Write the Research Essay

Students will research and write an essay (maximum 1,000 words) in which they design a way to transport people in and around their future city.

This year’s topic:

Tomorrow’s Transit

DESIGN A WAY TO MOVE PEOPLE IN AND AROUND YOUR CITY.

Thousands of years ago we had only one way to move—on foot. In today’s cities there are lots of ways to get around, including bikes, cars, mass transit (like buses, trains, subways, and ferries), escalators, and walkways. Engineers design solutions like these to transport people quickly, safely, and using the least amount of energy. But with so many people on the move, there are bound to be safety problems (like crashes), environmental impacts (like air pollution), and health impacts (like long commutes). Whatever the size and location of your future city, you’ll need to think creatively to keep people moving. Your challenge: Identify a problem of moving people in your future city and design a mode of transportation to solve this problem.

Learning Outcomes

Students will be able to:

• Identify different modes of transportation.
• Describe the advantages and disadvantages of different modes of transportation.
• Discuss one transportation problem their future city faces and why it is important to address.
• Describe a solution for managing the problem.
• Evaluate the benefits and risks of their proposed solution.
• Recognize that perfectly designed solutions do not exist—all technological solutions have trade-offs and risks such as safety, cost, efficiency, and appearance.
• Describe the role of engineering in developing solutions to transportation.
• Identify the steps of the design process (define the problem; brainstorm various solutions; select a solution; design, build, test, and redesign a solution; share results).

Scoring: Up to 60 points
Schedule: September to December* Students will spend approximately 10–12 hours writing the essay.

*Dates may vary. Check futurecity.org for specific dates.

Students will spend approximately 10–12 hours writing the essay.
Guide Students’ Thinking

Use these questions to help your students write a research essay that meets competition requirements.

1. What transportation problems will your future city need to manage based on its population, location, terrain, and layout?
2. Identify one problem of moving people in your city. Why is it important for your city to address?
3. What transportation mode do you propose to solve this problem?
4. What infrastructure would you design to support this transportation: existing 2013 infrastructure, modified 2013 infrastructure, or futuristic infrastructure?
5. What are safety concerns and how will you address them?
6. How does your solution address one of these transportation issues: sustainability, accessibility, or intermodality?
7. What are the trade-offs connected with this solution and how will you reduce them?
8. How is your solution plausible (based on sound science)?
9. What types of engineering are used in your solution?
10. What is the role of the engineer you believe to be most useful in your solution?
11. How can you represent your solution in your city model?
12. As you develop your solution, how could you use the design process to help you work through problems (define the problem to solve; brainstorm various solutions; select a solution; design, build, test, and redesign solution; share results)?
13. Is your essay organized, well written, free of grammar and spelling errors, and no more than a 1,000 words (not counting the title)?

“I learned so much about engineering this year, from research and writing to planning a presentation. I also worked on the multiple moving parts for our city. I thoroughly enjoyed the challenge and look forward to becoming a civil engineer.”

– Logan B., Indiana Student Team Member

Essay Outline

I. INTRODUCTION: DEFINE THE PROBLEM

Briefly introduce your future city and describe its population, location, terrain type, and general layout. Identify one transportation problem your city needs to manage. Explain why this problem is important for your city to address.

2. BODY: DESCRIBE YOUR SOLUTION

- Introduce the mode of transportation you’ve chosen and describe how it works.
- Identify the infrastructure used to support your solution: existing 2013 infrastructure, modified 2013 infrastructure, or futuristic infrastructure. Provide one example to illustrate the infrastructure.
- Explain how your solution improves or solves your city’s transportation problem.
- Describe the potential safety concerns connected with your solution and what steps have been taken to reduce these concerns.
- Explain how your solution addresses one of these transportation issues:
  - **Accessibility:** Does this transportation provide options for people with disabilities, the elderly, people with strollers, people with limited incomes?
  - **Intermodality:** Is this mode connected to other modes of transportation? Can citizens transfer seamlessly between other transit systems?
  - **Sustainability:** Does the mode of transportation use a fuel source that is renewable and has a limited impact on the environment? Can this solution be used to meet present needs as well as the needs of tomorrow?
- Describe some of the trade-offs connected with using the solution and how the solution reduces some or all of these trade-offs.

