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Phase I – Research and Planning – Due Date: Midterm

1. Identify the “Big” concept to be covered by the engineering design challenge.

The “Big” concepts of the “Balloon Cart Project” adapted from the NSTA “Beyond the Egg Drop” book can be divided into the science and engineering expectations. For science, the challenge hones in on some themes in physics. The Balloon Cart Project covers Newton’s second & third laws, and how energy transfer and momentum are being affected. The engineering concepts include ways to reduce friction, mechanics of structure and endurance, and maintaining the stability of the direction.

2. Research appropriate learning standards associated with the topic.

Listed below are the Next Generation Science Standards for this project.

Performance expectation

HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

Science and Engineering Practices

- Developing and using models
- Using mathematics and computational thinking
- Obtaining, evaluating, and communicating information

Disciplinary Core Ideas

- PS3.A: Definitions of Energy
- ETS1.A: Delimitating Engineering Problems

Crosscutting Concepts

- Cause and effect
- Systems and system models
- Energy and matter

3. Identify and discuss the different types of problem solving and declarative/procedure knowledge needed.

Firstly, students must have some level physical properties such as kinetic energy, potential energy, velocity, and acceleration, however extensive knowledge is not needed because we will be discussing it. Some procedural knowledge includes the ability to measure object effectively. Some students may not have access to a yardstick, which may require a smaller ruler to measure the given distance the cart must travel. They must also know how to measure specifications of the balloon cart. This will result in able to record careful empirical data. If notes are incomplete, it can render the design process unsuccessful. A declarative knowledge students should have in order to perform the project is making connections between environmental factors that may affect the speed, distance, and direction of the balloon cart. Wind speed, friction, and material of the floor are possible factors impairing its performance.

4. Explore objectives and ancillary concepts/content covered by the project.

- Students will be able to (SWBAT) Explain their initial design of their cart by describing each part and its purpose.
- SWBAT test their carts to allow opportunities for reiterations.
- SWBAT explain Newton’s laws, momentum, and energy in their design.
- SWBAT discuss possible design through sketches and research.
- SWBAT measure cart distance, time travel, average speed, average kinetic energy.

Ancillary concepts

- Systems (Balloon, Wheel)
- Connection: Structural support, physics focus
- Simulation of a small-scale cars
- Solutions for effective wheels and materials

5. Identify possible activities.

- “Balloon Cart Project”
“Wind Tube Hovercraft”

6. Select the best activity for your classroom

“Balloon Cart Project”