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

Experience 1: Introductory 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	**Experience 1:** Introductory Exploration In this experience, students will review the engineering design process, and be presented with a challenge to construct a dome with a set of materials. Students will help to devise a test to determine the effectiveness of their dome structure and finally reflect upon their experiences. These activities are meant to be used with Long Range Plan: Grade 7 Model 1 – April and May units related to Innovative Technology.
Prior Knowledge / Prior Skill Set(s)	Carrying out a building challenge requires careful planning with regard to the organization of materials and anticipating student questions. This activity is meant to serve as an introduction, so little to no prior content knowledge is required. However, students should be familiar with routines and expectations for group work, and be willing to work with a variety of peers. The focus throughout this task is to have students engage in effective problem-solving, perseverance, and collaboration.

Strand A - STEM Investigation and Communication Skills	**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). **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
Overview / Big Ideas/Fundamental Concepts	In Experience 1, students will be presented with a variety of materials and given a goal to construct a dome. The teacher will present students with a given set of materials and explain the challenge to the students. This will be a low-tech, collaborative construction activity with minimal content delivery. The main purpose of this activity is to introduce the theme of the unit through this initial construction challenge, and for students to observe, reflect, and gain some initial insight into some concepts that will be studied throughout these units. Following the construction activity, the goal will be to reflect upon the processes involved and introduce the unit's theme. Some guiding questions to engage students in conversation: ● What challenges did your team face? ● What did you notice when structures failed? ○ What kinds of things happened? (Describe - did it squish, pull apart, etc) ● What types of construction seemed to work well? ● How would you make improvements to your design? Additionally, some time will be spent previewing the theme of the upcoming unit to give a sense of the kinds of topics students will be learning about: ● Structural Strength and Stability ● Internal Forces ● Related Innovative Technology ● Sustainability ● Forces of Nature

Learning Goals / Success Criteria	Students will be introduced to the theme of the unit through a model dome construction challenge. Students will be designing, constructing, testing, and reflecting upon the process. **Learning Goal:** I can design and construct a structure based on a set of criteria and provided materials. Students will assist with the development of success criteria for this activity, as well as in developing an appropriate and effective testing procedure for their structures. This Experience will focus on STEM Skills and Connections, the Engineering Design Process, and Hands-on, Experiential Learning
Learning Experience **A1.3**	The teacher will present materials and the challenge to students. The time frame for design and construction should be 1-2 classes of 60 minutes, with testing and debriefing taking place during an additional class. For this task, it is recommended students have minimal computer technology or devices, and simply use problem-solving and exploration to help them create designs. **Minds On (15 minutes)** Upon providing students with the challenge document and reviewing "The Challenge" and "Materials", the teacher should spend some time co-developing "The Test" with the students (see Appendix A: Construction Challenge A - Dome Structure). The teacher may wish to present this slide deck in order to help share the details with the class. **Developing the Test - Think-Pair-Share** Tell students that you will be testing your structures to see who has made the most 'structurally sound' dome, and they need to come up with a procedure to test the structures. This is a good time to discuss the importance of **purpose** in design and construction.

	Students should be given some time to think on their own, and then pair up and share their ideas for effective testing with a partner. Partners will then compare their ideas and prepare to share. Record and briefly discuss or ask students to ask clarifying questions about tests. Once all pairs have submitted a suggestion, the class will vote to decide upon the method and type of testing that will occur on their structures. **Action (Remainder of this Class)** **Design** Provide students with an opportunity to make individual sketches, with labeled materials to plan for their construction. If possible, having teams working on vertical non-permanent surfaces (VNPS) would allow for teams to easily collaborate and make changes to their plans as they build. **Construct** Provide students with time to construct their model dome. While this is taking place, take time to visit teams to make observations and have conversations to determine background knowledge, collaboration highlights, and problem-solving skills. An excellent resource to provide a great deal of background and support for this construction activity is the Design a Dome Activity on the Try Engineering Website. **Consolidation (1 Class)** Opportunities to extend, reflect, and put students' ideas together, and how this will impact their future explorations **Test** During the first part of the second class, students will take turns testing their structures to determine how structurally sound they were - based upon their co-constructed success criteria.

