
Grade 7: Exploration and Application of Innovative Technologies - Structural Strength and Stability







Experience 3: Culmination Exploration

[Long Range Plan: Grade 7 Model 1](#)


Overview:

This series of activities is meant to serve as a collection of activities to be used during Innovative Technologies in Grade 7 Long Range Plans - Model 1. The purpose of this collection is to provide a creative way to introduce the concepts that will be studied throughout the unit through an initial exploration, an example of concept exploration that could be used in the midst of the unit, as well as a culminating activity for this unit.

Overview of learning experiences – why these activities	<p>Experience 3: Culmination Experience</p> <p>In this experience, students will demonstrate and apply their conceptual understanding, by carrying out a detailed engineering design, model construction, and reflection to demonstrate their learning from this unit. Students will consider purpose, design, cost, cultural and environmental impacts, and connections to skilled trades. In completing this task, students will be addressing the following guiding questions:</p> <p>How do we use structures to meet a need within a community?</p> <p>How is a structure designed to withstand the forces of nature (wind, snowfall weight, earthquakes, etc)?</p> <p>How can urban planners and engineers make cities and human settlements inclusive, safe, resilient and sustainable?</p> <p>How does the engineering design process help engineers create new and innovative solutions to problems?</p>
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	<p>These activities are meant to be used with Long Range Plan: Grade 7 Model 1 – April and May units related to Innovative Technology.</p>
<p>Prior Knowledge / Prior Skill Set(s)</p>	<p>Carrying out a building challenge requires careful planning with regard to the organization of materials, and anticipating student questions.</p> <p>A focus throughout this task is to have students engage in effective problem-solving, perseverance, and collaboration.</p>
<p>Strand A - STEM Investigation and Communication Skills</p>	<p> A1.4 follow established health and safety procedures during science and technology investigations, including wearing appropriate protective equipment and clothing and safely using tools, instruments, and materials (demonstrate understanding of hand tool, machine, and D&T room safety protocols).</p> <p> A1.2 Explore how the center of gravity affects a structure's ability to withstand a force applied to it.</p> <p> A3 Research how structural design can impact SDGs 9 (Industry, Innovation, and Infrastructure) and 11 (Sustainable Cities and Communities)</p> <p> A1.3 Design, build and evaluate a structure that is designed to serve a specific purpose, employing the engineering design process Ex: designing and building a chair from recycled materials to meet the needs of a specific user</p> <p> A1.3 Conduct a design thinking challenge (e.g. students must build the tallest tower using marshmallows and spaghetti). Add in a requirement (e.g. tower must support one textbook on top) and have students redesign with this in mind.</p> <p> A3 Research various engineering career pathways, noting the STEM skills that would be leveraged in each Let's Talk Science - Exploring Engineering Careers</p>

<p>Overview / Big Ideas/Fundamental Concepts</p>	<p>This experience is meant to be a culmination of the unit. During this experience, students will identify a community need, local interest, or culturally relevant type of structure that they will identify, research, and construct a model of. Upon completion of their construction, students will prepare a presentation in which they will communicate their understanding of key concepts and considerations used to decide upon their type of structure, and how key concepts of this unit needed to be applied during the construction process.</p>
<p>Learning Goals / Success Criteria</p>	<p>Students will be identifying a community need, local connection, or culturally relevant structure, and engaging in the engineering design process in order to complete this task.</p> <p>As this is a culminating activity, success criteria should be developed with the students with regard to:</p> <p>Structure Choice</p> <ul style="list-style-type: none"> ● reasoning and justification for the choice <p>Design:</p> <ul style="list-style-type: none"> ● detailed, labelled design ● consideration of forces in planning ● sustainability ● meets needs and purpose <p>Construction:</p> <ul style="list-style-type: none"> ● consideration of structure type, and appropriate selection of materials. <p>Reflection/Presentation:</p> <ul style="list-style-type: none"> ● How well the students are able to communicate all of their considerations and demonstrate an understanding of key concepts for this unit. <p>This experience has a focus on the engineering design process, and also makes effective use of hands-on experiential learning. Opportunities to make connections to skilled trades, emerging technologies, and contributions to science and technology.</p>