3. CONCLUSION: SUMMARIZE YOUR SOLUTION

- Summarize why your solution is the best way to help people move in and around your city. Explain how it makes your city a great place.
Draft Essay Using the Design Process
When engineers design solutions to problems, they go through a process of brainstorming, testing different ideas, learning from mistakes, and trying again. This is called the engineering design process. The steps of the engineering design process are:
- Define the problem to solve
- Brainstorm various solutions
- Select a solution
- Design, build, test, and redesign a solution and
- Share results

The engineering design process is a great way to work through any challenge that involves creating something that didn’t exist before, such as building a bridge, planning a trip—even writing an essay. You’ll use the design process as a framework to guide students through researching and writing their essay solutions.

Pre-Write Discussion Topics
Introduce the essay topic and get kids thinking about different modes of transportation—present, past, and future. Begin by having them brainstorm a list of transportation methods that are used today. Next have them look at how transportation has changed since the 1900s. Provide students with or have them construct a timeline that shows major transportation innovations. Then have them project 20–50 years into the future. What are realistic futuristic developments based on what has happened since the 1900s?

Help students understand that often travel is multi-modal, meaning that people use combinations of transit. For example, to get to school a student may walk to the bus stop and then take a bus. As a result, it is important that these systems are connected (intermodal). Talk about the ways people can move between the different systems students identified.

Point out that to travel efficiently, people need two things: a vehicle for propulsion, such as a bicycle, horse, or car; and infrastructure, including bikeways, roads, highways, and bridges on which to travel. Choose one mode of transportation (cars, for example) to discuss in detail with students. This discussion will model an approach students can use when researching later.

Ask:
- How are cars used to move people in and around a city?
- What infrastructure supports the use of cars (e.g., roads, highways, bridges, traffic signs and lights, markings on the streets, signage, fuel stations)?
- What are the benefits of moving around by car?
- What safety issues are connected to cars? What is being done today or being developed for tomorrow to improve car safety?
- Accessibility: What parts of the population use cars to travel? What options are there for people who are disabled, elderly, have limited incomes, etc.?
- Sustainability: What type of fuel do cars use and what impact do cars have on the environment?
- Intermodality: How are cars connected with other modes of transportation? How easy is it to move from cars to other transit systems?
- What are some of the trade-offs connected with using cars?
- What solutions are being developed for the future?

Quick Video Introduction
Show students the one-minute IBM SmarterCity Traffic segment to introduce urban transportation issues and initiate brainstorming. www-03.ibm.com/innovation/us/thesmarter-city/traffic/index.html

1. Define the Problem
To get started, engineers define the problem they want to solve and the project requirements.

Help students define the problem by reviewing this year’s topic description and essay outline together. How would they describe the essay problem using their own words? What are the different parts of the problem?
- Identify transportation problems your future city faces based on its population, location, terrain, and layout.
- Choose one transportation problem that will be most important to manage.
- Design a solution for managing this problem and describe how it works.
- Identify the infrastructure used to support your solution: existing 2013 infrastructure, modified 2013 infrastructure, or futuristic infrastructure.
- Describe potential safety concerns and how your solution will address them.
• Describe how the solution addresses one of these issues: accessibility, intermodality, or sustainability.
• Analyze the trade-offs connected to using the solution; incorporate into your design ways to reduce the trade-offs.
• Identify the roles of engineers in your solution.

Next have students look at their city’s population, location, terrain, and layout. What are different ways people travel around their city based on these features? What problems get in the way of moving people?

Then have them discuss and select one transportation problem that they think would be most important to manage. For example, they may choose a specific mode of transportation, such as bike or bus. They may focus on a segment of their population, such as the elderly. Or they may address how to move people within an area of their city, such as a highly developed city center.

2. Brainstorm Solutions

Next engineers brainstorm a range of possible solutions.

Starting with what they already know, have students brainstorm a range of solutions for managing the transportation problem they’ve identified for their city.

Then invite students to begin researching more ideas. They can use the Resources list to get started. Encourage students to think about which solutions interest them, including those in use today and those being developed for tomorrow. Invite them to research cities with locations and design features similar to their future city. (Share the case studies below to initiate ideas.) What modes of transportation do these cities use to help people move around? What problems get in the way of people getting to where they want when they want? What solutions are being developed for the future? Then have students share ideas and brainstorm as a group.

**Case Studies**

**Rio de Janeiro, Brazil: Cable Car System**

Rio de Janeiro is building gondolas to transport people from surrounding hillside communities to the city. The ride takes 16 minutes, instead of 50 minutes by foot, and connects with the city’s mass transit system. To top it off, each gondola is fitted with a solar panel, making it self-sufficient in terms of lighting, sound, and video surveillance systems.

