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| **Name:** John J. D’Alessandro | **Contact Info:** jdalessandro@stxavier.org | **Date:** 06/27/2016 |

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| **Lesson Title :** The Amazing Race | **Unit #:**  **1** | **Lesson #:**  **2** | **Activity #:**  **3** |
| **Activity Title:** The Amazing Race Happens |

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| **Estimated Lesson Duration:** | 3-4 Days (in class… 2-3 weeks overall) |
| **Estimated Activity Duration:** | 2-3 Days (in class… 2-3 weeks overall) |

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| **Setting:** | Room 1556 |

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| **Activity Objectives:** |

Students will video-tape their project and post it. They will have a rubric to score their devices with success based on having solutions to both tasks. They will have multiple lessons on circuits throughout the term. They will also have to write a short comparison of their solutions to the other teams.

The students will actually run their cars in a time-trial for the “Amazing Race” competition, which includes a few events. Everyone will be able to charge their device, “race” and “truck-pull,” but they will get different results. They will have documented multiple trials at home. Given time, we will have an early set of in-school trials, also.

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| **Activity Guiding Questions:** |

1. Is it better to have a device that can store more energy?
2. Is it better to have one that can charge faster?
3. What is the trade-off between the two?
4. What is the limiting factor on timing with the varioius stages… the car’s use of energy or the storage device’s power output?

| **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):** |

From *Course Outcomes for Regular Physics*, November 19, 2015.

4. Defend the use of 1st principles, assumptions, formulae, and graphs to accurately predict the outcome of a described physical phenomenon.

8. Analyze the current and future behavior of physical systems using the idea of kinetic and potential energy as well as the laws of conservation of energy and conservation of momentum.

10. Calculate the current, voltage and/or resistance in an electrical circuit.

11. Design and build electrical circuits using a single power source and resistors.

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| **Materials**: (Link Handouts, Power Points, Resources, Websites, Supplies) |

* Carolina STEM Challenge®: Solar Car Design Kit, Item # 18096, 8 per kit so need 3-4 kits at $145 each.
* Supercapacitors, capacitors, and small, rechargeable Li-Ion batteries (TBD)
* Students will have to supply wires and connecting methods
* Power supplies to charge devices
* Racing, pulling, and ramp-climbing tasks (TBD)

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| **Teacher Advance Preparation:** |

Make sure the energy and power requirements of the tasks meet the capacity of the devices to make this not too easy nor difficult. Acquire parts. Perform other Activities first. Present information on electric potential, current, and resistance.

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| **Activity Procedures:** |

Students need to submit first iteration attempts of their work at home on video at least a week before trials are run in school.

On the day(s) of timed trial, have the students run their trials one group at a time while timing the trial runs. Actually take the best of three runs, to accommodate flaws in construction quality and vagaries of apparatus. Also, have the students peer-review using the rubric, as they will be using the evaluation for the next lesson.

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

Students will submit a video of early, home-test events that will be scored with a rubric.

Students have to overcome challenge; make certain partners have worked in the group and understand underpinnings of their work. They will score each other’s work with rubrics and they themselves will receive a score based on a rubric.

**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.

Score the device and car with a rubric (TBD)

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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. |

With this being a project experience, it allows for implicit differentiation. Make certain rubric allows students with challenges to excel yet has enticement for strongest students to push themselves.

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| **Reflection:** Reflect upon the successes and shortcomings of the lesson.  This is the big activity where almost everything comes to fruition. Their cars were, in general, very good. Along with their power supplies, every group had at least decent success. Some had excellent success, mastering the rubric. The main weakness was that most did not realize that batteries, once discharged completely, take a long time to recharge and do NOT get to maximum potential until well into charging time. This was a POWER limitation for their cars, and could have benefited from having multiple batteries in series… but few realized that.  The reports were less successful. Although I know that most groups took many videos and photos, those did not make it into their electronic portfolios! It was very frustrating to see the students not defend their excellent work. I will need to point this out to future classes. |