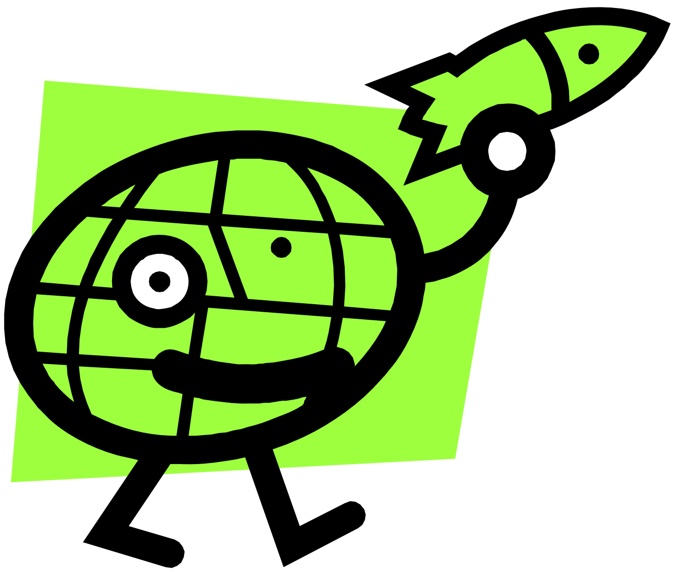
101 EFFECTIVE EARTH SCIENCE DEMONSTRATIONS USING ONLY ONE OR TWO ITEMS

101 of the Best Demos



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MASTER LIST OF ALL DEMOS

GEOSPHERE DEMONSTRATIONS:

1. Paper Towel Rock Folds (Demonstrating Folds in Metamorphic Rocks)

Toon G. Pronk, DNRE, Geological Survey Branch. Journal of Geoscience Education, v. 48, 2000, p. 573.

Objective: To show how folds can originate in metamorphic rocks and to help strengthen understanding of the rock cycle.

Standards: Properties of Earth Materials (physical properties of rocks), Changes in Earth and Sky (weathering), and Structure of the Earth System (the rock cycle).

Materials: One foot long piece of paper towel and spray bottle of water

Procedure:

(1) Tell the students that the piece of paper towel represents a layer of sedimentary rock.
(2) Push the paper towel together from its ends, causing a bulge.
(3) Flatten the paper towel back down on a table.
(4) Spray the paper towel with some water.
(5) Apply the same pressure to the sheet of paper towel and it will wrinkle, or produce folds.

Science Behind It: Metamorphic rocks often have different folds from the deformation they are put through. The first bulge of the paper towel is analogous to a geologic uplift event. After weathering has occurred (sprayed water) and additional pressure, the paper towel has become a metamorphic rock containing folds. The folds are evidence of the changes the rock has endured. This demonstration will hopefully allow students to understand the process of the rock cycle better as well as the processes involved related to the formation of metamorphic rocks.

2. **You Crack Me Up!**

Judy Breckenridge, Muriel Mandell, Anthony D. Fredricks, and Louis V. Loeschnig: 365 Super Science Experiments With Everyday Materials (2001), page 193.

Objective: To demonstrate how large rocks can be broken down into smaller pieces of rock through changes in the state of water.

Standards: Properties of Earth Materials (physical and chemical properties of rocks and water), Changes in Earth and Sky (weathering and erosion; diurnal and seasonal weather change – elements of weather i.e. temperature and precipitation), and Structure of the Earth System (the rock cycle).

Materials: Pieces of sandstone, sealable plastic bags, and water

Procedure:

1. Soak small pieces of sandstone in water overnight.
2. The next day place the pieces of sandstone into sandwich bags while ensuring they are sealed tightly.
3. Place the bags in a freezer overnight.
4. Take them out and examine them the next day.

Science Behind It: The sandstone absorbs some of the water as it is taken up in the pore spaces of the rocks. When the stones were placed in the freezer, the water froze and expanded. As this happened, it caused the rocks to break because of the expansion of water in tiny joints and pore spaces. This demonstration can also be used to illustrate the "freeze-thaw" principle as it readily occurs in nature. It would be a good idea for the teacher to relate this demonstration to the poor condition of many roads in Michigan. Like this demo, potholes and cracks result from the frequent freeze-thaw that tends to occur during seasonal changes. It may also be a good idea to experiment with various rock types in this demonstration in order to learn about the susceptibility of different rock types to freeze thaw.

3. It's a Dirty Job…

Judy Breckenridge, Muriel Mandell, Anthony D. Fredricks, and Louis V. Loeschnig: 365 Super Science Experiments With Everyday Materials (2001), page 185.

Objective: To determine how much air is present in different samples of soil and to then explain its relevance.

Standards*:* Properties of Earth Materials (physical and chemical properties of soils).

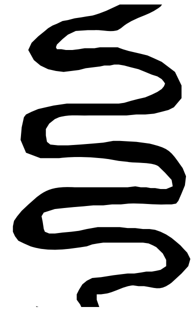
Materials: small clear jars, water, and soil samples

Procedure:

(1) Fill each jar about half full with a different soil sample.
(2) Then fill each jar almost to the top with water.

Science Behind It*:* Depending on the individual soil samples being tested, you will see a varying amount of air bubbles rising up from the soil to the top of the water in the jar. From this, you will be able to tell the approximate amount of air trapped in the spaces between the soil particles because a larger amount of air bubbles indicates a larger amount of trapped air. This demonstration can be used to discuss the properties of different soils. Soil samples that are densely packed, like clay textured soils, have less room for air to be trapped than other samples, like organic rich soil that form air pockets. This may also be a good time to discuss how most plants prefer soils with loose structures and many air pockets over densely packed soils.

4. **Student Made Body Waves**



Erica Kelly, Spring 2000, Students' Science Demonstrations: http://www.csulb.edu/~lhenriqu/300demo.htm#erica.

Objective: To kinesthetically learn about the motions of waves and the mediums through which they travel.

Standards: Position and Motion of Objects (object position and motion change; sound production by vibration), Motions and Forces (inertia with moving objects), and Interactions of Energy and Matter (waves possessing energy and transferring it through interaction with matter).

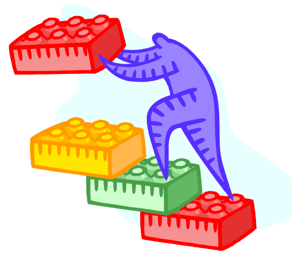
Materials: Eager students

Procedure:

(1) Ask for approximately ten student volunteers to form a straight line facing the class in which they position themselves shoulder to shoulder. Ensure that the students are just touching shoulders and not bracing or supporting themselves against the other students.
(2) Stand at one end of the line and gently push through the student's shoulder toward the opposite end of the line.
(3) Instruct the class to make observations and repeat if desired.
(4) Tell the volunteers to interlock their arms with each other.
(5) Begin pulling and pushing the first student back and forth in a rocking motion until the entire line of students is moving.
(6) Instruct the class to make observations and repeat if desired.

Science Behind It: The first demonstration represents a longitudinal or compression wave while the second demonstration represents a transverse wave. Make the students aware that waves are energy moving through a medium whether it be water, the earth, or in this case the students. Longitudinal waves vibrate parallel to or in the same direction as their medium. In contrast, transverse waves travel in a perpendicular direction to that of their medium. Also inform the class that the medium itself does not have to nor generally does not move. Other objects such as ropes or slinkies will essentially produce the same effect as this demonstration.

5. **Designing Minerals with Legos**



Christopher Visco. Website:
http://ourworld.compuserve.com/homepages/CVisco/demos.htm.

Objective: To stress and reinforce the importance of mineral structure.

Standards: Properties of Earth Materials (physical and chemical properties of rocks and minerals).

Materials: Sixteen Lego pieces of the same color and shape, two students.