**Hong Kong: Escalators**

With a glut of cars and bikes on the roads, Hong Kong decided to improve pedestrian methods of getting around. The city built a system of moving sidewalks and escalators that is 800 meters long and takes 20 minutes to ride from end to end (faster if you walk while riding). More than 55,000 passengers use the system daily to get to work, visit shopping malls, and go to downtown restaurants.

**Portland, Oregon: Bike Trails**

Portland is known as the top cycling city in America—and for good reason. The city has 260 miles of bike trails and lanes, including one that you can ride to the airport! To ensure biking is safe and accessible to all, the city provides low-income citizens with bikes with lights, as well as bike helmets and locks.

**Draw Lessons from Virtual City Design**

As students work on their Virtual City, help them see how the city population, location, terrain, and layout affect transportation. Ask: How do Sims move in and around your city? What kinds of problems get in the way of Sims going where they want, when they want (e.g., road congestion, commute times, inadequate public transportation coverage, lack of connection between public transportation systems, lack of Sims using public transportation). Have them try out their ideas to alleviate these issues in their virtual city. Did the solutions work like they thought? Were there any unanticipated consequences?
3. Select a Solution

*Engineers choose the best solution and plan how to build it.*

Have students choose one solution from their initial research in depth and describe in their essay.

4. Design, Build, Test, and Redesign a Solution

*Once a design is settled on, engineers begin building, testing, and redesigning their solution.*

Point students to [this year's topic description](#) and [Guide Students’ Thinking questions](#) to help direct their research. As they research, it’s likely students will need to refine their ideas and solve problems that come up. This is part of the process. Remind students to consider the following transportation issues as they research. Note that they should eventually select one and discuss how their solution addresses the issue in their essay:

- **Accessibility:** Does this transportation provide options for people with disabilities, the elderly, people with strollers, people with limited incomes?

- **Intermodality:** Is this mode of transportation connected to other modes of transportation? Can citizens transfer seamlessly between other transit systems?

- **Sustainability:** Does the mode of transportation use a fuel source that is renewable and has a limited impact on the environment? Can this solution be used to meet present needs as well as the needs of tomorrow?

Encourage creativity, innovation, problem solving, and futuristic thinking. The students’ transportation solution can be an improvement on an existing technology or a new invention. It can move one person or hundreds. It can utilize existing infrastructure, modified existing infrastructure, or futuristic infrastructure. Remind students they will need to provide one example that illustrates the infrastructure that supports their transportation solution. For example, solar-powered bikes could travel on existing roads that have a green lane marked to designate bike-only travel (modified existing); an electric-powered city zip line could move along a system of cables installed throughout the city connected to other main transit systems (futuristic infrastructure).

5. Share Results

*Engineers present their work to colleagues to show how they solved a problem and learn new ideas from each other.*

Now it’s time for your students to write their essay—the perfect “vehicle” for sharing their ideas with a panel of judges and kids across the country. Review with students the [Essay Outline](#) and [Rubric](#), which describes the sections judges will be evaluating. Remind students that the essay should be no longer than 1,000 words, and they should cite at least three sources of information. Students should use a variety of sources of information, such as interviews with experts, reference books, periodicals, and Web sites. (NOTE: Wikipedia is not accepted as a source of research.)

For additional tips about researching and writing the essay, view the “Writing the Essay” video and read essays from past winners. Both are available at [www.futurecity.org](http://www.futurecity.org).

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**Take Action Today: Safe Routes to School Program**

Did you know in 1969, about half of all students walked or biked to school? Today over half of all children get to school by car and one-quarter arrive on a school bus. The Safe Routes to School program (SRTS) strives to get more kids walking and biking to school again. If your school has a SRTS program, get involved. If your school doesn’t have a SRTS program, consider starting one. Find more information at [www.saferoutesinfo.org](http://www.saferoutesinfo.org/).
Check Progress

As students develop their essays, invite them to reflect on the process and evaluate their solutions (this process will help prepare them for the judges’ questions). Point out interesting ideas, creative thinking, and effective teamwork. Here are some questions to help guide discussion.

- What research has been helpful in understanding transportation issues and designing your solution?
- Where did you get inspiration for your solution?
- What are the intended benefits of your solution?
- What trade-offs come with your solution?
- How has the design process been helpful to you?
- What have you learned about yourself and your teammates during this process?
- What have you learned about engineering that you didn’t know before?

Research Essay Rubric—Have students review the rubric on pages 28–29 and evaluate their Essay using the same questions the judges do.