 <p>A1.5, A3</p>	<p>Additionally, students will be identifying and highlighting related skilled trades and innovative technology related to their projects.</p> <p>Consolidation (Varied, Depending Upon Presentations) During this portion of this experience, students will be sharing their presentations and demonstrating their understanding of all of the concepts related to this process.</p> <p>Inform students they should be prepared to respond to questions about their process, and that they should also be prepared to ask questions of others. Asking questions will be considered when assessing student understanding.</p>
<p>Science and Technology Expectations</p>	<p>Strand B - Life Systems Overall Expectations B1. Relating Science and Technology to Our Changing World assess the impact of human activities and technologies on the environment, and analyse ways to mitigate negative impacts and contribute to environmental sustainability</p> <p>Specific Expectations B1.1 assess the impact of various technologies on the environment B1.2 assess the effectiveness of various ways of mitigating the negative and enhancing the positive impact of human activities on the environment</p> <p>Strand D - Structures and Mechanisms Overall Expectations D1. Relating Science and Technology to Our Changing World analyse personal, social, economic, and environmental factors that should be considered when designing and building structures D2. Exploring and Understanding Concepts demonstrate an understanding of the relationship between structural forms and the forces acting on them</p> <p>Specific Expectations D1.1 evaluate environmental, social, and economic factors that should be considered when designing and building structures to meet specific needs for individuals and communities</p>

	<p>D2.1 classify structures as solid structures, frame structures, or shell structures</p> <p>D2.3 identify the magnitude, direction, point of application, and plane of application of the forces applied to a structure</p> <p>D2.4 describe the role of symmetry in structures, and identify instances of symmetry in various structures</p> <p>D2.5 describe factors that can cause a structure to fail</p> <p>D2.6 identify the factors that determine the suitability of materials for use in manufacturing a product or constructing a structure</p> <p>D2.7 describe methods engineers and other professionals use to assess, improve, and maintain the safety of structures</p>
<p>Science and Technology Vocabulary</p>	<ul style="list-style-type: none"> ● internal and external forces ● live load, dead load ● Structure ● Stability ● Structural Integrity ● Sustainability ● Engineering Design Process ● Prototype ● Initiating and Planning ● Analyzing ● Interpreting
<p>Equipment and Materials</p>	<p>To be determined by student plans. Students will need access to technology for research and planning. Anticipating potential design and builds, items from this collection of lists would be of benefit.</p> <ul style="list-style-type: none"> ● Cardboard ● Wooden dowels ● Aluminum Foil ● Construction paper ● Tissue paper ● String ● Rubber bands ● Wire or pipe cleaners ● Popsicle sticks ● Paper cups ● Plastic/Paper Straws ● Screen ● Fabric

	<ul style="list-style-type: none"> ● String ● Glue (wood glue, and/or hot glue) ● Paperclips ● Paper ● Cardboard ● Cardboard Tubes (paper towels/toilet paper) <p>This list is a compilation of materials from several design challenges, that are referenced in the resource section.</p>
<p>Timeline and Preparation</p>	<p>To prepare for this task, it would be beneficial to begin collecting the materials listed above prior to beginning this experience, throughout the unit of study. Sending notice home to collect found materials would be of benefit in order to repurpose materials that may be seen as waste.</p> <p>The time to complete this experience will vary greatly, depending upon the depth that the teacher chooses to take students, whether it can be considered integrated with other subjects - and whether those subjects are taught by the same teacher.</p>
<p>Safety Considerations</p>	<p>When students are constructing their models, and carrying out tests for them, they need to be trained with any equipment or tools they will use, and to be sure to follow safety protocols for any materials being used during construction or testing phases.</p> <p>Refer to these safety resources:</p> <p>Safety in Elementary Science and Technology (STAO)</p> <p>Safe Activity Foundations in Education Document (SAFEdoc) Science and Technology, Grades 1-8 (OCTE)</p> <p>Ontario Curriculum Program Planning – Health and Safety</p>
<p>Opportunities For Assessment</p>	<p>Assessment Of Learning Opportunity: As this is an end of the unit experience, the majority of the assessment is an assessment of learning. Teachers can make use</p>

