

Engineering design Project Phase 1 - Design an object to hit a target exploring propulsion

This activity will be explored with children between grade 1 and 4.

1. Big Concept:

The big concepts being explored here are energy and motion as well as how the amount of energy affects the motion of an object and how the design can affect the overall motion and distance an object travels. This explores kinetic and potential energy and motion of objects as well as measurement.

2. Learning Standards:

NGSS:

K-PS2-1 Motion and Stability: Forces and Interactions - Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

K-PS2 - 2 Motion and Stability: Forces and Interactions - Analyze Data to determine if a design solution works as intended to change the speed or direction of an object with a push or pull.

3-PS2-2 Motion and Stability: Forces and Interactions - Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

4-PS3-1 Energy: Use evidence to construct an explanation relating the speed of an object to the energy of that object.

4-PS3-4 Energy: Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

K-2-ETS1-1: Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

K-2-ETS1-2: Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

CCSS Math:

CCSS.MATH.CONTENT.1.MD.A.2 Express the length of an object as a whole number of length units, by laying multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps.

CCSS.MATH.CONTENT.1.MD.C.4 Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data

points, how many in each category, and how many more or less are in one category than in another.

CCSS.MATH.CONTENT.2.MD.A.1 Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.

CCSS.MATH.CONTENT.3.MD.B.4 Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters.

CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically.

Technology:

Standard 2: Students will develop an understanding of the core concepts of technology.

Standard 8: Students will develop an understanding of the attributes of design.

Standard 9: Students will develop an understanding of engineering design.

Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

3. Types of Problem Solving and Knowledge (Declarative/Procedural)

The activity to be explored can be a well structured or moderately structured problem depending on the students' problem solving abilities. Younger students may need more structure with the design and the materials and may not explore design changes such as adding weight to the nose of a rocket or using varied materials for the body and wheels of the car to have them move more effectively. Students will be able to use different materials and designs to work to solve the problem of creating a rocket that can reach a target or car that can travel a specific distance. Students that are more developed with problem solving strategies will be able to explore a more moderately structured problem where they have more freedom to choose materials to further develop and improve the efficacy of their designs. Students will need to have declarative knowledge of understanding what measurement is as far as length. They will also need to be able to discuss what happens when a push/pull is placed on an object. They will need to know how different features may affect the design such as weight, or the amount of air in a balloon. As students may not have a background with potential and kinetic energy, it will be important to discuss this and provide students with multiple examples of each. Procedural knowledge that is required is knowing how to read a measurement with a ruler/yardstick and how to launch the rocket.

4. Objectives and Ancillary concepts/content covered by the project

This activity also explores students' interpersonal skills as they will need to discuss their design ideas and analyze the successes and limitations of the rockets that they create. Students are also learning more about rockets and motion while connecting their designs to real world designs. They will also look at exploring cross cutting concepts of cause and effect and structure and function as they look at how the energy moves from one object to another and what happens when this occurs.

5. Possible Activities:

One possible activity is from the NASA/Design Squad On the Moon Guide. The [Launch It activity](#) is easy enough for my varied age group of students, but also allows for the challenges of adding additional parts to the design to affect the motion and velocity of the rocket.

Another possible activity from the Design Squad would be to [build a four wheeled car](#). This could be an extension of the Launch It activity as students would already have practice of the balloon and straw design with the Launch it activity and then could also extend to understand propulsion of a vehicle.

[Build and Launch a Foam Rocket](#) from Nasa's Jet Propulsion Laboratory looks at designing a rocket and determining how the materials/design help the rocket fly based on launching at different angles. This activity may be too challenging for younger students and they materials may be more difficult to gather.

6. Best Activity for the classroom

I plan to use the Launch It activity from On the Moon NASA/Design Squad as this activity will meet the needs of the varied ages of students in the class and also allow for students to explore different designs to help their rocket to be more accurate. If students move through this activity quickly, then the build a four wheeled car activity can be explored as an additional extension.

References

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