



# IGNITE MY FUTURE

## LESSON TITLE

# Transportation Tech

*Guiding Question: Why should we continue to explore?*

## Ignite Curiosity

### SUBJECTS

Science  
Engineering  
English/Language Arts

### COMPUTATIONAL THINKING PRACTICE

Collaborating  
Around Computing

### COMPUTATIONAL THINKING STRATEGY

Build Models

### MATERIALS

Computers with Internet access (this activity can be modified to incorporate physical modeling if computers are not accessible)

[School Transit Report student capture sheet](#)

[TinkerCAD Beginnings student capture sheet](#)

Paper and pencils

- How do you get to school every day?
- Have you ever ridden in a school bus? How would you redesign a school bus to make it more comfortable or efficient?
- What transportation challenges do you think we'll face in the future? How can computers help us solve them?

In this lesson, students will use the computational thinking strategy of building models to ideate two modifications to a common school bus. One of their modifications must improve a rider's experience on his or her way to and from school. The other modification must make the school bus more efficient in dense urban settings. In **THINK**, students will act as transportation engineers who work for a busy school district. The school district has been using school buses to transport its many students to school, but students are complaining that the busses are old and uncomfortable. In addition, teachers are also noticing that students are coming in late more often because busses are getting stuck in traffic and breaking down. The school district desperately needs a new transportation solution. Students will examine the specifications of a current school bus and identify strengths and weaknesses in the design. In **SOLVE**, students will work in teams to devise two suggested modifications to the school bus that address the city's criteria of improving rider comfort and increasing efficiency. In **CREATE**, students will continue their work in teams to build a CA model of school bus that demonstrates their modifications. In **CONNECT**, students will discuss how imagination drives research that leads to technological innovations and learn more about related career fields, such as city planning, transportation engineering, and automated vehicle operators.

Students will be able to:

- **Apply** a collaborative approach to designing a transportation vehicle,
- **Evaluate** and modify the design of a transportation vehicle, and
- **Create** a CAD model of a school transit vehicle that adheres to predefined parameters.



## Students will act as transportation engineers challenged to modify an existing design for a vehicle to transport students to school.

**1 Read** the following scenario to students:  
*Imagine you are a transportation engineer who works for a busy school district. The school district has been using school busses to transport its many students to school, but students are complaining that the busses are old and uncomfortable. In addition, teachers are noticing that students are coming in late more often because busses are getting stuck in traffic and breaking down. The school district desperately needs a new transportation solution, and it is looking to you for help. Your task is to build a digital model of a school bus that demonstrates two updates in the design—one that improves the bus riders' experience and one that increases the school bus's efficiency. Let's see what you come up with!*

**2 Discuss** current trends in transportation.

**Teacher Note:** If classroom computer access is available, access the following links to demonstrate current trends to students. If there is no computer access, a class discussion can introduce students to the concepts. Class discussion could include some of the following information:

- Tata Consultancy Services has launched an initiative in Belfort, France, called [Smart City Technology](#) to enhance urban transportation.
- The [Hyperloop](#) developed in California is a form of high-speed transportation that uses vacuum tunnels through which pods can move.
- One form transportation from the movie 2001: A Space Odyssey was turned into a model. The [Moon Bus](#) transported goods and people. It operated from rocket motors and thrust power.
- [Tesla](#) produces electric cars in Palo Alto, California.
- Japan is breaking speed records with its [Maglev](#), a train that travels by magnetic levitation.

Challenge students to consider the benefits and drawbacks of these transportation methods. Ask students to think about which transportation trends might provide ideal solutions for their design challenge of improving efficiency and comfort in a busy city.

**3 Divide** students into four groups and distribute one computer to each group (or assign groups desktop computers). Direct students to [this CAD model of a school bus available on the CAD library Thingiverse](#).

**4 Distribute** the [Transportation Report](#) student capture sheet for students to use as they work through the Design Process.

Students will build their report for the school transit vehicle based on the school bus model.

Encourage students to research requirements school buses must meet, such as safety requirements, to ensure their designs include important information. Students must include at least two supporting science or technical sources in their report.

- Suggested technology to help with science and technical text sources:
  - [Pew Research Center](#) can provide information on alternative energy and school trends.
  - [Data.gov](#) can provide information to help build the Futures Report. Possible searches: school buses, alternative energy, or transportation.



