

ASSESSMENT

Vocabulary List

Center of gravity: center of the mass, or average location of the weight, of an object

Elliptical shape: a somewhat egg-shaped object

Force: strength or amount of influence on a body

Mass: a grouping of like substances

Acceleration: amount of change of speed over time in a certain direction

Angular momentum: change of position from a standstill on a particular spot to a spot up an axis from that original spot.

Physics: scientific exploration about matter, energy, motion, force

Conservation of Energy: assuming no interference from an outside source, the amount of energy existing in any one system does not increase or reduce. It is a constant.

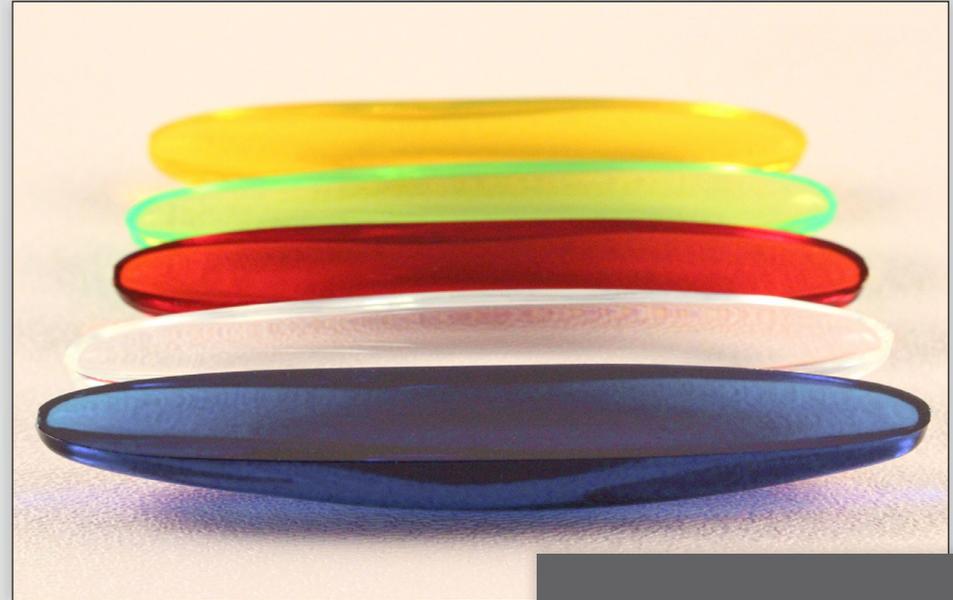
Newton's three laws of motion

- Items tend to keep doing what they are doing. If they are stopped, they stay stopped, and if they are moving, they will continue to move (also called the Law of Inertia.)
- Force is Mass multiplied by acceleration.
- For every action, there is an equal and opposite reaction.

Discovery Sheet Questions

- Write several phrases that describe the physical appearance of the rattleback.
- Describe the response of the rattleback to your push and release of one end.
- Describe what happened when you tried to spin the rattleback in the direction it didn't spin in question 2.
- Using your new vocabulary, explain which part of its physical appearance causes this strange response/movement. (Be ready to share with the class.)
- Newton's law of motion # _____ states:
 - The rattleback demonstrates this law by...
- What current technology might use the advantage of form to create a desired response that would make a task easier or possible?
 - (Would the rattleback shape be good for a canoe? A pair of rollerskates? Why, why not? Just to get you started.)

TEACHERS GUIDE



RATTLEBACKS
ITEM # 9222-23

ENERGY - MOTION

Rattlebacks are a great way to get students to understand the concept of center of gravity, and how we can use the natural tendencies of items to reduce the needed effort in a task. Try and spin them the opposite direction and they will rock from instability, which will stop their spin and reverse it.



Materials

- Rattlebacks (enough for one per group of two students)
- Student Handout (Vocabulary Sheet and Student discovery sheet)

Goals & Objectives

Students will:

- observe that form affects function, in this case involving gravitational force and Newton's laws of motion.
- explain the rattlebacks' phenomenon using the terms in the vocabulary handout.
- explain how this fact might assist in developing technology.

How does it work?

The Rattleback is flat on top and has an asymmetrical ellipsoidal bottom, which will spin on its axis in a preferred direction. If spun in the opposite direction, it becomes unstable, appears to rattle, and actually reverses its spin to the preferred direction. The specific alignment of the long axis of the ellipsoid in relation to the long axis of the flat top causes the directional preference.

In other words, they're not parallel so the rattleback is predisposed to spinning in one direction. Simply push down on one end of these colorful plastic rattlebacks and their offset center of gravity will set them spinning, but always in the same direction!

ACTIVITIES

- 1 Distribute rattlebacks, vocabulary handout in front of each pair of students. A Student discovery sheet should go to each student so that each student is held accountable to learn, even though the lab is shared amongst a pair.
- 4 Pairs should discuss what part of their description list is the cause of the responses. Conclusions following discussion should be written down. These should be shared aloud so the teacher can give guidance and feedback for accurate thinking.

- 2 Ask them to write a list of description regarding their physical appearance.



- 3 Let the teams push down and release one end of the rattleback and note the response.

Note

It is always best to DO an experiment ahead of time to be able to best present it to the class.



- 5 Students should then consider Newton's three laws of motion, choose one law that seems most relevant to the rattlebacks, and write how the rattlebacks demonstrate the law.

DISCUSSION

Enrichment Activities

Have students brainstorm and research what current technology might use the advantage of form to create a desired response that would make a task easier or possible. For less proficient students, this might be a bonus challenge.

STUDENT HANDOUT

Student Name: _____

Student Discovery Sheet

- 1 Write several phrases that describe the physical appearance of the rattleback.
 - 5 Newton's law of motion # _____ states:

The rattleback demonstrates this law by...
- 2 Describe the response of the rattleback to your push and release of one end.
- 3 Describe what happened when you tried to spin the rattleback in the direction it didn't spin in question 2.
- 4 Using your new vocabulary, explain which part of its physical appearance causes this strange response/movement. (Be ready to share with the class.)
- 6 What current technology might use the advantage of form to create a desired response that would make a task easier or possible?
(Would the rattleback shape be good for a canoe? A pair of rollerskates? Why, why not? Just to get you started.)



S T U D E N T
H A N D O U T 

Vocabulary List

- 1 Center of gravity
- 2 Elliptical shape
- 3 Force
- 4 Mass
- 5 Acceleration
- 6 Angular momentum
- 7 Physics
- 8 Conservation of Energy
- 9 Newton's three laws of motion

•

•

•