Procedure:

(1) Give eight Lego blocks to a student on one side of the room and give the other eight to another student on the opposite side of the room.
(2) Instruct both students to build something with the Legos while not looking at each other. Provide some basic guidelines for the structures to be built so that the students do not construct something totally unrelated to mineral structure.
(3) When both students are done, show their creations to the rest of the class

Science Behind It: Things such as diamond and graphite are both made of carbon atoms yet they have totally different properties and characteristics. The reason why these two substances are different is because of their mineral structure; the way the carbon atoms are formed together. By having two students use the exact same materials and produce unique structures with them, you can reinforce the importance of mineral structure and the way substances are put together.

6. **My Teacher Caused an Earthquake**

Christopher Visco; Website:
http://ourworld.compuserve.com/homepages/CVisco/demos.htm.

Objective: To introduce the topic of seismic waves produced by earthquakes.

Standards: Structure of the Earth System (plate tectonics and its relation to earthquakes), Transfer of Energy (energy types, characteristics, and transfer properties), and Interaction of Energy and Matter (waves have energy and can transfer energy when they interact with matter).

Materials: Pieces of cardboard and a large boulder or heavy, old bowling ball

Procedure:

(1) Place the piece(s) of cardboard on the floor of your classroom.
(2) Pick some students to go to different corners of the classroom, out in the hall, and perhaps down the hall.
(3) Tell the remaining students in the class to place their hands flat on their desks, feet firmly on the floor, and to be very quiet and still.
(4) Drop the boulder or heavy ball onto the cardboard while standing on top of a chair or desk.

Make sure that you have permission to perform this demo from the custodians, principal, and teachers that may have classrooms below you before proceeding with it

Science Behind It: The resulting vibrations felt from the "earthquake" are analogous to seismic waves. Discuss what the students felt, who felt it stronger, how far away it could be felt, etc. This is a great eye opening and attention grabbing demo to introduce the topic of seismic waves and their properties with your class.

7. Seismic Waves in a Popcorn Bowl

William Johnston

Objective: To demonstrate how understanding the properties of seismic waves leads to understanding the composition of earth's interior.

Standards: Properties of Earth Materials (physical and chemical properties of rocks and soils, water, and gas), Structure of Earth System (layering and properties of Earth's internal structure; plate tectonics and its relation to earthquakes), Transfer of Energy (energy types, characteristics, and transfer properties), and Interactions of Energy and Matter (waves have energy and can transfer energy when they interact with matter).

Materials: One 2 qt. bowl, glass soft drink bottle, and pencil.

Procedure:

(1) Fill the bowl approximately half full with water.
(2) Set the bottle in the center of the bowl of water.
(3) Tap the surface of the water several times near the side of the bowl with a pencil

Science Behind It: As waves ripple out from where the pencil tapped the water to the glass bottle, most reflect back towards the pencil. These waves of energy that are not able to move through the bottle are analogous to secondary (S) waves from an earthquake. S waves arrive after primary (P) waves during an earthquake because they are slower and have less energy than P waves. S waves have the ability to move through solid objects but cannot move through liquids. The S waves move through the solid parts of Earth's interior, but just as the water waves hitting the bottle, they are reflected back to the epicenter by Earth's liquid core. P waves travel completely through the center of the Earth, but S waves are reflected back, indicating the inner part of the earth is liquid material.

8. **P and S Waves in the Hallway**

Christopher Visco; Website: http://ourworld.compuserve.com/homepages/CVisco/demos.htm.

Objective: To understand the difference in travel times of P and S waves during an earthquake and to know how to use this time difference to calculate epicenter distance.

Standards: Structure of Earth System (layering and properties of Earth's internal structure; plate tectonics and its relation to earthquakes), Transfer of Energy (energy types, characteristics, and transfer properties), and Interactions of Energy and Matter (waves have energy and can transfer energy when they interact with matter).

Materials: Three pieces of paper, marker or pen, and a measuring tape.

Procedure:

(1) Make three signs with different city names on them.
(2) Hang these signs in the hallway at different distances from the end of the hall before class.
(3) Designate one student the earthquake epicenter, one student the P wave, and another student an S wave.
(4) The P and S wave stand together at the epicenter. When you sound "earthquake!" the P wave begins running while the S wave begins walking.
(5) When the P wave reaches the first city, both waves stop.
(6) The remaining students measure the distance between the P and S waves. Briefly discuss why there is a difference.
(7) The P and S waves go back to the epicenter and the procedure is repeated two more times, as the P wave stops at the second city and then the third city.

*** This demo should be done in an area that will not interrupt other classes***

Science Behind It: P and S waves travel at different speeds because they contain different amounts of energy. The two waves also travel at different rates because P waves can easily travel through both solid and liquid material, whereas S waves can only travel through solid materials. Knowing the properties of these waves and how to calculate their travel times and distances, is integral in seismologists pinpointing the location of an earthquake's epicenter. Through completing this kinesthetic demonstration, students will have an insight and understanding of this process.

9. **My Dirty Laundry Relates to Geology?**

Cool Science; Website: http://www.coolscience.org/CoolScience/KidScientists/Earth%20Science%20home%20projects/law%20of%20superposition.htm.

Objective: To teach the scientific principle of the Law of Superposition and its importance in science.

Standards: Properties of Earth Materials (fossil properties; historical significance), Earth's History (uniformitarianism and catastrophism; fossils show how life and environmental conditions have changed), Origin and Evolution of the Earth System (geologic dating methods), and Understandings About Scientific Inquiry (scientists use scientific explanations until they are disproved).

Materials: Full laundry basket

Procedure:

(1) At home, fill a laundry basket with various clothes.
(2) Arrange the clothes in layers such that each layer has common characteristics (i.e. color, brand name, clothing type).
(3) Have students remove one piece of clothing at a time, make observations, and record their findings.
(4) Discuss observations and the relevance of the findings.

Science Behind It: The Law of Superposition is a unifying theory in geology and is a crucially important principle in all fields of scientific dating. Things deposited at the bottom of the laundry basket are older and were worn before objects on top of it. Layers deposited during certain time periods usually have similar characteristics and this is used to date events and learn about specific periods in history. Geologists and archeologists use this principle frequently.

10. **Which Rocks Will Fizz?**

E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 41.

Objective: To quickly be able to test rock specimens and identify them and to also learn about the chemical properties of rocks.

Standards: Properties of Earth Materials (physical and chemical properties of rocks).

Materials: small sampling of various rocks including limestone or marble and two ounces (60 mL) of lemon juice (or vinegar).

Procedure:

(1) Pour lemon juice over the various rocks.
(2) Observe and discuss.

Science Behind It: Students will be able to quickly identify samples of limestone and marble because the lemon juice will "bubble" or effervesce on the surfaces of these rocks. This occurs because limestone contains calcium carbonate which is an alkaline substance. When the acidic lemon juice is added, it reacts with the alkaline of the limestone to produce carbon dioxide, therefore resulting in the appearance of bubbles. Marble is a rock formed from limestone and will react with the acid the same way as the limestone. Similar results will also occur when adding lemon juice to chalk, as it is also made of limestone.

11. **BARtender**

E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 186.

Objective: To demonstrate how magnets will always orient themselves towards the north and south poles.

Standards: Light, Heat, Electricity, and Magnetism (magnets attract and repel each other and certain kinds of other materials), and Conservation of Energy and Increase in Disorder (kinetic energy, potential energy, energy contained by a field like electromagnetic energy).

Materials: bar magnet and a long piece of cotton string.

Procedure:

(1) Tie one end of the long string around the center of the bar magnet.
(2) Clearly indicate the north and south ends of the magnet.
(3) Tie or tape the other end of the string to a light fixture, closet pole, or other structure where it can swing freely.
(4) Ensure the magnet is properly balanced and does not hang down on one side or the other; adjust if necessary.
(5) Spin the magnet so that it rotates several times and observe what happens.
(6) Repeat procedure if desired.

