COSI
Center of Science and Industry

Thank you for inviting COSI on Wheels into your school! To enhance your students' experience, we encourage you to continue to explore space and matter in your classroom or home.

Extension Activities:

- Hot Spoons
- Balloon in a Bottle
- Egg Drop
- Microgravity at Work
- Density Stacker
- Booklist

HOT SPOONS

ACADEMIC STANDARDS: Physical Science 4.5, 5.1, 5.2; Scientific Inquiry 3.5, 5.3

OBJECTIVE: The students will gain an understanding of thermal conductivity and learn the differences between high and low thermal conductivity.

MATERIALS:

Wooden Spoon	Metal Spoon
Plastic spoon	Bowl of water
Butter	3 marbles

PROCEDURE:

1. Heat bowl of water so that it's hot, but not boiling.
2. Place a pat of butter on the ends of each spoon and press a marble into each pat of butter.
3. Place all three spoons into the bowl of water with the buttered ends sticking out.
4. When the spoons heat up the butter will begin to melt, eventually dropping the marbles.
5. Watch the marbles. The first to fall is from the spoon with the highest thermal conductivity.

WHAT HAPPENED: Each substance has a different level of thermal conductivity. This is the property that determines the movement of heat or cold through an object. Something with high thermal conductivity, like iron, is a good conductor of heat. That means it would get much hotter or colder than something like sand. Heat won't go very far through sand; it has a low thermal conductivity. Silica is the chemical taken from sand which is used to make the space shuttle tile. Silica protects the shuttle from heat during reentry. Record the results of each of your tested materials. Which is high? Low? In what situations would we want high thermal conductivity? Look around the room. What else would be a good carrier of heat? What would be a good insulator (objects with a low thermal conductivity)?

BALLOON IN A BOTTLE[1]

ACADEMIC STANDARDS: Physical Sciences 3.3, 4.4; Scientific Inquiry 2.5, 5.3

OBJECTIVE: To demonstrate that air takes up space and has pressure.

MATERIALS:

Cola bottle or any small-mouthed bottle
Balloon – large enough to fit over the mouth of the bottle

PROCEDURE:

1. Slip the balloon through the neck of the bottle.
2. Stretch the opening of the balloon around the mouth of the bottle.
3. Try to inflate the balloon by blowing into it.

WHAT HAPPENED: The balloon expands only slightly. The bottle is filled with air. Blowing into the balloon causes the air molecules inside the bottle to move closer together, but only slightly. The air pressure inside the bottle is pushing on everything, the bottle and the balloon, not allowing it to be inflated.

TRY THIS: Punch a small hole (about the size of a nail) into the bottom of the bottle. Then repeat steps one through three.

WHAT HAPPENED: The hole in the bottle provides an exit for the air molecules in the bottle. These air molecules are then forced out, as the air in the balloon fills the space.

TRY THIS: Heat water in a flask until boiling occurs. Remove flask from heat and set flask upon a hot pad. Immediately place mouth of pre-stretched balloon over the mouth of the flask, leaving remainder of the balloon outside the flask. As the water cools, the balloon is pushed into the flask by the change in air pressure.

[1] Spangler, Steven. "Balloon in a Bottle." Steven Spangler Science: Making Science Fun. http://www.stevespanglerscience.com/experiment/00000166

EGG DROP[2]

ACADEMIC STANDARDS: Earth and Space Science K.3, 4.1;
Physical Science 3.3, 3.4, 4.4

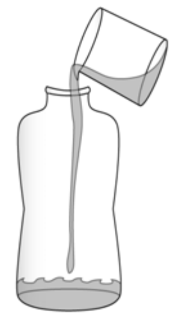
OBJECTIVE: To observe the effects of air pressure on objects.

MATERIALS:

Hard Boiled Egg
Bottle (Needs an opening just slightly smaller than the egg. Sport drink bottles work well)
Hot Water or Matches and Paper

PROCEDURE:

** Students should be in groups of 3 or 4. With younger students, the teacher should do the experiment as a demonstration.*

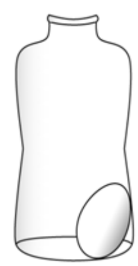


1. Ask the students what air pressure is and discuss.
2. Peel the hard-boiled egg.
3. Pour hot water into the bottle. Only pour enough to cover the bottom of the bottle. Swish the bottle around to circulate the warm air in the bottle.