	It is important to have students make observations while testing takes place, taking notes on how structures failed. ● Did the structure have stress points? ● Did certain materials fail in a particular way? ● Describe how it failed. If possible, it would be beneficial for the tests to be filmed and perhaps replayed in slow motion to watch how the structure failed during the debriefing, or for use later in the unit - when studying forces. **Reflection/Extension** Have students write reflection journal entries to respond to some or all of the following guiding questions: ● How would you change your design if you were to do this challenge again? ● Which aspects of design and construction were the most challenging? Most enjoyable? ● What advice would you give to a classmate trying this for the first time? ● What aspects of the structures tested appeared to be the most helpful? Why? ● Which materials were the most valuable? Why? Close out this experience by giving a brief preview of some of the topics that will be covered throughout this unit: ● Structural Strength and Stability ● Internal Forces ● Related Innovative Technology ● Sustainability ● Forces of Nature Throughout this activity, students will have the opportunity to make use of STEM Skills as they take part in the Engineering Design Process through this Hands-On Experiential Learning Activity.
Science and Technology Expectations	**Strand D: Structures and Mechanisms** **D2.1** classify structures as solid structures, frame structures, or shell structures **D2.2** describe ways in which the center of gravity of a structure affects the structure's stability

	D2.4 describe the role of symmetry in structures, and identify instances of symmetry in various structures
Science and Technology Vocabulary	• Structure • Stability • Structural Integrity • Sustainability • Engineering
Equipment and Materials	• 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 • Balloon (can not be left inflated and intact on final construction, but may be used during construction)
Timeline and Preparation	**Gather Materials** Using the list of materials as a guide, gather materials within the school, or suggest donations or found materials from home. This will need to be prepared in advance, depending upon the immediate availability in your school. **Carry Out Experience** This experience should take 1-2 classes, as outlined in the notes above.
Safety Considerations	Refer to these safety resources: Safety in Elementary Science and Technology (STAO) Safe Activity Foundations in Education Document (SAFEdoc) Science and Technology, Grades 1-8 (OCTE)

	Ontario Curriculum Program Planning – Health and Safety Students should follow lab safety rules, and ensure care is taken with materials in order to ensure items are kept neat and organized - without clutter. Additionally, structures should be carefully stored in a manner that will not pose a risk of falling. While students are engaged in the design and construction process, the teacher should monitor the students and participate in conversations to promote problem-solving and productive use of class time. The students will work in small groups or pairs to execute their plans and construct their models, according to their specifications.
Opportunities For Assessment	**Assessment for Learning Opportunity:** Throughout the Design, Construction, and Testing Phases of this activity, teachers have opportunities to make anecdotal notes based on observations and conversations. These notes can help determine students' current level of ability - related to collaboration, problem-solving/perseverance, and background knowledge related to concepts that will be studied in this unit. This will help to inform future instructional goals. **Assessment As Learning Opportunity:** Providing feedback to students following this activity, will help students to identify strengths and next steps - and to set goals related to collaboration and perseverance. For further considerations regarding assessment, visit: https://www.dcp.edu.gov.on.ca/en/assessment-evaluation
Instructional Strategies and Adaptability	During the debrief sessions, teachers may want to discuss with students about cultural connections they may have with regard to structures of significance, and to identify the features they have that are shared with each other, and whether those features are for aesthetics or whether they add to structural integrity.

	This experience will provide an opportunity for students to build skills related to, but not limited to ● critical thinking and problem-solving; ● innovation, creativity, and entrepreneurship; ● collaboration, and; ● communication
Additional Supporting Resources	The main inspiration for this activity, and a source of additional, detailed background information can be found at: https://tryengineering.org/teacher/design-dome/#materials-preparation Other resources referred to in this experience include: Dome Construction Challenge Slide Deck Appendix A: Construction Challenge A - Dome Structure
Cross-Curricular Opportunities	Language ● Oral communication: ○ reflect on and identify their strengths as listeners and speakers, areas for improvement, and the strategies they found most helpful in oral communication situations. Visual Arts ● 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;

Appendix A: Construction Challenge A - Dome Structure

Construction Challenge A - Dome Structure

The Challenge:

Your team will need to make use of only provided materials in order to construct a dome structure that is at least 20 cm tall (measured from the inside of the top directly to the base), and a base diameter of at least 25 cm in all directions.

Your dome structure must be a frame structure in the shape of a dome, with no additional supports on the inside of the dome. Additionally, your dome must be free-standing, and not attached to the surface (Your frame will simply sit on a surface, and needs to be able to be moved to the testing surface without including a floor).

Materials Available:

- 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
- *Balloon (can not be left inflated and intact on final construction, but may be used during construction).*