Science Behind It: The bar magnet will continue to align itself in a similar manner to that of which it began, regardless of how many times it is spun around. The marked poles on the magnet should be in their same starting positions each time the magnet stops rotating. As the magnet hangs freely in this demonstration, it acts like and becomes a compass which aligns itself according to the magnetic field of earth.

12. **Bubble Blowers**

E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 173.

Objective: To learn about the physical properties of porous rock types.

Standards: Properties of Earth Materials (physical and chemical properties of rocks and soils).

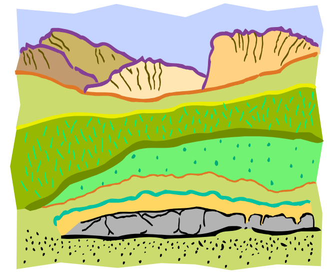
Materials: Various porous rocks, a shallow baking pan or plugged sink, and water.

Procedure:

(1) Place the porous rocks in the baking pan or plugged sink.
(2) Pour in enough water to cover the rocks generously.
(3) Closely watch and observe the rocks.

Science Behind It: Streams of bubbles will flow out of the rocks. The more porous the rocks are in this demo, the more bubbles will be seen. Depending on the weight of the rocks and the force of the air leaving them, the rocks may display slight movement or oscillation in the water. These observations occur in this demo because oxygen is present in the porous rocks and flows out from the spaces between the minerals that make up the rocks. Examples of porous rocks include many igneous rocks such as pumice, scoria, and basalt.

13. **My Soil Has Layers!**



E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 172.

Objective: To learn about properties of soils and how their contents relate to the principle of density and sedimentation.

Standards: Properties of Earth Materials (physical and chemical properties of rocks and soils; soil properties), Structure of the Earth System (layering and properties of earth's internal structure; soil properties: biotic, physical, and chemical; biotic influence on rock formation and weathering), and Properties and Changes in Matter (substance density).

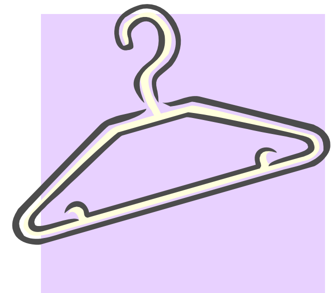
Materials: jars with lids, ½ cup of each soil sample from different locations and depths (topsoil, upper soil, subsoil, or deeper soil), and water.

Procedure:

(1) Fill each jar with ½ cup of soil.
(2) Add water to each jar so that each jar is approximately three-quarters filled.
(3) Ensure that each lid is securely fastened and shake well.
(4) Repeat the above procedure with the desired amount of soil samples to be tested.
(5) Wait for the soil to fully settle (may take a few hours so you will want to prepare this before the day of school begins).
(6) Observe each jar of soil and have the students make illustrations with labels describing what they see.

Science Behind It: As the soil samples settle, they form bands or layers depending on the content of each sample. In mostly all soil samples, the heavier, larger, and more dense particles settle to the bottom while the lighter colored and weighted particles tend to settle towards the top. From doing this simple test, it is easy to determine the texture and composition of various soils. This demo also relates to sedimentation and layering of sedimentary rocks. It would be a good idea for teachers to interrelate these concepts in order to help the students relate their knowledge and gain a more thorough understanding.

14. **Hotwire High Jinks**



E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 149.

Objective: To demonstrate how rocks inside the earth can be changed due to heat, pressure, and folding.

Standards: Structure of the Earth System (layering and properties of earth's internal structure; the rock cycle) and Transfer of Energy (energy types, characteristics, and transfer properties).

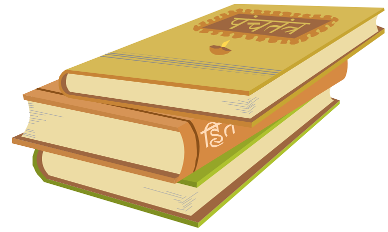
Materials: wire coat hanger and candle

Procedure:

(1) In preparation to this experiment, unhook or cut the wire coat hanger apart.
(2) Bend one section of the hanger rapidly back and forth (in the same section) approximately 30 – 50 times.
(3) Quickly place the bent section against the candle while being careful not to touch the bent section.

Science Behind It: Bending the hanger produced heat energy which when placed against the candle, caused some grooves or ridges to appear in the wax. This process is related to how metamorphic rocks are formed. Deep within the earth, these types of rocks are formed by the constant folding of the earth which produces heat and changes the composition of the rocks.

15. **Earthquakes: They're Definitely Not Your FAULT!**



E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: <u>365 Simple Science Experiments with Everyday Materials</u> (1997), page 116.

Objective: To demonstrate a dip – slip and strike – slip fault movement.

Standards: Structure of the Earth System (plate tectonics and its relation to volcanoes, mountain building, and earthquakes).

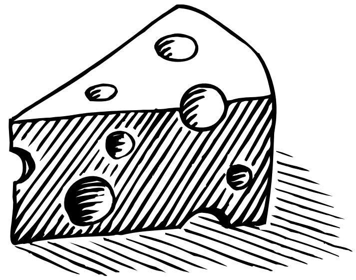
Materials: three similarly sized hardcover books

Procedure:

(1) Hold the three books firmly together with the book spines facing upward and bring them close to your chest.
(2) By reaching under, push up on the middle book so that it slides upward between the two outer books.
(3) Repeat this step many times to make a smooth and straight lift.
(4) Next, hold the books firmly out away from your body while keeping them evenly and firmly together.
(5) Make sure the books are held sideways again, with the spines facing upward and apply a large amount of force to the outside of the books to restrict them from slipping.
(6) Release some of your pressure so that the middle book slips downward, between the two outer books.
(7) Thirdly, hold the books firmly together, spines facing upward, and resting them on a table.
(8) While holding the outer two books only, slide them back and forth repeatedly.

Science Behind It: In the first two quick demos, dip slip fault movements were displayed. When the books were held close to your chest and the middle book was forced up, this resembled a thrust fault. When the books were held away from your body and the middle book slipped downward, this resembled a normal fault in a dip slip fault movement. In the third demo, a strike slip fault was shown as the movements of the books were parallel to each other and slid back and forth. This was caused by a quick buildup and release of friction, and therefore energy, between the books.

16. **Fractures in Cheese**



Geoff Collins, Brown University, MadSci Network; Website: http://www.madsci.org/experiments/archive/871082838.Es.html.

Objective: To learn how fractures in earth's crust develop by pulling on the edges of a slice of cheese.

Standards: Structure of the Earth System (plate tectonics and its relation to volcanoes, mountain building, and earthquakes).

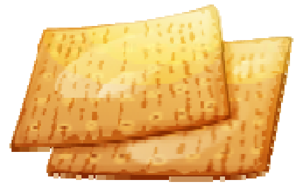
Materials: Pre-sliced pieces of American cheese

Procedure:

(1) Make a small cut parallel to the edge of the cheese slice, in the middle of the slice.
(2) Pull on the edges of the cheese that are parallel to the cut, therefore in a perpendicular direction to the cut.
(3) As you slowly tear the cheese apart, have students observe how the shape of the growing fracture grows and how it develops faster as it gets larger.
(4) Using a new slice of cheese, make two cuts in the middle of the cheese approximately one inch apart and offset from each other diagonally.
(5) Repeat the above tearing process and observe how the fractures grow with this slice of cheese. As the tips of these fractures begin to grow past each other, they will also begin to curve towards each other and eventually join to produce a single fracture.