   OR

   Use the matches to light the piece of paper and place the paper in the bottle.

4. Quickly place the peeled egg on the opening of the bottle small end down to create seal.
5. Observe for several minutes.
6. The egg should end up inside the bottle. Ask the student how the egg ended up in the bottle.
7. Explain the role air pressure is taking in the experiment.
8. Ask the students how to get the egg out of the bottle.
9. Try different suggestion before showing them how.
10. Hold the bottle upside down with the small end of the egg in the bottleneck.
11. Tilt the bottle down until there is a small opening between the neck of the bottle and the egg.
12. Blow hard into the bottle making a closed seal with your mouth. Before you remove your mouth, tilt the bottle upside down.



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[2] Bartholomew, Bruce. "Air Pressure." Utah Education Network. August 10, 1998. http://www.uen.org/Lessonplan/preview.cgi?LPid=1686

Egg Drop[3] (continued)

WHAT HAPPENED: The warm air inside of the bottle expands, which makes the air inside of the bottle weigh less than the air outside. As the air inside the bottle cools, it starts to condense. This creates an uneven pressure on either side of the egg. The egg is the seal between the two air pressures, which is not letting the air pressure even out. The outside air (or high pressure air) being greater pushes the egg down into the bottle. Once the egg falls into the bottle, the air pressure equalizes. Blowing into the bottle creates the same effect of unbalanced pressure.

MORE FACTS ON AIR PRESSURE: The egg drop experiment demonstrates what meteorologists call a down draft. An updraft is the opposite movement of pressures. This is what causes tornados. Standard atmospheric pressure is 14.7 psia (pounds per square inch, absolute) at sea level. Each location does differ dependent upon the altitude from sea level. A barometer is the instrument used in measuring atmospheric pressure.

[3] Martha Suarez, Stephen F. Austin University Nacogdoches TES Course, 1994.
http://www.reachoutmichigan.org/funexperiments/agesubject/lessons/tnrcc/airpressurelesson.html

MICROGRAVITY AT WORK[4]

ACADEMIC STANDARDS: Scientific Inquiry 1.41, 3.2, 5.3; Physical Science 3.3, 3.4

OBJECTIVE: To observe how microgravity affects objects.

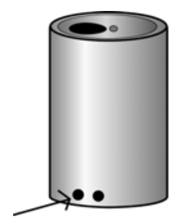
MATERIALS:

Empty Soda Can
Push Pin or Tack
Plastic cup
Flat tray, cookie sheet, or a flat board
Water
Bucket

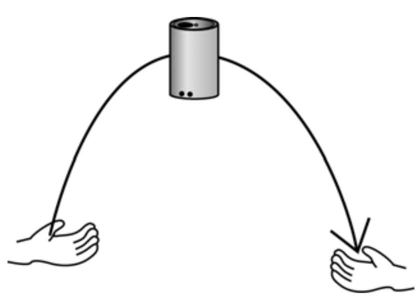
PROCEDURE:

*This experiment should be prepared inside but completed outside. The students should be grouped in pairs. The teacher can do the experiment as a demonstration for the younger students. *

Can Toss



1. Take the empty can and put two holes in the side near the bottom.
2. The holes should be one next to the other.
3. Covering the holes with your finger, fill the can ¾ full of water.
4. Move the finger covering the holes and observe the water draining out of the holes.
5. Toss the can upright in an arc between the two students or toss the can straight up and down.
6. Observe what happens when the can is falling down.



