TATA CONSULTANCY SERVICES | Discovery EDUCATION

IGNITE MY FUTURE

THINK SOLVE CREATE CONNECT

LESSON TITLE

Transportation Tech

Guiding Question: Why should we continue to explore?

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

Ignite Curiosity

- 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 buses are old and uncomfortable. In addition, teachers are also noticing that students are coming in late more often because buses 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 CAD 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.

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IGNITEMYFUTURE

THINK SOLVE CREATE CONNECT

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 buses to transport its many students to school, but students are complaining that the buses are old and uncomfortable. In addition, teachers are noticing that students are coming in late more often because buses 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 being developed in Canada 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. Canada used to have a Maglev as well a long time ago!

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 to 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:
  - Transport Canada can provide information on school bus regulation and safety
  - Provincial/Territorial School bus associations can provide information to help build our knowledge about school bus safety and operations at a more local level.
  - Ever thought a school bus could be a show on wheels? This community of Metis musicians prove you can!

Find more easy-to-implement resources to integrate computational thinking practices into your classroom by visiting **ignitemyfutureinschool.ca**

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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?

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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 on TinkerCAD so you can assist students as needed.

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. Alternatively, you can share this video of creating a school bus using the program.

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?

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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?

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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.

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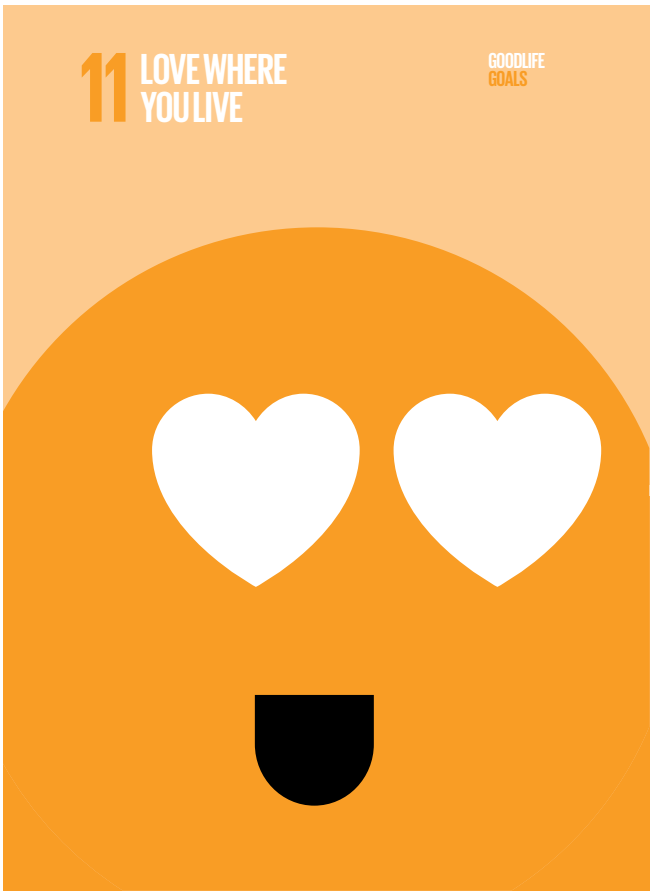
Curriculum Connections

UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS

11 SUSTAINABLE CITIES AND COMMUNITIES

"For the goals to be reached, everyone needs to do their part: governments, the private sector, civil society and **people like you**."
–The United Nations

"The Sustainable Development Goals are the blueprint for a better future. And together we can reach them. By following the Good Life Goals, we can all help make tomorrow better than today. Let's do this! #GoodLifeGoals"



Source:
[The Good Life Goals by Futerra Sustainability Communications Ltd and 10-Year Framework of Programmes on Sustainable Lifestyles and Education Programme is licenced under CC BY-ND 4.0.]

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Global Competencies

CMEC (Council of Ministers of Education, Canada) Pan-Canadian Global Competencies Descriptions

Highlighted sections apply to this lesson

Global Competency	Definition	Student Descriptors
Collaboration	Collaboration involves the interplay of the cognitive (including thinking and reasoning), interpersonal, and intrapersonal competencies necessary to participate effectively and ethically in teams. Ever-increasing versatility and depth of skill are applied across diverse situations, roles, groups, and perspectives in order to co-construct knowledge, meaning, and content, and learn from, and with, others in physical and virtual environments.	Students participate in teams by establishing positive and respectful relationships, developing trust and acting co-operatively and with integrity. Students learn from and contribute to the learning of others by co-constructing knowledge, meaning, and content. Students assume various roles on the team, respect a diversity of perspectives, and address disagreements and manage conflict in a sensitive and constructive manner. Students network with a variety of communities/groups and use an array of technology appropriately to work with others.
Communication	Communication involves receiving and expressing meaning (e.g., reading and writing, viewing and creating, listening and speaking) in different contexts and with different audiences and purposes. Effective communication increasingly involves understanding both local and global perspectives, societal and cultural contexts, and adapting and changing using a variety of media appropriately, responsibly, safely, and with regard to one's digital footprint.	Students communicate effectively in different contexts in oral and written form in French and/or English through a variety of media. Students communicate using the appropriate digital tools and create a positive digital footprint. Students ask effective questions to acquire knowledge, listen to understand all points of view, voice their own opinions, and advocate for ideas. Students gain knowledge about a variety of languages and understand the cultural importance of language.

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Global Competencies cont.