Science Behind It: This demo represents creating tension fractures. Fractures like these occur in Earth's crust by the pulling of tectonic forces. As you pull on the edges of the cheese slice, you create tensional forces throughout the volume of the slice. If there is an imperfection or break in the slice (or Earth's crust), the tension cannot pass through it. Therefore, the tension becomes concentrated around the tips of the break and increases as the fracture grows. The increase in tension makes it easier for the fracture to expand. When the two cuts in the cheese curve towards each other and "combine, it is because the tension can not be transferred in a straight line across the space between the two cuts. Tension fractures are important in understanding earthquakes and earthquake prone areas. These types of fractures are also present as deep cracks in glaciers, are responsible for volcanic eruptions in Hawaii, and are seen readily in asphalt roads. Good write up

17. **Graham Cracker Earthquake**



Charles Wolf, MadSci Network; Website:
http://www.madsci.org/experiments/archive/1117652897.Es.html.

Objective: To demonstrate the forces that cause earthquakes, the tension that can build up at earthquake faults, and the ensuing debris produced at a fault.

Standards: Structure of the Earth System (plate tectonics and its relation to earthquakes) and Transfer of Energy (energy types, characteristics, and transfer properties).

Materials: One half of a graham cracker (one cracker with a perforated line down the middle).

Procedure:

(1) Break the graham cracker along the perforation.
(2) Place the two pieces back together so they are touching where they broke.
(3) Move one piece towards you and one piece away from you as you keep the pieces touching.
(4) Observe the small crumbs that form as they move against each other.
(5) Break one of the halves into two pieces. The resultant edges should not be smooth.
(6) Put the pieces back together so they are touching, just as before.
(7) Repeat step three.
(8) Note that the pieces do not move as easily as they did before.
(9) Keep moving the pieces until they do move and observe the larger crumbs.

Science Behind It: Pushing the graham crackers past each other represents a transform fault where earthquakes occur. As the tectonic plates (or crackers) move, tension builds up causing vibrations and therefore earthquakes. The more uneven or rough the fault is, the more pressure that builds up because it is harder for the plates to move past each other. This therefore results in a much larger earthquake when the plates get past each other, resulting in the larger debris, as seen in step nine from above.

18. **Peanut Butter Ridge**

Charles Wolf, MadSci Network; Website:
http://www.madsci.org/experiments/archive/1117652897.Es.html.

Objective: To demonstrate the processes of mid ocean ridge formation.

Standards: Structure of the Earth System (plate tectonics and its relation to volcanoes, mountain building, and earthquakes) and Energy in the Earth System (convective circulation in the mantle that propels plate tectonics).

Materials: Two graham crackers and peanut butter.

Procedure:

(1) Place two graham crackers against each other with their edges touching.
(2) Place a small amount of peanut butter underneath the graham crackers where their edges meet.
(3) While applying downward pressure, slide the crackers apart from each other.

Science Behind It: As you slide the crackers apart, the peanut butter should "ooze" or flow up from below the crackers. This is a representation of magma circulating convectively in the mantle below Earth's crust and forcing its way up between plates at a divergent boundary. This demo should be used to illustrate such landforms as the Mid – Atlantic Ridge.

19. **Penny Decay**

Exploratorium; Website: http://www.exploratorium.edu/snacks/radioactive_decay.html.

Objective: To demonstrate the concepts of exponential radioactive decay and half life in a hands – on and graphical manner.

Standards: Energy in the Earth System (internal sources of energy – radioactive decay) and Origin and Evolution of the Earth System (geologic dating methods).

Materials: One hundred pennies and a container to hold the pennies.

Procedure:

(1) Toss all 100 pennies onto a table surface.
(2) Remove all pennies that landed tails side up.
(3) Place the removed pennies on the left side of the table top and arrange them in a straight, vertical column.
(4) Collect the remaining pennies and toss them again.
(5) Again remove the tails side up pennies and place them in another vertical column directly besides the first column.
(6) Repeat this process until all pennies are removed. If no pennies land tails side up during a toss, leave that column empty and continue tossing the pennies.

Science Behind It: In this demo, the removal of a penny is analogous to the decay of a radioactive nucleus. Each time a penny is tossed, it has the same 50% chance of being removed. Therefore, after the initial toss, about one half of the pennies are removed. After the second toss, about one - fourth of the total pennies remain, followed by one – eighth, one – sixteenth, and so on. This pattern of repeated decrease by a fixed fraction is known as exponential decay. The time it takes for one half of the pennies to be removed (essentially one toss given the 50% chance of removal per toss) is deemed the half – life. Different substances have different half lives, and this principle could be demonstrated by tossing dice or colored blocks. Dice have longer half lives than pennies because each side of a die has a 1/6 chance of being removed compared to the ½ chance of the penny. Arranging the pennies in columns allows the students to view this concept graphically.

20. **Erosion and Weathering in my Mouth**

Mark Francek

Objective: To illustrate the differences between weathering and erosion and to strengthen understanding of these concepts.

Standards: Changes in Earth and Sky (slow erosion, weathering) and Properties of Earth Materials (physical and chemical properties of rocks and soils).

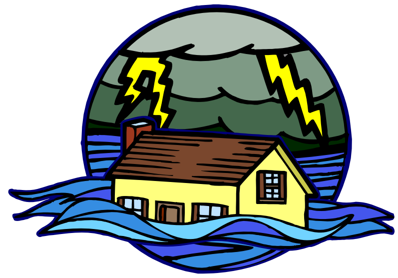
Materials: Enough bite – sized Snickers candies for all students in the classroom.

Procedure:

(1) Pass out one bite – sized Snickers to every student in the class.
(2) Instruct the students to put the Snickers in their mouth but to not chew or swallow them.
(3) Have the students make note of what is happening to the Snickers in their mouths as their saliva begins to dissolve it.
(4) Once the students have dissolved the candy down to only nuts allow them to chew the nuts while making continued observations of how the nuts are being broken down.
(5) Allow the students to now swallow the snickers.

Science Behind It: This demo effectively illustrates three processes that readily confuse many students. The first process illustrated was chemical weathering. This occurred because the Snickers remained in situ as chemicals of the mouth broke it down without movement or work. This part of the demo can be compared to such things as acid rainwater dissolving limestone, for example. The second process was mechanical or physical weathering and this occurred as the students worked to break down the nuts of the candy through chewing. A real life example of this process would be any situation where something is broken down through the direct action of heat, water, ice and pressure. The third process in this demo was erosion and occurred as the students swallowed the snickers. This illustrates erosion because it involves the movement or transportation of materials from one place to another (from the mouth through the esophagus and into the stomach). It is important for teachers to distinguish between weathering and erosion in this demo as these concepts are usually misunderstood by students. The main difference between erosion and weathering is that erosion involves the movement and transportation of sediments from one place to another while weathering happens in situ and does not involve transportation.

ATMOSPHERE DEMONSTRATIONS:



21. **Why No Flood?**

E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: <u>365 Simple Science Experiments with Everyday Materials</u> (1997), page 28.

Objective: To demonstrate air pressure and its effects and influences on surrounding materials.

Standards: Structure of Earth System (atmospheric composition and properties at different elevations) and Structure and Properties of Matter (properties of solids, liquids, and gases).

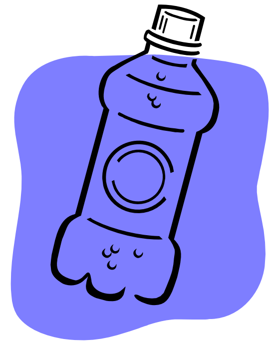
Materials: large index card, glass or cup, and water.

Procedure:

(1) Fill the glass with water (you will have to adjust amount of water depending on size and shape of glass).
(2) Place the index card over the entire mouth of the glass.
(3) Ensure that no air bubbles enter the glass as you hold the index card tightly against it.
(4) Slowly turn the glass upside down over a sink or basin.
(5) Remove the hand holding the cardboard.
*** May want to practice this demo at home a few times before presenting in front of the class so that water does not dump everywhere. ***

Science Behind It: The index card remains in place and the water remains in the glass. This happens because the pressure of the air outside the glass is greater than the pressure of the water inside the glass. The air pressure therefore keeps or "holds" the water in the glass because the air pressure pushing upward against the index card is stronger than the pressure of the water in the glass pushing downward. This is why it is very important to prohibit air bubbles from entering the glass as you hold the card against it and turn the glass upside down. If bubbles enter the glass, the pressure will increase and become greater than the air pressure outside of the glass resulting in the water spilling. The air pressure may become increased in this way because if the seal is not perfect, air can easily enter the water and add pressure.