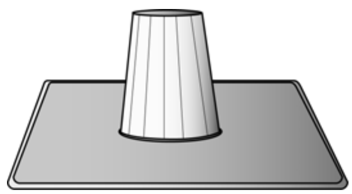
[4] Vogt, Gregory. Space Exploration Projects for Young Scientists. Danbury, CT: Franklin Watts, 1995

MICROGRAVITY AT WORK (continued)

Cup Drop

*This experiment should be prepared inside but completed outside. The students should be grouped of three or four. The teacher can do the experiment as a demonstration for younger students. *

1. Fill a plastic cup to the brim with water.
2. Place the tray, sheet, or board on top of the cup. (Make sure if the tray or cookie sheet has a lip, to use the backside of the tray on the cup)
3. Grab the cup and push down on the tray and flip them both upside down. The tray should create a seal with cup, so that the water is not leaking.
4. Slowly push the cup towards the edge of the tray or board.
5. Once the cup is at the edge of the tray, quickly pull the tray away from the cup. Remember to hold the tray flat. Letting the cup fall straight down.



6. Observe the water and the cup falling. The water stays inside the cup all the way till it hits the floor.
7. Repeat as often as need so that each student gets to observe the experiment.

WHAT HAPPENED: As the can is traveling down in the arc, the can and the water inside are in a free fall. In this free fall state, the g force is very near zero making it weightless. With both the can and water being weightless the water falls at the same rate as the can. This is similar to the KC-135 plane that is used to create temporary microgravity.

In the cup drop, the water does not fall out of the cup when the tray is removed, because the cup and water are both experiencing microgravity. The cup and water fall together relative to each other, because in free-fall there is virtually no gravity. Gravity still is present in both experiments, because both objects are still falling toward the earth. But between the water and the object, the microgravity effects are present in the free-fall. Microgravity does exist outside free-fall, but it is hard to find here on earth. One is able to find microgravity in space between the moon and earth.

MORE FACTS:

- With the lack of gravity on the body of an astronaut, their body changes without preventative measures being taken.
- The blood of the human body will tend to pool in the chest and in the face. An astronaut will appear swollen. They also experience cold like symptoms from the excess fluid in their heads.
- An astronaut must work out at least 90 minutes a day to keep blood flow, muscle structure, and prevent bone loss due to microgravity environment.

DENSITY STACKER

ACADEMIC STANDARDS: Physical Science 3.1; Scientific Inquiry 1.9, 2.5, 2.6, 5.3

OBJECTIVE: To illustrate the property of density.

MATERIALS:

- Glass jar
- Liquid measure
- Golden syrup
- Cooking oil
- Water
- Piece of plastic
- Grape
- Small cork

PROCEDURE: Pour one-third cup golden syrup into glass jar, followed by equal measurements of cooking oil and water. Drop in the piece of plastic, then the grape, followed by the cork.

WHAT HAPPENED: The syrup remains at the bottom of the jar, the water settles on the surface of the syrup, and the oil floats on top of the water. Each object will sink to the level of the liquid that has a greater density than the object. The object will then float on that layer.

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Space Exploration

Grades K-6

Books at the Columbus Metropolitan Library, 96 South Grant Ave.

PICTURE BOOKS

Enchanted Lions by David Greenberg, 2009. Picture Book GREENBERG
Rose takes a magical journey through the cosmos.

Balloon on the Moon by Dan McCann, 2008. Picture Book MCCANN
Big brother Jake is on a mission to save Will's balloon as it flies to the moon, but he first must get permission from NASA.

Sheep Blast Off! by Nancy Shaw, 2008. Picture Book SHAW
When a spaceship lands in their field, all the sheep climb on board for this weightless adventure.

NON-FICTION

Air Is All Around You: Let's Read and Find Out Science by Franklyn M. Branley, 2006. j515.5 B821a
An introduction to the concept of air, this book explains its importance in our everyday lives, as well as, incorporates experiments that can be easily done at home.

Matter: Science Concepts by Alvin Silverstein, 2009. j530 S587m
You will learn in this book, the different forms of matter and the shapes that they take on.

States of Matter: Why Chemistry Matters by Lynnette Brent, 2009. j530.4 B839s
This book will give readers a simple understanding of different states of matter.

Heating: Changing Materials by Chris Oxlade, 2009. j530.4 OXL
The reader will explore the properties of everyday materials when heat is involved.

Conductors and Insulators: My World of Science by Angela Royston, 2002. j621.319 R892c
This series introduces the reader to complex concepts using every day terminology.

Look to the Stars by Buzz Aldrin, 2009. j629.409 A365l
Join Buzz, as he takes us on a historical journey to the moon.

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