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| **Lesson 1 : Exploring Tunnels & Writing Equations** | **Unit #: 1** | **Lesson #: 1** | **Activity #: 1** |
| **Activity 1.1.1: Introduction to Tunnels & Development of Essential Questions** |

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| **Estimated Lesson Duration:** | **4-5 days** |
| **Estimated Activity Duration:** | **2-3 days** |

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| **Setting:** | **classroom** |

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| **Activity Objectives:**   * **Brainstorm what students know about tunnels** * **Research possible careers related to building tunnels** * **Develop the Big Idea & Essential Questions** * **Student input about a Challenge** |

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| **Activity Guiding Questions:**   * **What possible shapes are tunnels?** * **What is a good tunnel?** * **What do I know about tunnels?** * **What did I see in the videos about tunnels?** * **What is the Big Idea?** * **What are some Essential Questions?** * **What type of Challenge can we do?** |

| **Next Generation Science Standards (NGSS)** | |
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| **Science and Engineering Practices (Check all that apply)** | **Crosscutting Concepts (Check all that apply)** |
| ☒ Asking questions (for science) and defining problems (for engineering) | ☐ Patterns |
| ☐ Developing and using models | ☐ Cause and effect |
| ☒ Planning and carrying out investigations | ☐ Scale, proportion, and quantity |
| ☐ Analyzing and interpreting data | ☐ Systems and system models |
| ☐ Using mathematics and computational thinking | ☐ Energy and matter: Flows, cycles, and conservation |
| ☐ Constructing explanations (for science) and designing solutions (for engineering) | ☒ Structure and function. |
| ☐ Engaging in argument from evidence | ☐ Stability and change. |
| ☒ Obtaining, evaluating, and communicating information |  |

| **Ohio’s Learning Standards for Science (OLS)** |
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| **Expectations for Learning - Cognitive Demands (Check all that apply)** |
| ☐ Designing Technological/Engineering Solutions Using Science concepts **(T)** |
| ☐ Demonstrating Science Knowledge **(D)** |
| ☐ Interpreting and Communicating Science Concepts **(C)** |
| ☐ Recalling Accurate Science **(R)** |

| **Ohio’s Learning Standards for Math (OLS) and/or**  **Common Core State Standards -- Mathematics (CCSS)** | |
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| **Standards for Mathematical Practice (Check all that apply)** | |
| ☒ Make sense of problems and persevere in solving them | ☐ Useappropriate tools strategically |
| ☐ Reason abstractly and quantitatively | ☐ Attendto precision |
| ☒ Construct viable arguments and critique the reasoning of others | ☒ Look for and make use of structure |
| ☐ Model with mathematics | ☐ Look for and express regularity in repeated reasoning |

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| **Unit Academic Standards (NGSS, OLS and/or CCSS):**   * F-IF.8 Write a function * F-BF.1 Build a function that models a relationship between 2 quantities * G-MG.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder.) |

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| **Materials**: (Link Handouts, Power Points, Resources, Websites, Supplies)   * **Brainstorm recording document – each group contributes 2-3 facts** * **Career Worksheet 1.1.1a** * **Template for reporting Guiding Questions** |

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| **Teacher Advance Preparation:**   * **Upload 4-5 pre-unit videos of real tunnels to Canvas platform with reflection assignments** * **Prepare pre-test over writing/using equations to model real world situations.** |

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| **Activity Procedures:**   * **Before the unit begins, students will be assigned 4-5 short videos about various types of real tunnels. They will access them from Canvas and complete a short reflection on-line.** * **On the first day of Activity 1, students will brainstorm in groups of 4 and list things they know about tunnels, using small whiteboards. Each group will share 2-3 things from their list for a class compilation of tunnel knowledge.** * **Using laptops, students will research various careers related to building tunnels, hopefully including civil engineer, geologist, project management, construction, etc. They will choose one career and submit their group findings on a template. (see worksheet 1.1.1a)** * **Students will identify the Big Idea.** * **On day 2, students will be introduced to Challenge Based Learning and propose Essential Questions and ideas for a Challenge.** * **Students will take a pre-test over writing/using equations to model real world situations.** * **On day 3, students will discuss the Essential Question and devise Guiding Questions to identify what they will need to learn to complete the Challenge. Each group will submit their list of questions. At this point, students might discuss the pre-test as they write Guiding Questions.** * **The Challenge will be introduced and discussed.** |

**Formative Assessments:** Link the items in the Activities that will be used as formative assessments.

* Video reflections
* Brainstorm lists
* Career template
* Pre-test
* Guiding questions

**Summative Assessments:** These are optional; there may be summative assessments at the end of a set of Activities or only at the end of the entire Unit.

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| **Differentiation:** Describe how you modified parts of the Lesson to support the needs of different learners. Refer to Activity Template for details.  Some students did not have access to the Internet or technology at home. I provided time in class for some of the video watching and for some of the research. I also had time after school for students to come and do some of this work. For some students with life issues, I allowed them to do a shorter list of videos so they could be successful. I did this after talking to them about their ability to complete the work in a timely manner. I.e. one student had a job that took much of his time after school. The student had to work to help with family expenses. Students submitted most of their work on-line but I accepted some written papers or photographs from those with technology problems. |

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| **Reflection:** Reflect upon the successes and shortcomings of the lesson.  Most of the lesson went well. The students were used to working in small group cooperatively in my class. They were able to brainstorm and talk together about tunnels and careers and other topics. One thing I did change was including the “make a duck” LEGO activity as an introduction to the Engineering Design Process in this lesson. (Each student had a bag of 7 LEGO bricks. Students decided what characteristics a duck needs. Then they made their own “duck” and shared in their groups. It worked well because when we started to engineering part of the unit, I could refer back to the ducks. This helped students know what kinds of questions to ask about tunnels. |