22. **Pop Top**



E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 279.

Objective: To demonstrate the properties of air when it is warmed.

Standards: Structure of the Earth System (atmospheric composition and properties at different elevations), Energy in the Earth System (heating of Earth's surface and atmosphere drives weather and ocean currents; convective circulation), Properties of Objects and Materials (object properties: temperature), Transfer of Energy (energy types, characteristics, and transfer properties; heat flows from warmer objects to cooler until equilibrium is reached), Structure and Properties of Matter (properties of gases), Light, Heat, Electricity, and Magnetism (ways to create heat – what is conduction?), and Conservation of Energy and Increase in Disorder (heat consists of random vibrations and motion of atoms and molecules).

Materials: a large, empty plastic pop bottle with its cap.

Procedure:

(1) Wet the cap of the pop bottle.
(2) Place the cap upside down on the top of the bottle.
(3) Lightly put your hands around the bottle.
(4) Hold the bottle but do not squeeze it.

Science Behind It: The cap will eventually "jump" or pop off of the bottle. This happens because when your hands are placed around the bottle, they cause the air inside the bottle to be warmed. As the air warms, the molecules of the air expand, and begin vibrating at a higher rate in an attempt to leave the bottle. The wet cap serves as a seal to the bottle at first, but eventually as the air becomes warmer and warmer, some of it will escape or vibrate against the cap so much that it causes the cap to "move" or fall off the bottle.

23. **Lets Cause Some Thunder!**

E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 243.

Objective: To simulate thunder and in doing so, learn why and how it happens in Earth's atmosphere.

Standards: Structure of the Earth System (atmospheric composition and properties at different elevations; clouds-formation and impact on weather and climate), Energy in the Earth System (heating of earth's surface and atmosphere drives weather; global weather and climate as influenced by cloud cover and mountain ranges), Position and Motion of Objects (sound is produced by vibrating objects), and Conservation of Energy and Increase in Disorder (heat consists of random vibrations and motions of atoms and molecules).

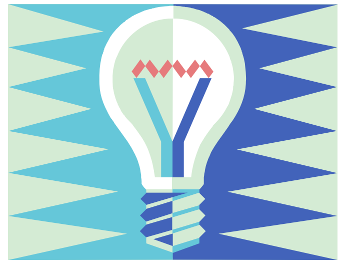
Materials: One balloon or lunch – sized paper bag.

Procedure:

(1) Blow up the balloon or paper bag.
(2) Close the balloon or bag by tying it with a rubber band or piece of string.
(3) Place one hand on top and one hand on bottom of the balloon or bag and pop it.

Science Behind It: The resulting sound is analogous to thunder. Thunder is created by causing a parcel of air to move very quickly. Thunder stems from a lightning strike because as the lightning flashes through the sky, it heats the surrounding air and forces it to expand rapidly. This movement of expanding air is what produces the sound of thunder. Sound is produced from an object when it vibrates. In areas where there is heavy cloud cover, mountains, or other large obstructions, the sound of thunder may be more pronounced as in these settings it has more and larger objects to bounce its vibrating sound waves off of, thus creating more of an echo.

24. **Light Bulb Air Current and Wind**



E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 220.

Objective: To learn about air currents and wind and how they relate to each other.

Standards: Structure of the Earth System (atmospheric composition and properties at different elevations; global circulation patterns and influence on local weather), Energy in the Earth System (heating of earth's surface and atmosphere drives weather), and Properties and Changes in Matter (substance density).

Materials: talcum powder and unshaded lamp.

Procedure:

(1) While the lamp is turned off and cooled, sprinkle some talcum powder above it.
(2) Observe what happens.
(3) Light the lamp and let it warm up for a few minutes.
(4) When the lamp becomes hot, sprinkle more talcum powder above it (you may want to turn off the light to see the full effect).
(5) Observe what happens.

Science Behind It: When the lamp is heated, the powder rises up from the lamp because the bulb is producing heat and causing the air above it to rise and carry the powder with it. This represents convection, where the warmer air pushes upward because it is less dense and the molecules in the air are farther apart from each other. Before the lamp was hot, the talcum powder sank down along with the colder and denser air around the lamp. As the warm air rises, the cooler air flows in and sinks to occupy its place. Vertical movement of air is known as an air current, while horizontal movement of air on the same level is known as wind. The speed of air currents and wind is typically determined by the temperature difference between adjacent regions. The wind's direction also depends on the location of these regions or areas.

25. **Track Star**

E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 160.

Objective: To learn about the wavelengths of light produced by the sun and the electromagnetic spectrum.

Standards: Objects in the Sky (sky object properties; why is the sun important?), Origin and Evolution of the Universe (how stars produce energy and the formation of all elements), Light, Heat, Electricity, and Magnetism (light reflectance, refraction, and absorption), and Transfer of Energy (light transmission, refraction, absorption, reflection, and scattering; the sun's range of wavelengths).

Materials: sheet of paper, drinking glass half – filled with water, and a place located outside in full sunlight.

Procedure:

(1) Locate a fully lit outdoor area.
(2) Place the sheet of paper on the ground where you wish to conduct the demo.
(3) Using only your thumb and forefinger, firmly hold the glass of water about three to four inches above the sheet of paper (it is important that you do not block the sides of the glass while holding it).
(4) Move the glass up and down, while slanting it to focus the light on the paper in a way that a clear, colorful pattern appears.

Science Behind It: The glass of water serves as a prism in this demo and casts a rainbow of colors on the paper. The glass, as well as other prisms, changes the direction of light by refracting it so that the bands of color can be observed. As the wavelength of light is split and altered by the prism, the many colors that occupy white light become apparent. These properties of light wavelengths and their colors are frequently used by astronomers in determining what elements or gases compose stars. This demo would be a great one to use to introduce the topics of the electromagnetic spectrum, light, or stars.

26. **Stubborn Paper Wad**

E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: <u>365 Simple Science Experiments with Everyday Materials</u> (1997), page 137.

Objective: To learn more about air pressure and its properties.

Standards: Structure of the Earth System (atmospheric composition and properties at different elevations), and Motions and Forces (laws of motion).

Materials: A small – mouthed bottle and a small piece of scrap paper.

Procedure:

(1) Place the bottle on its side on a table.
(2) Form a small wad with the scrap paper that is approximately the size of a pea.
(3) Place the paper wad just inside the bottle's mouth.
(4) Blow hard and fast into the bottle.

Science Behind It: The paper wad should fly out of the bottle back towards the person who blew at it (adjust wad placement and degree of blowing if this does not result). This occurs because the rapid moving air goes past the wad and strikes the bottom and sides of the bottle. As a result, this increases the air pressure inside the bottle and as this air suddenly rushes out of the bottle to equalize air pressure, it pushes the wad out with it as well.

27. **The Great Coin Blowing Demonstration**

E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 134.

Objective: To learn about the relationship between air speed and friction.

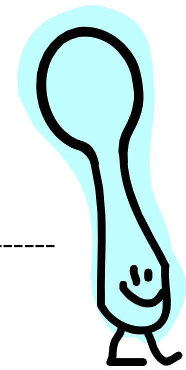
Standards: Structure of the Earth System (atmospheric composition and properties at different elevations), Motions and Forces (what happens when more than one force acts on an object; laws of motion).

Materials: drinking glass and small coin.

