Toys - More Than Play Time

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Next Generation Science Standards

Grades 2-5 - Matter and its Interactions

2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

Engineering Design

Students who demonstrate understanding can:

3-5-ETS1-1.Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2.Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Grades 6-8 (Ages 11-14) Engineering Design

Students who demonstrate understanding can:

MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

Science and Engineering Practices

- Ask questions based on observations to find more information bout the natural and/or designed world(s).
- Ask questions about what would happen if a variable is changed.
- Develop a diagram or simple physical prototype to convey a proposed object, tool, or process.

Cross-cutting Concepts

- Substructures have shapes and parts that serve functions.
- Cause and effect relationships are routinely identified, tested, and used to explain change.

Principles and Standards for School Mathematics (ages 11 - 14) Measurement Standard

-Apply appropriate techniques, tools, and formulas to determine measurements.

- Solve simple problems involving rates and derived measurements for such attributes as velocity and density.

Challenge: Create a spinning top that spins for at least 10 seconds and within a 20 cm area.
Using the 5-E Model

Engage:
Share a variety of topics with students. Do not tell them what you are giving them.
Let the students play with the "tops" and talk about
What questions are generated? What makes a top? Can you make one that spins longer?
Use a KWL to determine characteristics of a spinning top. Use these characteristics to determine the best spinning top.

Explore:
How to make a top spin longer? Design a spinning top and explain the reasons for the design.
Provide materials for the students to construct their top.
Students will test their tops, collect data, and determine the effectiveness of their top.

Explain:
Students reveal their data and summarize the principles involved.
Students share their data with the class.

Extend/Elaborate:
Application of design in real-world designs (i.e. satellites, etc)

Evaluate:
Create a rubric.
Possible questions:

1. Did you succeed in creating a top that spun for at least 10 seconds within the 30 cm circle? If so, what was the maximum time it spun? If not, why did it fail?
2. Did you decide to revise your original design or request additional materials while in the construction phase? Why?
3. Did you negotiate any material trades with other teams? How did that process work for you?

Materials:
- sharpened pencils or pens
- toothpicks
- cds
- coffee stirrers

- marbles
- paper plates
- plastic lids
- pennies
- metal washers or tape
- string
- clay
- scissors
- stopwatches
- ruler

Resources:

Yeany, Bruce. (2006) “Can You Top This?” *If You Build It, They Will Learn*. NSTA Press.

Kemp, Andrew (2005). “Putting a Twist on Inquiry.” *Science Scope*, NSTA.

Ashbrook, Peggy (2011). “The Early Years: Objects in Motion.” *Science & Children*. NSTA.

Worch, Eric (2009). “The Great Top Challenge.” *Science Scope*, NSTA

Darling, Gerald (2012). “How Does Force Affect Motion?” *Science & Children*, NSTA