Students' reports should include the following information, with each student in the group taking the lead on one of the questions below:

- How many students can the vehicle transport?
- What type of safety issues would you need to consider?
- What other protocols and facts would you need to consider?
- What is your proposed rider experience modification?
- What is your proposed efficiency modification?

Reconvene the class for a summarizing discussion. Ask students why they think CAD modeling is a useful way to solve this design problem. How would the experience be different if they had to build models with actual materials? When it comes to vehicles, we have to test them to know they are safe for drivers and passengers. How can building computer models make this a safe and efficient process? How do they think the transportation vehicles of the future are being tested?



## Students will use the computational thinking strategy of building models to tweak and refine existing engineering designs in CAD to suit an intended purpose.

**Teacher Note:** It is suggested that you create an account and run through the tutorials listed on the [TinkerCAD Beginnings](#) student capture sheet so you can assist students as needed. In addition, click the Features tab and review the tutorial video to become familiar with this web-based tool. There is other information on this tab that can help you learn TinkerCAD.

- 1 Ensure** that students remain in their home groups. Distribute the [TinkerCAD Beginnings](#) student capture sheet to each student. Allow students time to navigate the tutorials and website, providing assistance as needed.
- 2 When students have acclimated** to TinkerCAD, check for understanding by visiting each group and ensuring that they have successfully uploaded the school bus model into their Thingiverse project page.
- 3 Provide** groups with time to add their two suggested modifications to the CAD design.
- 4 When students are nearing completion**, reconvene the class and ask students to describe their CAD design process. Did mistakes happen as they were building? If so, how did they fix them? What was easier than they expected? What was harder?



**Students will iterate their designs by regrouping into different teams and adding one of the modifications from their home group design into the design of their new group.**

- 1 With students in their home groups,** have each student count off by numbers 1 through 4. Instruct students that they are going to move into a new group, but they are to leave their computer with their CAD model in its current place.
- 2 Have all 1s gather together, all 2s gather together, and so on,** making sure computers remain in place. While there will be some students who end up in their original location, the goal is to make it so that a majority of students are sitting at a pod with a computer model they did not work on.
- 3 In their new groups,** students must discuss the other modifications they made to the school bus design in their original groups and decide on one more modification to add to the CAD model in front of them. One member of the group will be responsible for taking notes on the decision-making process the group uses to select its new modification.
- 4 When the group has decided,** instruct them to add their agreed-upon modification to the CAD model in front of them.
- 5 Once the modifications have been added,** reconvene the class. Have the student who recorded the decision-making process report out to the class on how the group decided on its modification.
- 6 When all groups have reported,** ask students the following critical-thinking questions:
  - Was it easier or harder than you thought to agree on a new modification?
  - Did you have trouble adding your new modification to the model? Why or why not?
  - How would this process be different if you were using physical materials instead of computer models?
  - What are some other scenarios in which computer models can help us test solutions?



## Select one of the strategies listed below to help students answer these questions:

- How do this problem and solution connect to me?
- How do this problem and solution connect to real-world careers?
- How do this problem and solution connect to our world?

- 1 Write** the three questions on PowerPoint or flip chart slides and invite students to share out responses.
- 2 Display** pieces of chart paper around the room, each with one question written on it. Ask students to write down their ideas related to the questions on each sheet.
- 3 Assign** one of the questions to three different student groups to brainstorm or research, and then share out responses.
- 4 Invite** students to write down responses to each question on a sticky note, and collect them to create an affinity diagram of ideas.

### How does this connect to students?

Building models reduces the time needed in a design process. By working in teams, students learn from their peers and see a challenge from a variety of perspectives. When students work in teams, they support one another, which promotes success.

Building models and using a design process helps students think creatively, fosters their imagination, and enables them to practice problem-solving skills.

### How does this connect to careers?

**Engineers** in many fields use the design process to solve problems and design solutions.

**Materials Scientists** research and study the structures and properties of various materials. They frequently collaborate with other engineers in the design process.

**Architects, Drafters, and Interior Designers** use CAD programs to design and share blueprints and drawings.

**Industrial Designers** develop concepts for manufactured products such as vehicles. They use the design process and CAD to create new products.

### How does this connect to our world?

Advancements in society often come from collaborative activities. A collaborative design process brings incremental changes that spur growth. For example, creating a new type of vehicle to reduce fuel use would involve engineers, materials scientists, industrial designers, tool and die workers, manufacturers, and scientists to test the prototype. Even consumers are part of the process because they buy and use the technology and provide feedback to improve new designs.