Competition Checklist

- Include the name of your city on each page of your Research Essay. Remember, your future city name needs to remain consistent throughout the competition.
- Place the word count at the end of the essay. The word count does not include the title and reference list, but does include captions of graphics and illustrations. A maximum of four graphics/illustrations are allowed.
- Complete the Research Essay Form. You can find this form on page 30 or download the writeable PDF at www.futurecity.org. Please remember the educator or the mentor must sign the form to attest to its accuracy.
- Use a variety of sources of information for research, such as interviews with experts, reference books, newspaper and magazine articles, and Web sites (Wikipedia is not accepted). Be sure to attach a list of at least three sources and use the Modern Language Association (MLA) format. Go to www.futurecity.org to download a MLA reference template.
- Make a copy of the Essay Form, Research Essay, and Reference List to keep with your records.
- Upload your Research Essay and Research Essay Form to www.futurecity.org. An email with upload instructions will be sent to you shortly before the submission due date.

Find your region’s submission deadlines at www.futurecity.org. Click on Find My Region and view the online calendar.

“The competition has given me confidence and the knowledge that as a girl, I can contribute just as much as the boys on the team.”

Rachel L., Texas Student Team Member
Competition Scoring

Teams can earn up to 60 points for their Research Essay. Make sure students have thoroughly covered the five categories to maximize points:

<table>
<thead>
<tr>
<th>Category</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define the Problem</td>
<td>6</td>
</tr>
<tr>
<td>Specs and Solution</td>
<td>15</td>
</tr>
<tr>
<td>Understand Engineering Roles</td>
<td>6</td>
</tr>
<tr>
<td>Judge Assessment of Solution</td>
<td>15</td>
</tr>
<tr>
<td>Writing Skills</td>
<td>18</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>60</strong></td>
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</tbody>
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Scoring Deductions

- **5 points**  Late work is accepted but with a slight penalty.
- **2 points**  A missing or incomplete Research Essay Form.
- **10 points** 10 points will be deducted for exceeding the 1,000 word count limit.

Resources

Use these online and print resources to help students launch their own research.

**WEBSITES:**

- **Engineering Go For It (transportation)**
  [http://students.egfi-k12.org/category/explore-engineering/transportation-explore-engineering](http://students.egfi-k12.org/category/explore-engineering/transportation-explore-engineering)
  Review articles that describe innovative transportation ideas.

- **IBM's The Smarter City**
  Click on “Traffic” and “Rail” for brief videos about smart transportation solutions.

- **NSF’s Green Revolution**
  Learn about electric cars and MIT’s city car.

- **StreetFilms**
  [www.streetfilms.org](http://www.streetfilms.org)
  View short educational films about sustainable transportation. Search under categories such as Bicycles, Cars & Parking, Transit, and Traffic Calming.

- **Sustainable Cities: Transport**
  Click on the “Transport” theme and read cases describing what cities around the world are doing to solve transportation problems.

- **Sustainable Cities Institute: Transportation**
  [www.sustainablecitiesinstitute.org/view/page.basic/class/tag.topic/transportation](http://www.sustainablecitiesinstitute.org/view/page.basic/class/tag.topic/transportation)
  Explore alternative fuels, bike paths, ride share, traffic calming and other ways to create sustainable transportation systems.

“I learned that engineers play a big role in the production of a city.”

—Caroline Z., Chicago Student Team Member
BOOKS:

• **Green Transportation** (World Book, 2009)
  Examine different modes of transportation (cars, trains, buses, etc.) and ways to reduce their environmental impact.

  Explore land, water, and air travel and related careers that focus on making transportation more eco-friendly.

• **The Future of Transportation** by Lori Dittmer (Creative Education, 2013).
  Learn about the history of transportation and future developments in safety, efficiency, and fuels.

• **Traveling Green** by Jacqueline A. Ball (Bearport Publishing, 2010).
  Find out about different types of sustainable travel.

**Internet Word Search Suggestions**

- Autonomous Vehicles
- Bike
- Car share
- Complete Streets
- Connected Vehicles
- Future of urban transportation
- Intelligent cars
- Intelligent transportation
- Intelligent transportation systems
- Mass transit
- Public transportation
- Smart cars
- Smart growth
- Sustainable city
- Sustainable transportation
- Urban transportation
- Vehicle to infrastructure
- Vehicle to vehicle

**Field Trip Ideas**

Visit local organizations or interview people in transportation careers.

- Your local Department of Transportation (Google “dot + name of your city or state”)
- University or college that has experts in the field
- Businesses and organizations that develop transportation solutions such as:
  - American Planning Association (APA)
  - Smart growth and sustainability-oriented organizations
  - Traffic operations/management centers
  - Any large highway and transit design engineering firms