Procedure:

(1) Place drinking glass on a flat table.
(2) Carefully balance the coin on the rim of the glass so that about half of it hangs over the inside of the glass and the other half hangs over the outside of the glass.
(3) Blow softly at the edge of the coin (coin should fall off the rim of the glass).
(4) Have class observe what happens.
(5) Carefully balance the coin again as you did in step two.
(6) While positioning several inches back from the coin, blow hard and fast directly at its edge, making sure that you do not blow above or below the coin (this may have to be repeated a few times until the optimal positioning and degree of blowing is determined).
(7) Have class observe and discuss.

Science Behind It: The first time you blew softly at the coin, it fell off the rim of the glass. This occurred because you did not blow with enough force and speed to set the coin in rapid motion. However, when you blew directly at the coin with a larger force and speed, your lungs were able to propel the coin across the glass. This happened because the coin is light enough to overcome the small amount of friction it has when properly balanced on the rim of the glass. Once you have directed the coin in the path it needs to take with enough force and by blowing directly at its edge, air speed takes over. It may also be a good idea to experiment with different coin and glass sizes and observe the differences.



28. I'm Upside Down in a Spoon!

E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 123.

Objective: To demonstrate reflection of light and to learn and discuss properties of light.

Standards: Light, Heat, Electricity, and Magnetism (light reflectance, refraction, and absorption), Transfer of Energy (light transmission, refraction, absorption, reflection, and scattering).

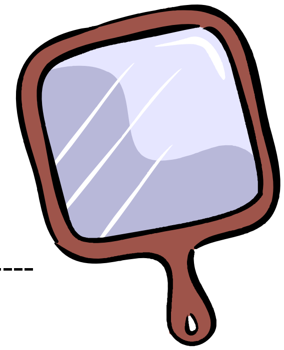
Materials: The largest and shiniest spoon you can find

Procedure:

(1) Hold the spoon up so that you can see yourself in the scoop.
(2) Pass the spoon around and let the students in your class do the same thing.
(3) Observe the orientation of your reflection.

Science Behind It: Your reflection should appear upside down in the spoon's scoop due to the principles of light reflection. Light rays both travel and reflect in a straight – lined path. However, because the scoop of the spoon is a curved surface, the light rays reflect off of it and leave its surface at different angles. The reflected images of yourself and your students appear upside down because of the angle of the reflected rays of light.

29. **The Vanishing Reflection**



E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 123.

Objective: To demonstrate reflection of light and to learn and discuss properties of light.

Standards: Light, Heat, Electricity, and Magnetism (light reflectance, refraction, and absorption), Transfer of Energy (light transmission, refraction, absorption, reflection, and scattering).

Materials: Ten inch long piece of aluminum foil and one pair of scissors.

Procedure:

(1) Using the scissors cut a piece of aluminum foil off of the role. It is recommended that it is cut and not torn to avoid wrinkles in the foil and to maintain its smoothness.
(2) Look at the shiny side of the foil.
(3) Observe your reflection.
(4) Crumple the foil into a loose wad.
(5) Flatten out the wad of foil.
(6) Look at the foil and observe.

Science Behind It: Once you crumple the foil, you will not be able to see your reflection in it. The reflection is not visible because light is reflected in straight lines. Now that the foil is crumpled and has a very ridge – filled surface, the reflected light bounces off of it in all directions. Since the light is being reflected in every direction at many different angles, the image of your reflection does not form in the way that it did when the foil surface was smooth and the light was reflected straight back at you.

30. **The Tapping Finger**

E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 107.

Objective: To investigate sound waves and the mediums they travel through.

Standards: Structure of the Earth System (atmospheric composition and properties at different elevations), Properties and Changes in Matter (substance density), and Position and Motion of Objects (sound is produced by vibrating objects – how and why pitch changes).

Materials: A wooden table or desk top.

Procedure:

(1) Tap your finger on the surface of the table of or desk.
(2) Observe the loudness of the sound you hear.
(3) Place your ear flat on top of the table or desk.
(4) With your finger about one foot away from your ear, tap the table top again.
(5) Observe the loudness of the sound you hear.

Science Behind It: The volume of the sound you hear with your ear on the desk is much louder than with it off the desk. Sound waves are capable of traveling through many solid materials as well as through air. The many solids, like wood for example, transfer the sound waves much better than air typically does because the molecules in a solid substance are much closer and more tightly packed together than they are in air. This allows the solids to carry the waves easier and more efficiently, resulting in a louder sound. The density of the air itself also plays a determining factor in the loudness of sound waves passing through it.
*** This demo can also be done by placing a fully blown balloon next to your ear and tapping on it or by using a yardstick or ruler to press against a ticking clock and the outside of your ear. With the balloon, the air inside of it is more tightly compressed and closer together than the air molecules in the rest of the room. The air inside the balloon is then a better conductor than the air outside of the balloon. The wooden yardstick is a better conductor of sound than air allowing you to hear the clock's sound more easily through the yardstick.***

31. **The Screamer**

E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 104.

Objective: To understand how sound is produced and what creates variance in the tone or pitch of sound.

Standards: Position and Motion of Objects (sound is produced by vibrating objects – how and why pitch changes).

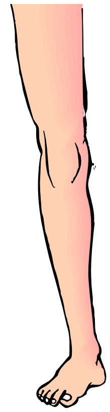
Materials: One piece of cellophane that is two inches square.

Procedure:

(1) Tightly stretch the piece of cellophane and hold it between the thumbs and index fingers of both hands.
(2) Place your hands directly in front of your face so that the cellophane is right in front of your lips.
(3) Blow as hard and as fast as you can directly at the edge of the cellophane, keeping your lips close together to produce a thin stream of air.
(4) If a high pitch sound is not produced, adjust the distance between your lips and the cellophane until desired sound is achieved.

Science Behind It: The thin stream of air produced by keeping your lips close together makes the cellophane vibrate extremely rapidly. Sound is produced from the vibration of objects and the faster something vibrates, the higher the tone will be of the sound.
*** This demo can also be done using two sheets of notebook paper placed on top of each other, with the bottom sheet sticking out towards you (about 1/2 inch past the top paper) and blowing between these sheets. ***

32. **The Invisible Leg**



Martin Gardner, Science Puzzlers, Website: http://64.233.167.104/search?q=cache:zVGnQA9cniEJ:www.vidyaonline.net/arvindgupta/martingardner.pdf+%22the+invisible+leg%22+experiment&hl=en&ct=clnk&cd=2&gl=us.

Objective: To demonstrate static electricity and to learn how it is created.

Standards: Structure of the Earth System (atmospheric composition and properties at different elevations), Structure of Atoms (properties of matter, atoms, and smaller components), and Structure and Properties of Matter (atoms interact with one another; the physical properties of compounds reflect molecule interaction).

Materials: One nylon stocking and one polyethylene bag (plastic grocery bag).

Procedure:

(1) Press and hold the toe of a nylon stocking against a wall in your classroom.
(2) With the other hand, rub the nylon briskly several times up and down.
(3) Hold the nylon freely in the air and observe.

Science Behind It: When you hold the nylon freely after stroking it with the bag, it should fill out as if an "invisible leg" were inside of it. This happens as a result of a strong static charge on the nylon from the plastic bag. Like charges of atoms and molecules repel each other and therefore, the sides of the nylon stocking will spread as far apart from each other as possible.

33. I Can Create Lightning

Jean Potter: Science in Seconds for Kids: Over 100 Experiments You Can Do in Ten Minutes or Less (1995), page 120.

Objective: To demonstrate static electricity and discuss how it is involved in lightning and weather.

Standards: Objects in the Sky (sky object properties, locations, and movements), Structure of the Earth System (atmospheric composition and properties at different elevations; clouds-formation and impact on weather and climate), Light, Heat, Electricity, and Magnetism (electricity in circuits can produce light and heat), Structure of Atoms (properties of matter, atoms, and smaller components), and Structure and Properties of Matter (atoms interact with one another; the physical properties of compounds reflect molecule interaction).