	<p>of this rubric in order to evaluate student learning for this task (see Appendix B: Design Challenge Assessment Rubric)</p> <p>Ensure that students review the extensive list of considerations found on the handout for this experience (see Appendix A: Addressing a Community Need Through the Engineering Design Process).</p>
<p>Instructional Strategies and Adaptability</p>	<p>Students should be encouraged to explore cultural connections and the impact on their local community that their proposals will have.</p> <p>For further reference, review the following Ministry of Education resources related to Human Rights, Equity, and Inclusive Education as well as Culturally Responsive and Relevant Pedagogy. These considerations should be shared with students during their brainstorming process, and as they make decisions on what project they plan to complete.</p> <p>https://www.dcp.edu.gov.on.ca/en/program-planning/considerations-for-program-planning/human-rights-equity-and-inclusive-education</p> <p>This activity will require students to engage in all of the transferable skills outlined in this Ministry of Education resource: https://www.dcp.edu.gov.on.ca/en/program-planning/transferable-skills</p>
<p>Additional Supporting Resources</p>	<p>The following resources, available in multiple languages could be used to help guide students in completing a design and build experience. Some aspects may be worth sharing with the students or previewing as a teacher in order to help guide students in their process.</p> <p>Build a Dome Build A Big Wheel Bridge Building Tall Tower Challenge</p>
<p>Cross-Curricular Opportunities</p>	<p>Mathematics Data Literacy manage, analyse, and use data to make convincing arguments and</p>

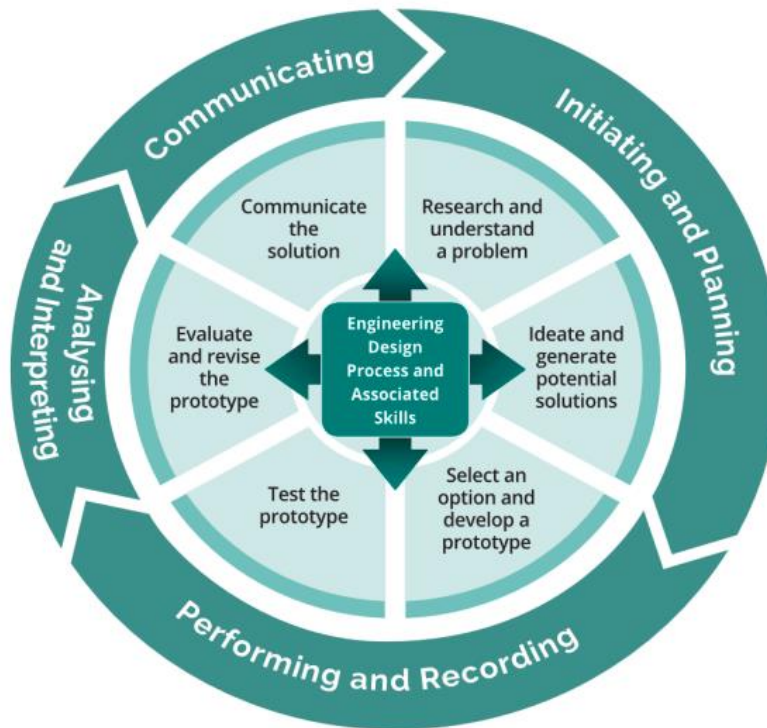
	<p>informed decisions, in various contexts drawn from real life</p> <p>Language</p> <p>Oral Communication</p> <ol style="list-style-type: none"> 1. listen in order to understand and respond appropriately in a variety of situations for a variety of purposes; 2. use speaking skills and strategies appropriately to communicate with different audiences for a variety of purposes <p>Writing</p> <ol style="list-style-type: none"> 1. generate, gather, and organize ideas and information to write for an intended purpose and audience; 2. draft and revise their writing, using a variety of informational, literary, and graphic forms and stylistic elements appropriate for the purpose and audience; 3. use editing, proofreading, and publishing skills and strategies, and knowledge of language conventions, to correct errors, refine expression, and present their work effectively <p>Media Literacy</p> <ol style="list-style-type: none"> 3. create a variety of media texts for different purposes and audiences, using appropriate forms, conventions, and techniques <p>Visual Arts</p> <p>Creating and Presenting: apply the creative process to produce art works in a variety of traditional two- and three-dimensional forms, as well as multimedia art works, that communicate feelings, ideas, and understandings, using elements, principles, and techniques of visual arts as well as current media technologies</p>
<p>Future Opportunities / Next Steps</p>	<p>Through completing this experience, students will gain valuable insight and development of their abilities related to the engineering design process.</p> <p>Should students complete their experience early, they can extend their learning by exploring more related technologies or skilled trades, acting as a facilitator, and consulting with peers to help them with their construction or testing process. They can also assist with documenting their peers' processes.</p>

Appendix A: Addressing a Community Need Through The Engineering Design Process

Addressing a Community Need Through the Engineering Design Process

This project will serve as an opportunity for you to demonstrate your understanding of many concepts that have been explored over the course of the past several weeks. Here, you will find a summary of the steps in the process, and some key items to consider and include as you work to complete this assignment.

