawl in these areas?
- What discussions, if any, have been held among citizens or politicians concerning how the effects of sprawl can be lessened and how sprawl can be curtailed in future development?
- What do you think should be done about the sprawl situation in this area? Do you think it’s really a big problem, or are things okay as they stand now?

Have students write “sprawl reports” for the metropolitan area they have researched. Their reports should address the questions above.

EXTENSION: Have students undertake a sprawl photojournalism project. Ask them to use digital or regular cameras to take pictures of sprawl scenes in their area. Then have them write captions to accompany their photographs and create a sprawl exhibit in the classroom. Their project should attempt to answer these questions: Where does sprawl exist? What does sprawl look like? Is sprawl a big problem?

SOURCE: NationalGeographic.com
SPINNING YOUR WHEELS

TOPIC AREA: Planning/Urban Development
AGE LEVEL: 9th - 12th Grade
DURATION: 
RESOURCES • "Building Better Communities: A Toolkit for Quality Growth," The Road Information Program (http://www.dnr.state.md.us/education/growfromhere/LESSON6/LESSON6_1.HTM)
• "Greetings from Smart Growth America," Smart Growth America (http://www.dnr.state.md.us/education/growfromhere/LESSON6/LESSON6_2.HTM)

OBJECTIVE: Students will:
• Read and to articles on topics related to the topic of transportation and land use
• Support their responses with textual references
• Engage in one of the following: panel discussion, shared inquiry discussion, value line, debate
• Compose a persuasive essay on a topic related to the topic of transportation and land use

BACKGROUND: Transportation and land use planners must consider a variety of issues, including cost-effectiveness, environmental impacts, equity (how their decisions impact different communities or groups of people), economic development, and community impacts. Moreover, they must consider these issues within a regional framework, because transportation needs and systems cross town, county, and State boundaries.

In recent years, two dominant philosophies have emerged:

1. The single-occupancy vehicle is the transportation mode of choice; government should support it.

2. Land use patterns that create great distances between destinations force people to drive and are not supportive of people who cannot or do not wish to drive. Building more roads only reinforces the type of development that is designed primarily, if not exclusively, for cars. The government should also invest in alternatives to driving and ensure that land use patterns allow people to get to many of their destinations without having to drive. This philosophy supports communities that offer people transportation choices.

Each philosophy has its own "spin" or perspective on how transportation and land use impact public investment, the environment, equity, economic development, and communities.

TASKS:

1. Students will engage in a strategic reading of "Building Better Communities: A Toolkit for Quality Growth", "Greetings From Smart Growth America.", and related newspaper articles on transportation identified by students or teachers.

2. When students have completed reading the articles, lead students in one or more after reading activities that prompt students to:
   • Summarize the selection
   • State the idea
   • Interpret and evaluate the ideas in the texts
   • Apply ideas from the text
   • Use study strategies: i.e., locate and organize information, investigate additional resources

3. To prepare students to take a position in a persuasive essay, students will engage in one of the following discussion activities: panel discussion, shared inquiry discussion, value line, debate.

4. Following the discussion activity, students will draft their persuasive essay.

SOURCE: LessonPlanet.com
AND THE SURVEY SAYS...

TOPIC AREA: Planning/Urban Development
AGE LEVEL: 9th - 12th Grade
DURATION: 
RESOURCES
• Student Handout: Background on Surveys
• Student Handout: Survey Score Sheet

OBJECTIVE: Students will:
• identify the types of information gathering styles and different surveying styles
• develop their own survey, implement it, evaluate the data they collect and identify any biases.

BACKGROUND: Surveys are used in many fields to gather data on the knowledge, attitude and behavior of the general public or specific populations. This information is used to design political campaigns, create marketing strategies, plan for public services and many other purposes. Planning offices may use surveys to determine public attitudes and preferences about growth options, or to assess the use of different public services, such as roads or playgrounds. Through this lesson, students will gain experience in gathering data used for decision-making, as well as the ability to more critically assess conclusions based on survey data.

TASKS:

Activity 1: Introduction to Surveys and Sampling. Teachers should introduce students to the basic concepts of sampling and surveying and familiarize students with statistical terms. The teacher may use the provided handouts, or develop their own lesson. Allow students to research the information individually or in teams and report back to the class.

Activity 2: Designing a Survey. Using the basic concepts of sampling and surveying, create a survey about transportation within your school. Before designing the survey you may wish to:
• Interview the principal or whoever is in charge of transportation issues within your school to find out about transportation issues at the school
• Have a Central Office staff person come to your class to give an overview of local school system transportation issues.

Activity 3: Distributing a Survey

Survey 1: Mass Survey. Distribute a survey around your school to determine the different forms of transportation used to get to your school.
• Divide the students into groups.
• Review the Survey Score Sheet with the students, or have students develop their own Score Sheet for grading their survey.
• Ask each group to make a list of questions that determine what kind of transportation is used by students, including distances and destinations. You may want to have all groups include common questions to allow for analysis of sub-samples
• Ask each group to peer review questions by other groups, looking for leading questions and bias.
• After reviewing the survey questions, allow students to design a method to distribute the surveys to a portion of the student body. Some options might include distribution to all students that have class with a particular teacher, or in a certain grade.
After the surveys are distributed and collected back have students analyze their findings and produce a final report. A final report might include graphs and tables of data, sample surveys, explanation of data, areas of possible error.

Sample Questions for a Survey:
- How did you get to school today?
- How will you go home?
- Have you made any transportation choices based on their environmental impact?
- How long does it take you to get to school?
- Do you have a choice in how you travel?
- How far do you travel in an average day to get to school?
- Would you take public transportation if it was available? Why or why not?

Sample questions that might be answered in a final report:
- How was your survey distributed?
- Who received the survey? Was this a random sample or biased sample?
- How did you measure responses?
- Do students at your school think environmentally?
- Is your community designed for easy transportation to schools?
- Is there a good public transportation system in your community? If not, how could you make it better?
- Do you think your survey could be applied to a larger population?

Compare similar questions and groups and analyze for bias

Survey 2: In-person Survey (Interview). Talk to three or more people representing three different generations and compare their attitudes about their community. Teachers may either have students compile a list of questions or provide a list of questions that every student will use when talking to the three respondents.

Sample Questions for an In-Person Survey:
- Where do you live?
- How long have you lived there?
- What changes in the area have you seen?
- What are the positive and negative aspects of these changes?
- Why do you live where you live?
- What do you like and dislike about living in your area?
- What future changes would you find beneficial in your area?

Think about:
- How will you prevent bias?
- What effect does a small sample have?
- Will combining data cause a bias?
- Does your data show a difference among generations?

Activity 4: Taking Action: Identify key issues raised by your transportation survey. Share the results with the school principal. If appropriate, send your findings to a local decision-maker (e.g., county planner, director, elected official, school board) with a letter explaining your results. What problems have been identified? What action(s) can be taken at your school to address the problem(s)? Continue with issues-based investigation.

Possible final products:
- students write a final analysis of the data
- groups pool data and analyze. Groups report out.

SOURCE: LessonPlanet.com