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Lesson Plan, Pendulum PHET Lab
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BACKGROUND INFORMATION

This activity is designed for primarily 9th grade, as they are starting to develop the necessary conceptual skills. It is designed as an online exploration that can be done with or without direct teacher guidance. It can work well for small groups with a teacher floating around the classroom to provide suggestions and leading questions.

I have used it with some success in high school (10th -12th) physical science, but it is too basic for a regular high school physics course. It has some use as an introductory lab for a Gen-Ed course in General Physical Science at the college freshman level for non-science majors.

This was originally written as an Inquiry Lesson, but now that I more fully understand Carl Wenning's inquiry hierarchies I am beginning to have my doubts. With its emphasis on experimental design and simple relationships I would now classify it as more of a Discovery lesson. The version I have attached is modified and updated from the one I published in PHET in 2018.

LEARNING GOALS & OBJECTIVES Students develop their concept of the Law of Conservation of Mass while building a first concept of laws of thermodynamics.

SELECTED NEXTGEN STANDARDS

MS-PS1-2 Plan in investigation that provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object, and

MS-PS1-4 Construct and present arguments using evidence to support the claim that gravitational attractions are attractive and depend on the masses of the interacting objects.

HS-PS-2.1 Analyze data that support the claim that Newton's 2nd Law of Motion describes the mathematical relationship among the net force on a macroscopic object its mass and its acceleration.

LESSON PLAN

See two attachments – student version and teacher’s version (with answers to questions)

Learning Pathways – this lesson is designed to operate as a discovery learning lesson. However, with the proper leading questions from a trained teacher it can also function as an inquiry lesson. The difference would be that an inquiry lesson would be less teacher-directed and would include more of an experiment-development component. Fortunately the PHET program is strongly suited for student-directed virtual experiments.

5E Structure

Engagement – Teacher swings a simple pendulum while asking some basic rhetorical questions such as “what affects the period of the pendulum?” (defines period).

“Where does the swing show KE? PE?”

“Is there any conversion from KE to PE?”

“What force is causing the motion?”

“At what point in the swing is there the greatest KE?”

Exploration – students manipulate various variables on the PHET application to get a feel for the program. Questions 2 – 9.

Explanation – students analyze their data and develop their concepts while working on questions 10-14.

Elaboration – students now take a look at acceleration. They should already have an introductory idea of what acceleration is, and as they complete questions 25-19 they should be able to fine-tune these concepts.

Evaluation will be done throughout the exercise, formally as the students answer the questions and informally as the circulating teacher discusses the exercise with the small groups. More advanced groups can be asked higher-level critical thinking questions.

USE of NASA REFERENCES and RESOURCES

The resources page of our reading links to the PHET organization, where the application for this activity is found. The direct link is <https://phet.colorado.edu/en/simulation/pendulum-lab>