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Curriculum topics:

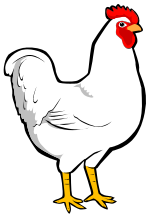
- Balance
- Center of Mass
- Characteristics of Life
- Inertia
- Motion

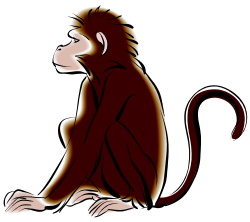
Subjects:
Physical Science, Life Science

Grade range: K – 8

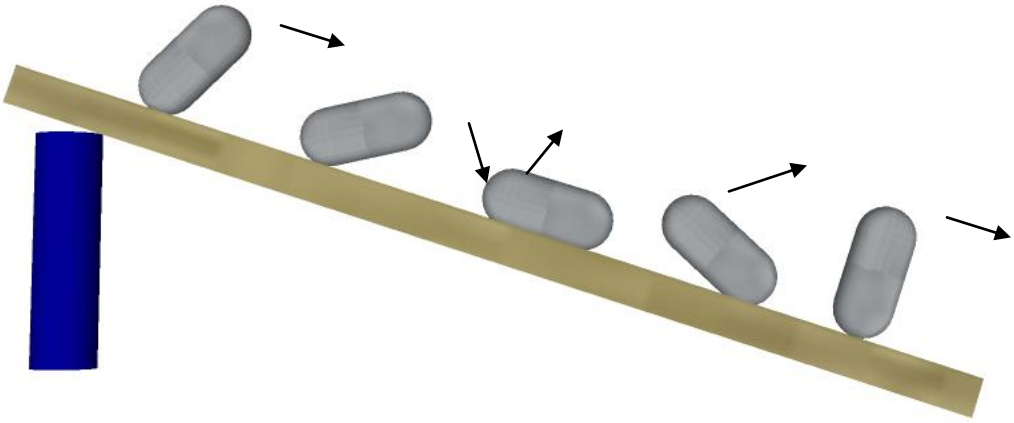
CRITTER CAPSULE

It moves! Is it alive?





Build student curiosity about motion, center of mass, and inertia with this fun activity! Use this activity as a tool to discuss the characteristics of living organisms. The reason for the capsule's tumbling motion is concealed by the foil which adds to its "mysterious" nature and provides an opportunity to practice observation and science process skills.



Who we are:

Resource Area for Teaching (RAFT) helps educators transform the learning experience through affordable "hands-on" activities that engage students and inspire the joy and discovery of learning.

For more ideas and to see RAFT Locations

www.raft.net/visit-raft-locations

http://www.raft.net/raft-idea?isid=679

Materials required

Per capsule:

- Capsule, plastic or equivalent, two-part, ~2.5 cm (~1”) diameter, ~5 cm (2”) long
- Steel ball or marble, ~15 mm to18 mm diameter
- Foil sheet, ~8.5 cm x 8 cm (~3 ¼" x 3")
- Plate, paper or plastic – when the plate is turned over, the rim creates a channel which is wider than the diameter of the capsule.

WARNING:

CHOKING HAZARD—Activity uses a marble and small parts. Not for children under 3 yrs.

How to build it

Note: If capsules are made of gelatin or other water-soluble material, keep moisture away from capsules.

1 Separate the two parts of the capsule. See figure 1.

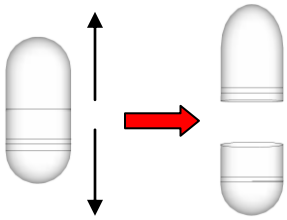


Figure 1

2 Enclose the steel ball or marble in the capsule. Push the capsule parts together securely. See figure 2.

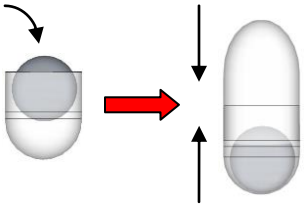
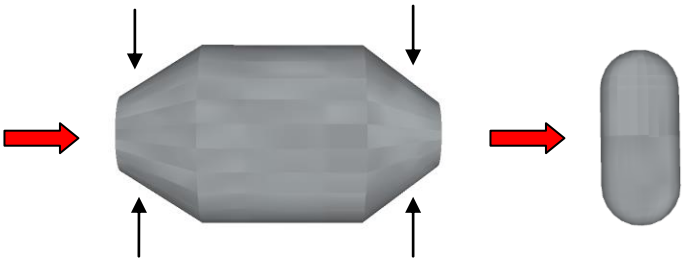


Figure 2

3 Wrap the foil around the capsule. Pinch the foil over the ends of the capsule, then carefully round the foil over each end. See figure 3.



Pinch the foil over the ends

Figure 3

Teaching Tip: The foil conceals the contents of the capsule. To preserve the capsule’s mysterious nature wrap the capsule with foil before the students observe it.

