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The Science of Curling

Lesson Objective & Summary

Objective: Students will understand the principle of "friction," and will be able to observe how friction affects different surfaces, as well as identify ways that friction is found in daily life.

Summary: Students will watch the video on "The Science of Curling." Students will then conduct a variety of simple experiments to see firsthand how friction affects an object going across a surface, and how the reduction of friction causes the object to glide more smoothly. Students will discuss and identify where friction is found in daily life.

GRADE LEVEL:
Upper Elementary

DURATION:
1-2 Lessons

SUBJECTS:
Science

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Standards & Benchmarks

From the National Science Education Standards, Grades K-4

Science as Inquiry (Standard A)

- Students will be able to plan and conduct a simple experiment (1b)
- Students will be able to employ simple equipment and tools to gather data and extend the senses (1c)
- Students can communicate investigations and explanations (1e)

Physical Science (Standard B)

- The position and motion of objects can be changed by pushing or pulling. The size of the change is related to the strength of the push or pull (2d)
- Heat can be produced in many ways, such as burning, rubbing, or mixing one substance with another. Heat can move from one object to another by conduction (3b)

Background Information for Educators

Friction is the resistance felt when two surfaces pass across each other. The greater the amount of surface contact there is between the two surfaces, the greater the friction there will be. The converse is also true: as there is less surface contact, there will be less friction.

The sport of Curling utilizes this concept. Tiny water droplets are sprayed onto the ice before a curling match. When the curling stone passes over these frozen water droplets, there is less contact area between the stone and the ice, and therefore the stone passes across smoothly. Sweeping is used to create friction that melts the surface of the ice into water, which also reduces the friction and allows the stone to move more freely. Curlers use a combination of scientific knowledge and strategy to help them succeed on the ice.

Guiding Questions	Key Vocabulary
What is friction? What increases/decreases friction between two surfaces? Where is friction seen in daily life?	Friction Surface Force

Lesson Plan

1. Ask students to think about what happens to cartoon characters when they run across a surface with ice. Have them discuss what happens.

2. Ask students to think about real-life examples when similar things happen. They may suggest scenarios like slipping on ice, cars hydroplaning, or watching water nymphs glide on the surface of water.

3. Explain that each of these is an example of "friction" taking place in the world. Friction is the resistance that is evident when two surfaces brush against each other. The greater the area of surface contact between the two surfaces, the more the friction.

4. Ask students to rub their hands together briskly for 10 seconds. What do they notice about their hands afterward? What do they think caused the heat? Their hand was heated because of the friction between their hands.

5. Ask students to share what they know about icy surfaces. What usually happens on icy surfaces? Is that because friction is greater or less?

6. Show students "The Science of Curling" video. Have students take notes on their observations of what may have increased friction on the ice, and what decreased friction on the ice.

7. Share with students that they will be conducting a variety of simple experiments to test and observe different instances of friction.

Friction Experiment

For each pair of students

1 metal tray (such as a baking sheet)
1 sheet of waxed paper
A small amount of liquid dish soap
1 plastic cup (not paper)
Ice Cubes (kept frozen until right before they are needed)
Warm Water
Small Hand Towel

Teacher Note

Students will be working with water and soap. You may want to spend a few extra minutes modeling appropriate use of these items before allowing students to use them.

Experiment Task 1
Ask students to slide their plastic cup, lip-side down, across the metal tray by tapping its side gently with their finger. How did the cup move across the tray? Have students describe what they noticed.

Experiment Task 2
Ask students to predict what might happen if they slide the cup across a sheet of waxed paper on the tray. Have students place a sheet of waxed paper on their tray, and then ask them to slide the cup across, tapping it gently with their finger once again. How was this different from the first experiment? Did the cup move more or less smoothly? Why?

Experiment Task 3
Ask students to predict what might happen if the cup is wet with soapy water. How will it slide across the tray surface? Using the dish soap and warm water, have students wash their plastic cup, ensuring that the soapy water they use is nice and frothy. Making sure the cup is still warm and soapy, have students slide their plastic cup across the metal tray by tapping it with their finger once again. What do students notice? What caused the differences?

Experiment Task 4
Have students dry the tray and the cup as much as possible. Have student pairs share a tray with another group. On one tray, place one ice cube. On the other tray, cover another ice cube with the plastic cup. Ask students to predict what will happen as the ice cube is moved around on the tray with greater motion. How will that be different from the ice cube that is staying alone on the tray? Have students gently move the cup with the ice cube underneath, increasing their speed, but still maintaining good self-control. Have students experiment and share their observations. The ice cube on the tray under the cup should melt faster than the ice cube that is left alone on the other tray, because increased friction between the ice and the tray (while it is moving) causes heat that melts the ice.

If time allows, have students to experiment on other surfaces and/or with different items to see friction in action.

Lesson Plan, continued

8. Following the experiments (or during), ask students to record their observations from each experiment task. Have students sketch and label what they noticed.

9. Ask students to consider where else in the world friction is seen. If needed, guide students to look at the bottom of their shoes, or at a car's tires. Ask students to consider how "tread" works. Does it decrease or increase the amount of friction between the tire/shoe and the ground? How do you know?

Challenge Questions

What other sports require an understanding of friction?

How would an understanding of friction help in terms of building strategies in these sports?

After identifying aspects of everyday life where an understanding of friction is necessary, can you explain why this understanding is pertinent?

Assessment

Evidence of Understanding

Students will make predictions, conduct experiments, and explain their findings about what they learned about friction.

Assessment Rubric	Below Expectations	Meets Expectations	Exceeds Expectations
Experiment Notes, Student Observations, & Oral Discussions	Student's explanation of friction reflects a limited and/or inaccurate understanding of friction. Student may give limited explanations during the experiment, and may not be able to explain the differing amounts of friction between each of the experiment tasks. Students can name 1 or 2 examples of friction in daily life.	Student can clearly explain what friction is, and how friction affects different surfaces as they pass by one another. Student uses understanding of friction to explain why the cup moved more smoothly across the tray when it was wet than when it was dry. Student can name several examples of how friction is evident in daily life.	Student can clearly explain what friction is, how friction affects different surfaces, and can give examples of what surfaces may cause more or less friction. Student tests predictions during the experiment process, and can explain how different surfaces can have different amounts of friction. Student can name multiple examples of friction in daily life and explain friction's purpose.

Additional Resources

History of Curling
http://www.worldcurling.org/history-of-curling

A Scientific Explanation of the Physics of Curling
http://scienceblogs.com/builtonfacts/2010/02/20/the-physics-of-curling/

Real World Physics Problems
http://www.real-world-physics-problems.com/physics-of-curling.html