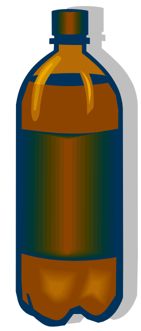
Materials: two balloons and a wool mitten

Procedure:

(1) Inflate both balloons.
(2) Vigorously rub one balloon with the wool mitten and the other balloon against a smooth wall.
(3) Dim the lights or darken the room.
(4) Holding one balloon in each hand, slowly move the balloons closer together and have the students observe what happens.

Science Behind It: In the start of the demo, both balloons had negative and positive electrical charges within them. Once one balloon was rubbed with the mitten and the other rubbed against the wall, their overall charges were changed. One balloon then had more negative charge while the other had more positive charge in it. When the balloons were held close together, a strong attraction between the positive and negative charges was created. This charge "jumped" from the negative balloon to the positive balloon; the path that all electricity follows. Electricity formed in this way is known as static electricity. Lightning results when electricity travels from clouds in the atmosphere to the ground. During lightning, negative charges build up at the bottom base of clouds and when the difference between the negatively charged clouds and the positively charged ground becomes large enough, lightning strikes.

34. **Weather Predictions from a Pop Bottle**



Jean Potter: Science in Seconds for Kids: Over 100 Experiments You Can Do in Ten Minutes or Less (1995), page 121.

Objective: This demo will help to explain what a barometer is and how it can be used to help predict the weather.

Standards: Structure of the Earth System (atmospheric composition and properties and different elevations; clouds – formation and impact on weather and climate), Understanding About Science and Technology (scientists use tools; technological designs have constraints; science often advances with the introduction of new technologies), and Science and Technology in Local Challenges (benefits of science and technology – these benefits are not available to all people).

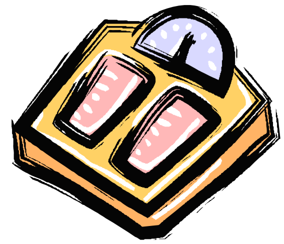
Materials: plastic bowl, two liter pop bottle, and tap water.

Procedure:

(1) Fill the plastic bowl about halfway with tap water.
(2) Fill the pop bottle with water so that it is about three – quarters full.
(3) Place and hold your hand over the opening of the pop bottle as you turn it upside down.
(4) Place the opening of the upside down bottle directly on the bottom of the bowl.
(5) Carefully and quickly remove your hand from the bottle.
(6) Observe and discuss what happens.

Science Behind It: As you observe the pop bottle, you should see the water level inside the bottle either rise or fall depending on the conditions of the surrounding air at the time. This happens because the changing pressure of the outside air on the water in the bowl causes the water level in the bottle to change. When air pressure rises, water is pushed up into the bottle and when air pressure falls, the water level in the bottle falls as well. These conditions assume that the pressure inside of the bottle remains the same, as it should if the demo was conducted properly. This pop bottle barometer can be used to help predict future weather conditions because high pressure usually means better weather, while low pressure typically indicates colder temperatures or rainfall. Scientists use barometers (much more sophisticated ones) to help understand and predict weather and climate patterns. Scientists then use this information to prepare citizens for the upcoming weather events.

35. **Instant Weight Loss with Elevation**



Jean Potter: Science in Seconds for Kids: Over 100 Experiments You Can Do in Ten Minutes or Less (1995), page 48.

Objective: To demonstrate how elevation in Earth's atmosphere and gravitational pull are related.

Standards: Structure of the Earth System (atmospheric composition and properties and different elevations) and Motions and Forces (gravitation properties and the law for predicting its strength).

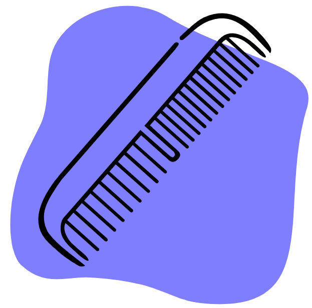
Materials: bathroom scale and a tall building with multiple floors.

Procedure:

(1) Have students weigh themselves on the top floor of the building and record their weights.
(2) Have students weigh themselves on the bottom floor of the building and record their weights.
(3) Discuss findings with class.

Science Behind It: Each student should have recorded a slightly lower weight for themselves on the top floor than on the bottom floor. This is because weight is the measurement of the net amount of downward force pulling on an object. The weight of a person slightly decreases as they move farther away from Earth's surface because as elevation increases, the forces of gravitational pull decreases. This is why astronauts are weightless in space, as they are not under the force of gravity at all.

36. **Comb Beams**



Jean Potter: Science in Seconds for Kids: Over 100 Experiments You Can Do in Ten Minutes or Less (1995), page 71.

Objective: To demonstrate how the angles of the sun's rays affect their strength and to explain how this is the cause of seasonal changes.

Standards: Objects in the Sky (sky object properties, locations, and movements; why the sun is important), Changes in the Earth and Sky (diurnal and seasonal weather changes), and Earth in the Solar System (position, properties of the sun, earth, and its moon; predictable motions explain day, the year, moon phases and eclipses; sun's weather, water cycle; cause of the seasons).

Materials: comb and piece of white cardboard.

Procedure:

(1) Place the comb on one edge of the cardboard with its teeth down so that the sun's rays shine through the teeth and onto the cardboard.
(2) Tilt the cardboard at various angles while always keeping the teeth of the comb next to the bottom edge of the cardboard.
(3) Instruct the students to observe how the angle of the cardboard affects the light pattern of the sun's rays on the cardboard.

Science Behind It: This demo shows how the light rays from the sun can be spread out or concentrated to cover large or small areas. The students should have observed that depending on the degree to which the cardboard was tilted, the rays shining through the comb's teeth were either lengthened or shortened. They should have also noted that when the light covered a larger area, it was not as bright because the rays were not as directly concentrated in any one spot. Since the Earth is tilted on its axis in relation to the sun, rays of light strike the Earth at different angles during different times of the year. This causes seasonal changes to occur. Summer in the northern hemisphere occurs when the northern hemisphere is tilted towards the sun and its rays shine on it more directly. Conversely, it is winter in the northern hemisphere when the northern hemisphere is tilted away from the sun and its rays then hit the hemisphere at more of an angle and are thereby more spread out.

37. The Collapsing Bottle

Judy Breckenridge, Anthony D. Fredericks, and Louis V. Loeschnig: 365 More Simple Science Experiments with Everyday Materials (1998), page 25.

Objective: To demonstrate the properties of warm and cool air.

Standards: Properties of Earth Materials (physical and chemical properties of gas), Light, Heat, Electricity, and Magnetism (ways to create heat - conduction), and Transfer of Energy (heat flows from warmer objects to cooler objects until both reach the same temperature).

Materials: plastic two liter bottle with cap and very hot tap water.

Procedure:

(1) Pour the very hot tap water into the bottle until is approximately half full and leave the cap off.

Be careful not to burn yourself with the water

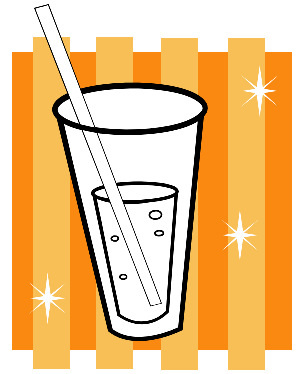
(2) Swish the water around in the bottle for about one minute.

(3) Pour the water out and quickly put the cap on the bottle, ensuring that it is tightly sealed.

(4) Observe.

Science Behind It: The sides of the two liter bottle should suddenly collapse inward. This happens because the hot tap water heats the air inside the bottle and since the cap is left off, the bottle completely fills with warm air. In step three when the water is poured out and the bottle is capped, the air inside the bottle rapidly begins to cool back towards room temperature. A property of cool air is that it takes up less space than warm air because its molecules are closer together. Because of this property, there is now “extra room” inside the bottle and to fill the space, the sides of the bottle suddenly collapse. The collapse is caused by the force of the greater air pressure outside of the bottle.