To do and notice

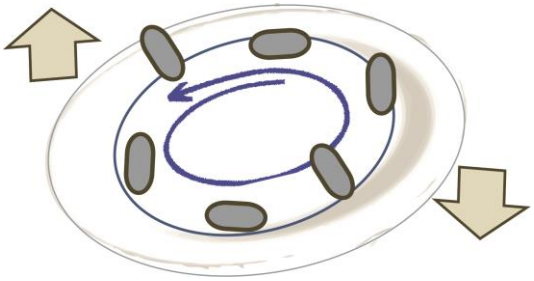
1 Place a capsule in the palm of the hand.

2 Tilt the hand back and forth and observe the motion of the capsule.

3 Hold the plate right side up and put the capsule onto the plate.

4 Tilt the plate back and forth and observe the motion of the capsule. Can the capsule be made to "travel" in a circle?

5 Turn the plate upside-down and put the capsule onto the plate's rim. Can the capsule be made to "travel" around the rim?



Wobble upside-down plate to get the 'Critter Capsule' to "walk" around the rim.

6 Place the capsule on an incline. If the capsule does not move give it a slight push or make the incline steeper. Observe the capsule's motion.

7 Form small groups and discuss how the motions of the capsule are similar and different from those of living organisms.

8 Develop criteria which could be use to decide if an object is alive. Test the criteria by thinking about a variety of familiar objects. Refine if necessary

Teaching Tip: Review the characteristics of living organisms with students prior to the activity, if needed.

The science behind the activity

Every object has a center of mass, which is the object's balance point. The balance point of the capsule changes as the ball moves inside it. The irregular motion of the capsule comes from the fact the ball has much more mass than the capsule. Small movements of the marble will cause large movements of the capsule as a new balance point is created for the two combined items. Since mass is a measure of an object's inertia (its resistance to change in its motion), a shift in the center of mass causes a change in the moment of inertia for the combined items, which the observer sees as the wobbling and jerking motion of the capsule.

Students often have difficulty defining "life". By definition, living organisms have systems for metabolism, growth, reproduction, and response to stimuli. Although the capsules appear to move on their own and respond to stimuli, they do not exhibit any of the other characteristics that would classify them as "alive".

A real-world example of an unusual living organism is a virus, which responds to stimuli and moves but cannot reproduce on its own or even with other viruses. Viruses are the exception to the typical criteria used to define living things. As biologists learn more about such anomalies they refine the criteria to include these unusual organisms.

Curriculum Standards:

Life cycles
(Next Generation Science Standards: Grade 3, Life Science, 1-1)

Forces & Motion
(Next Generation Science Standards: Grade K, Physical Science 2-1 & 2-2; Grade 3, Physical Science 2-1 & 2-2; Middle School, Physical Science 2-2)

Gravity
(Next Generation Science Standards: Grade 5, Physical Science 2-1)

Science & Engineering Practices
(Next Generation Science Standards: Grades K – 8)

Additional standards at: http://www.raft.net/raft-idea?isid=679

Learn more

- Predict the capsule's path of movement on various surfaces.
- Determine the average number of "tumbles" the capsule makes moving downhill for both the marble and steel ball versions.
- Load capsules with 2 marbles or steel balls and observe motion.
- Toss capsule into the air and observe whether the motion is similar to that seen on a flat surface. (Be sure to catch it!)
- Experiment with using the capsule without the foil wrap. How does its behavior change?

Extend this activity with the following suggestions:

- Have students make large replicas of the capsules with items like tennis ball cans and billiard balls.
- Help students design an experiment that relates motion of the capsules with motion of a specific organism.
- Create a multi-level track for the capsule to follow using pipe insulation, right angle molding, or equivalent.

Related activities:

Force Meter -
http://www.raft.net/ideas/Force Meter.pdf

Gravity Defying Frog -
http://www.raft.net/ideas/Gravity Defying Frog.pdf

Inertia Ball -
http://www.raft.net/ideas/Inertia Ball.pdf

Where is the Life?
http://www.raft.net/ideas/Where is the Life.pdf

Resources

Visit www.raft.net/raft-idea?isid=679 for "how-to" video demos & more ideas!

See these websites for more information on the following topics:

- **Characteristics of life** – http://infohost.nmt.edu/~klathrop/7characterisitcs_of_life.htm
- **Motion-related activities** – http://sprott.physics.wisc.edu/demobook/chapter1.htm
- **Videos on Balanced and unbalanced forces from the Khan Academy:** https://www.khanacademy.org/science/physics/forces-newtons-laws/balanced-unbalanced-forces/v/balanced-and-unbalanced-forces

Acknowledgements:

Based on a classroom activity developed by Glen Kimoto.