Highlighted sections apply to this lesson

Global Competency	Definition	Student Descriptors
Global Citizenship and Sustainability	Global citizenship and sustainability involve reflecting on diverse worldviews and perspectives and understanding and addressing ecological, social, and economic issues that are crucial to living in a contemporary, connected, interdependent, and sustainable world. It also includes the acquisition of knowledge, motivation, dispositions, and skills required for an ethos of engaged citizenship, with an appreciation for the diversity of people, perspectives, and the ability to envision and work toward a better and more sustainable future for all.	Students understand the ecological, economic, and social forces, their interconnectedness, and how they affect individuals, societies, and countries. Students take actions and responsible decisions that support quality of life for all, now and in the future. Students recognize discrimination and promote principles of equity, human rights, and democratic participation. Students understand Indigenous traditions and knowledge and its place in Canada, learn from and with diverse people, develop cross-cultural understanding, and understand the forces that affect individuals, societies, and nations. Students engage in local, national, and global initiatives to make a positive difference. Students contribute to society and to the culture of local, national, global, and virtual communities in a responsible, inclusive, accountable, sustainable, and ethical manner. Students as citizens participate in networks in a safe and socially responsible manner.

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Global Competencies cont.

Highlighted sections apply to this lesson

Global Competency	Definition	Student Descriptors
Critical Thinking and Problem Solving	Critical thinking and problem solving involve addressing complex issues and problems by acquiring, processing, analysing, and interpreting information to make informed judgments and decisions. The capacity to engage in cognitive processes to understand and resolve problems includes the willingness to achieve one's potential as a constructive and reflective citizen. Learning is deepened when situated in meaningful, real-world, authentic experiences.	Students will solve meaningful, real-life, complex problems by taking concrete steps to address issues and design and manage projects. Students will engage in an inquiry process to solve problems as well as acquire, process, interpret, synthesize, and critically analyse information to make informed decisions (i.e., critical and digital literacy). Students will see patterns, make connections, and transfer what they have learned from one situation to another, including in real world applications. Students will construct, relate, and apply knowledge to all domains of life such as school, home, work, friends, and community. Students will analyze the functions and interconnections of social, economic, and ecological systems.
Innovation, Creativity and Entrepreneurship	Innovation, creativity, and entrepreneurship involve the ability to turn ideas into action to meet the needs of a community. The capacity to enhance concepts, ideas, or products to contribute new-to- the-world solutions to complex economic, social, and environmental problems involves leadership, taking risks, independent/unconventional thinking and experimenting with new strategies, techniques, or perspectives, through inquiry research. Entrepreneurial mindsets and skills involve a focus on building and scaling an idea sustainably.	Students formulate and express insightful questions and opinions to generate novel ideas. Students contribute solutions to complex economic, social, and environmental problems or to meet a need in a community in a number of ways including; enhancing concepts, ideas, or products through a creative process, taking risks in their thinking and creating, making discoveries through inquiry research, and by hypothesizing and experimenting with new strategies or techniques. Students demonstrate leadership, initiative, imagination, creativity, spontaneity, and ingenuity in a range of creative processes and motivate others with an ethical entrepreneurial spirit.

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Global Competencies cont.

Highlighted sections apply to this lesson

Global Competency	Definition	Student Descriptors
Learning to learn and to be self-directed and self-aware	Learning to learn and to be self-directed and self-aware, means: becoming aware and demonstrating agency in one's process of learning, including the development of dispositions that support motivation, perseverance, resilience, and self-regulation. Belief in one's ability to learn (growth mindset), combined with strategies for planning, monitoring and reflecting on one's past, present, and future goals, potential actions and strategies, and results. Self-reflection and thinking about thinking (metacognition) promote lifelong learning, adaptive capacity, well-being, and transfer of learning in an ever-changing world.	Students learn the process of learning (metacognition) (e.g., independence, goal-setting, motivation) and believe in their ability to learn and grow (growth mindset). Students self-regulate in order to become lifelong learners and reflect on their thinking, experience, values, and critical feedback to enhance their learning. They also monitor the progress of their own learning. Students develop their identity in the Canadian context (e.g., origin and diversity) and consider their connection to the environment. They cultivate emotional intelligence to understand themselves and others. They take the past into account to understand the present and approach the future. Students develop personal, educational, and career goals and persevere to overcome challenges to reach these goals. They adapt to change and show resilience to adversity. Students manage various aspects of their lives: physical, emotional (relationships, self-awareness), spiritual, and mental well-being.

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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:

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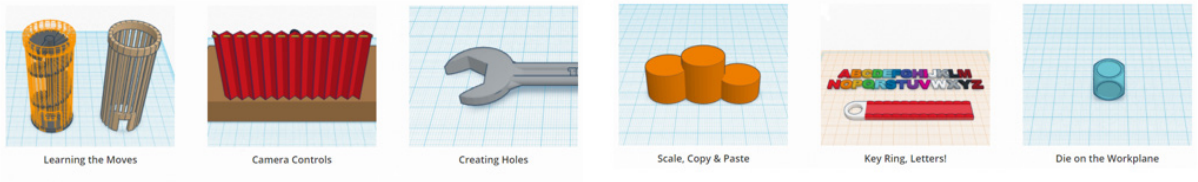
TinkerCAD Beginnings

1 **Create** a free account.

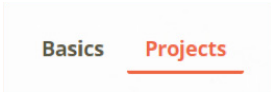
2 **Run** through the tutorials if needed.

3

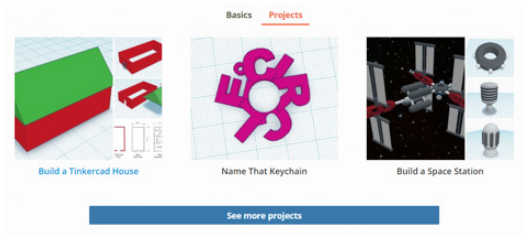


4 **Click** on ***Learn*** in the menu bar.

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.

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