The Engineering Design Process Diagram



Throughout this process, you will be following these general steps or phases. For each phase, there are some guidelines and checklists,

While this is presented as a clean set of phases to work through, it may be necessary to revisit earlier phases as you work through the process.

Phase 1: Initiating and Planning

What kind of structure is needed in your community to meet the needs of your local population, and what are the important factors to consider when designing the structure?

Important Considerations:

- What information do you need to gather before making a selection?
- What considerations related to sustainability and health and safety need to be addressed?
- Who are the different users of the facility?

Ideate and Generate Solutions:

- How does the way it is used affect the structure?
- Where will it be located?
- Will the location need to be prepared before construction?
- What are the internal and external forces acting upon the structure?
- How will the structure support live and dead loads?

Phase 2: Performing and Recording

Prototype Development

- Plan your design, with detailed labels and explanations to address the internal and external forces you expect your structure to have to withstand.
- With your design, share how you considered economic, environmental, ethical, and health and safety concerns.
- Share with your teacher, the type and amount of materials you will need to create a model of your prototype.
- Use your design to create a model of your structure.
- Document your prototype by taking pictures to be shared in your presentation.
- Obtain feedback on your prototype from peers and your teacher.
- Select a skilled trade that you would like to highlight that would be an important part of creating your structure. Be prepared to share how their contributions will help your project.
- Identify any innovative technology that you would include in your structure.

Prototype Testing

- Develop tests to determine whether your structure model will be successful (be prepared to share how you decided to test your prototype)
- Conduct tests, and document the process with images and/or video (to be shared in your presentation).
- Record observations

Phase 3: Analyzing and Interpreting

- Analyze the results from testing to determine what changes need to be made to your prototype.
- Consider whether there are possible improvements to be made to your design.
- Refine the prototype to develop a finished product.

Phase 4: Communicating

- Develop a Presentation in which you will share the details of your entire research and design process, as outlined above.
- Additionally, include details related to the following prompts:
 - Which aspects of the engineering design process were the most challenging, and how did you overcome them?
 - What did you learn about the engineering design process while taking part in this experience?

Appendix B: Design Challenge Assessment Rubric

Design Challenge Assessment Rubric

	Level 1	Level 2	Level 3	Level 4
Knowledge and Understanding: uses structures and mechanisms terminology	Demonstrates limited knowledge of content	Demonstrates some knowledge of content	Demonstrates considerable knowledge of content	Demonstrates thorough knowledge of content
Thinking and Investigation: gathers and records data from the testing of the prototype	Uses processing skills and strategies with limited effectiveness	Uses processing skills and strategies with some effectiveness	Uses processing skills and strategies with considerable effectiveness	Uses processing skills and strategies with a high degree of effectiveness
Thinking and Investigation: analyzes, interprets and acts on the data from the prototype	Uses critical/creative thinking processes, skills and strategies with limited effectiveness	Uses critical/creative thinking processes, skills and strategies with some effectiveness	Uses critical/creative thinking processes, skills and strategies with considerable effectiveness	Uses critical/creative thinking processes, skills and strategies with a high degree of effectiveness
Communication: presents the prototype, results of testing and interpretations of the investigation to peers	Expresses and organizes ideas and information with limited effectiveness	Expresses and organizes ideas and information with some effectiveness	Expresses and organizes ideas and information with considerable effectiveness	Expresses and organizes ideas and information with a high degree of effectiveness
Application: the final product proposes a practical solution to the problem of water sustainability as a problem in our changing world	Proposes courses of practical action with limited effectiveness	Proposes courses of practical action with some effectiveness	Proposes courses of practical action with considerable effectiveness	Proposes courses of practical action with a high degree of effectiveness