The ability to transfer concepts into drawings that can be shared, simulated, tested, and modified is required in many fields. This process of design allows us to choose the best initial idea, develop prototypes, and consider ideas before developing a solution.

# National Standards

## NEXT GENERATION SCIENCE STANDARDS

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>Engaging in Argument from Evidence</b></p> <ul style="list-style-type: none"> <li>Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2)</li> </ul>	<p><b>MS-ETS1-2 Engineering Design</b></p> <p>ETS1.B: Developing Possible Solutions</p> <ul style="list-style-type: none"> <li>A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4)</li> </ul> <p>ETS1.A: Defining and Delimiting Engineering Problems</p> <ul style="list-style-type: none"> <li>The more precisely a design task’s criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1- 1)</li> </ul>	<p><b>Influence of Science, Engineering, and Technology on Society and the Natural World</b></p> <ul style="list-style-type: none"> <li>The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)</li> </ul> <p><b>Systems and System Models</b></p> <ul style="list-style-type: none"> <li>Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.</li> </ul>

## National Standards

### COMMON CORE STATE STANDARDS CONNECTIONS

- [CCSS.ELA-LITERACY.RST.6-8.1](#): Cite specific evidence to support analysis of science and technical texts.
- [CCSS.ELA-LITERACY.RST.6-8.7](#): Integrate quantitative or technical information expressed in words in a text with a version of information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- [CCSS.ELA-LITERACY.WHST.6-8.9](#): Draw evidence from informational texts to support analysis, reflection, and research. (MS-ETS1-2)

### Integration of Knowledge and Ideas:

- [CCSS.ELA-LITERACY.RST.6-8.7](#) Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- [CCSS.ELA-LITERACY.RST.6-8.9](#) Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

### Comprehension and Collaboration:

- [CCSS.ELA-LITERACY.SL.8.1](#) Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.

### K-12 COMPUTER SCIENCE FRAMEWORK

#### Practice 2. Collaborating Around Computing

Collaborative computing is the process of performing a computational task by working in pairs and on teams. Because it involves asking for the contributions and feedback of others, effective collaboration can lead to better outcomes than working independently. Collaboration requires individuals to navigate and incorporate diverse perspectives, conflicting ideas, disparate skills, and distinct personalities. Students should use collaborative tools to effectively work together and to create complex artifacts.

#### Works Cited:

<https://www.citylab.com/transportation/2014/10/the-future-of-transportation-is-not-all-flying-cars/381333/>

## School Transit Report

**Team Members:**

**The purpose of this report is to:**

**Background Research (topics and results):**

**Design Parameters (requirements for the final vehicle):**

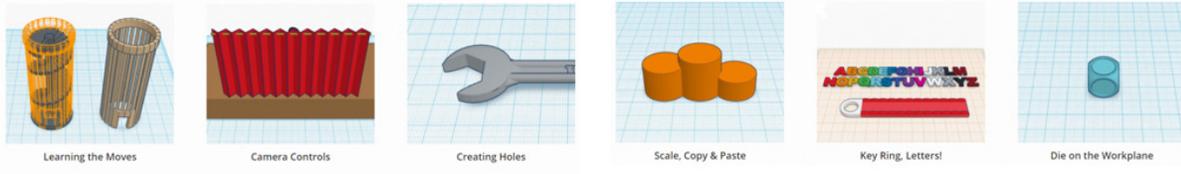
**First Drafting:**

**Testing and Redesign:**

**Final Recommendation:**

## TinkerCAD Beginnings

- 1 Create** a free account.
- 2 Run** through the tutorials if needed.
- 3**



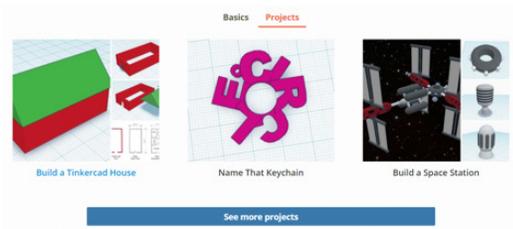
- 4 Click** on **Learn** in the menu bar.



- 5 Click** on **Projects**.



- 6 Choose** which project you want to begin your school transit vehicle by clicking on the image. You can find more choices if you click on **See more projects**.



- 7 Scroll down** to the bottom of the page and run through the lessons as needed, or click on the last lesson to modify the drawing.