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| **Lesson Title : The Challenge** | **Unit #:1** | **Lesson #:2** | **Activity #:4** |
| **Activity Title: The Challenge** |

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| **Estimated Lesson Duration:** | **12 days** |
| **Estimated Activity Duration:** | **6 days** |

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| **Setting:** | **After all content has been taught. Classroom and at home to build.** |

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| **Activity Objectives:** |

I can construct a vehicle using the engineering design method.

I can calculate the speed of the vehicle.

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| **Activity Guiding Questions:** |

1. What is a vehicle?
2. What can I use to create the vehicle? Why can I only use the items set forth in the constraints?
3. How will I measure distance and time?
4. Can I use more than one force to move my vehicle?

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| **Next Generation Science Standards (NGSS)** | |
| **Science and Engineering Practices (Check all that apply)** | **Crosscutting Concepts (Check all that apply)** |
| X 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 | X 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 |  |

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

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| **Common Core State Standards -- Mathematics (CCSS)** | |
| **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, ONLS and/or CCSS):** |

**OHIO 5 PS 4 The amount of change in movement of an object is based on the mass of the object and the amount of force related.**

**NGSS 3-5 PS2 A Force and Motion**

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| **Materials**: |

Worksheet

5 meters sticks for track

2 Stopwatches

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| **Teacher Advance Preparation: review worksheet with students** |

Pass out the worksheet for the project.

<https://docs.google.com/viewer?a=v&pid=sites&srcid=c2FzZWFzLm9yZ3xtZWxpc3NhLWEtZG9sbC0yMDE1fGd4OjE0M2U0MGM0Njk2ZGIyZmI>

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| **Activity procedures:** |

Task: Create a vehicle that can travel a distance of at least 5m using one of the forces from the unit.

Constraints are as follows:

· The vehicle cannot be pushed or pulled to begin movement.

· It must be an original design. No store purchased toys or kits may be used.

· It must travel a distance of at least 5m for three consecutive trials.

· No vinegar and water, mementos and coke, gas- propane or derby cars.

· Must use items found in your house.

1. Review the rubric for grading with the students.
2. Day one work on brainstorming items to use for project and picking a force and sketching first design.
3. Day two brainstorm possible problems with design by sharing ideas at table. List possible problems and solutions from your group. Sketch second design based on changes. Homework bring in items to make your design.
4. Day three and four Design and test. Make any necessary changes.
5. Day five compete using the rubric for scoring.
6. Day six using stop watches and meter sticks measure the speed of the cars. Let students create super cars based on using each other designs and parts as a table.

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

Students will be filling out the worksheet and a data table of their initial trials.

**Summative Assessments:**

**Scoring Rubric:**

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| Rubric Score | Criteria |
| 90-100 | * Vehicle travels 5m at least once out of the five trials. * Vehicle travels 5m three out of five trials. * Vehicle meets all of the constraints/original design * Paper work completed in detail, with no missing information, well thought out. * Able to explain how force moved vehicle. |
| 80-89 | Meets 3 of 5 criteria |
| 70-79 | Meets 2 of 5 criteria |
| 60-69 | Meets 1 of 5 criteria |

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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. |

The students worked in peer groups to support diverse learners.

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| **Reflection:** Reflect upon the successes and shortcomings of the lesson. |

The challenge was only completed by the Tutorial and Enrichment group, 27 students. The challenge could not be incorporated into the lessons for science due to district time constraints on finishing a unit. A solution to this problem would be to do the challenge earlier in the unit, right after the mass and speed lab. The challenge could be conduct in less time if the supplies were provided. The students could be provided with the choice of rubber bands, magnets, balloons, cardboard, tires and straws.

The students did enjoy the challenge. They fully embraced designing and redesigning their vehicles. (scan an hyperlink in the student work). Students created vehicles using magnetism, either attached to a car and pulled along or in a piece of PVC pipe and rolled along. The used wind/air to propel light vehicles, ramps to use gravity and sling shots to use spring force. Each group created a uniquely different solution that was successful. All vehicles after redesign were able to travel 5 meters. The students also successfully completed the paperwork with sketches of designs and redesigns.

The students in the Tutorial and Enrichment class have been able to carry the knowledge of the Engineering Design Model to other projects. The enjoyed this challenges so much that they ask for challenges with every unit. They have begun to state with their first design that it is ok if it does not work it is their first idea they will just get together and redesign. They like to try many ideas out and not just hurry to finish, they work on making a good solution to the problem. This is evidence that students learn from challenges yet the time to do the challenges with all the students is something I need to problem solve.