38. Magical Bending Straw



E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: <u>365 Simple Science Experiments</u> (2000), page 21.

Objective: To learn about refraction of light and the properties of light as it travels through different mediums.

Standards: Light, Heat, Electricity, and Magnetism (light reflectance, refraction, and absorption), Transfer of Energy (light transmission, refraction, absorption, reflection, and scattering).

Materials: drinking glass, drinking straw, and water.

Procedure:

(1) Fill the glass halfway with water.
(2) Place the drinking straw in the glass.
(3) Look at the straw from the top, the bottom, and the sides.
(4) Make note of observations.

Science Behind It: Students should notice that the straw appears bent or broken at the point where the it meets the water as they observe it from the sides of the glass. The straw appears bent because rays of light travel more slowly through mediums such as glass and water than they do through air. Since the light from the straw in the water reaches observers eyes later than the part of the straw not in the water, the straw appears broken or bent.

39. **A Balloon Rocket**

Judy Breckenridge, Anthony D. Fredericks, and Louis V. Loeschnig: 365 More Simple Science Experiments with Everyday Materials (1998), page 72.

Objective: To learn about the properties of air and air pressure while also learning about Newton's third law of motion.

Standards: Properties of Earth Materials (physical and chemical properties of gas), Structure and Properties of Matter (properties of gases), and Motions and Forces (laws of motion).

Materials: One balloon.

Procedure:

(1) Inflate the balloon as full as you possibly can.
(2) Hold the end of the balloon tightly closed as you describe why the balloon appears as it does (described below).
(3) Instruct students to observe the balloon as you let go of it.
(4) Discuss why the balloon acted the way it did (described below).

Science Behind It: In step two, the balloon appears large and round because the air pressure inside of the balloon pushes equally in all directions. The air pressure causes a balance that allows the balloon to float as you hold it. As you let go of the balloon and the air inside of it begins to rush out, the balance of air pressure is gone. The air rushes out of the balloon because it was under higher pressure inside the balloon than the air outside of it. As things commonly do in science, the air moved from higher pressure concentration to lower pressure concentration. The air rushes out from the balloon in one direction and causes the balloon to travel in the opposite direction. This is a demonstration of Isaac Newton's third law of motion: "every action has an opposite and equal reaction." The air rushes out and the balloon moves in the opposite direction around the room until all the air is gone from inside the balloon and it falls to the ground.

40. **Bent Water**

Jean Potter: Science in Seconds for Kids: Over 100 Experiments You Can Do in Ten Minutes or Less (1995), page 36.

Objective: To demonstrate static electricity and to use it to explain how positive and negative charges are attracted to each other. This knowledge of static electricity should also be related to phenomena in the atmosphere such as lightning.

Standards: Properties of Earth Materials (physical and chemical properties of water), Structure of the Earth System (atmospheric composition and properties at different elevations; clouds – formation and impact on weather and climate), Structure of Atoms (properties of matter, atoms, and smaller components), and Structure and Properties of Matter (atoms interact with one another; the physical properties of compounds reflect molecule interaction).

Materials: tap water and a comb.

Procedure:

(1) Turn on the water faucet to allow a thin stream of water to flow.
(2) Comb your air approximately thirty times or for approximately thirty seconds.
(3) Hold the comb near the stream of water without touching the water.
(4) Observe what happens.

Science Behind It: By combing your hair, you charged your hair with static electric charges. This caused the comb to become primarily negatively charged. Water on the other hand is positively charged, and since opposite charges attract, the negative charges from the comb attracted the positive charges of the water. This attraction is what caused the stream of water to bend towards the comb. Static electricity, like that demonstrated here, is the driving mechanism behind lightning in the atmosphere. When storm clouds form, negative charges build up in the bottom of the clouds and strive to reach the positive charges of Earth's surface. When the difference between these charges becomes great enough, lightning strikes as the negative charges "jump" from the clouds to the ground.

41. **Expanded Air is Cold**

Mark Heilbrunn, Prep Academy for Writers

Objective: To demonstrate the properties of air when it expands.

Standards: Properties of Earth Materials (physical and chemical properties of gas), Structure of the Earth System (atmospheric composition and properties at different elevations), Properties of Objects and Materials (object properties – temperature), Conservation of Energy and Increase in Disorder (heat consists of random vibrations and motions of atoms and molecules), and Structure and Properties of Matter (properties of gases).

Materials: a bottle of compressed air keyboard cleaner and students' hands.

Procedure:

(1) Spray students' hands with the compressed air keyboard cleaner.

Science Behind It: The students will observe that the air feels cold on their hands. This is because the air has expanded by leaving its bottle. When the air was in the bottle, it was under higher pressure than it is in the normal atmosphere of your hand. This demo can relate to air temperature differences at different elevations. For example, temperatures tend to be the highest at the base of mountains and the lowest at the peak of mountains. This is because as you increase with elevation, atmospheric pressure decreases. Since the pressure is decreased, molecules tend to spread out more. Because heat is produced by the random vibrations of and motion of atoms and molecules and the molecules are further apart at higher elevations, fewer vibrations between the molecules occur, resulting in less heat produced, and thus a lower temperature.

42. **Bernoulli's Law with Pop Cans**

Mark Francek

Objective: To demonstrate Bernoulli's Law and explain its relation to air pressure differences and what happens because of these differences.

Standards: Properties of Earth Materials (physical and chemical properties of gas) and Motions and Forces (laws of motion).

Materials: two empty aluminum pop cans and a flat surface.

Procedure:

(1) Place the empty cans a few inches apart on a flat surface.
(2) Ask the class what they think will happen when you blow between the cans from above them.
(3) Blow between the two cans from directly above them and observe what happens.
(4) Set the cans up again as in step one and ask the class what they think will happen when you blow between the cans horizontally from the level of your flat surface.
(5) Blow horizontally between the cans from the direct level of the flat surface they are on and observe what happens.

Science Behind It: This demo shows what happens when air pressure is changed between the cans. When blowing between the cans in step three, the cans rolled away from each other. This happened because by blowing down between them, you increased the air pressure between them. Air has a natural tendency to move from high to low pressure. Because of this, the cans rolled away from where you blew so that the high pressure between them could equalize with the lower pressure on the other side of the cans. However, when you blew between the cans from a horizontal position in step five, the cans rolled together. This is probably the opposite of the result that the majority of your class predicted. This occurred because this time, you lessened the pressure between the cans. As you blew horizontally, you essentially "cleared out" the air between the cans therefore creating an area of low pressure. The higher pressure on the outside of the cans pushed the cans together towards the area of lower pressure. As the speed of air increases, the pressure of the air decreases and the faster the air moves the less pressure it has. The lessening of pressure due to high speed movement of air is one of the reasons why tornadoes can be very destructive as objects are thrown into the whirling air by the stronger air pressure around them.

HYDROSPHERE DEMONSTRATIONS:

43. **Water's Great Escape**

E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 116.

Objective: To illustrate the process of capillary action and it relate it to plant roots.

Standards: Properties of Earth Materials (physical and chemical properties of water and soils; soil properties) and Structure of the Earth System (water cycle).

Materials: two drinking glasses, two sheets of paper towels, and water.

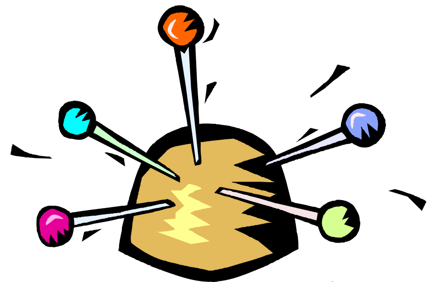
Procedure:

(1) Fill one drinking glass almost completely full with water.
(2) Place this glass next to the other glass. If both glasses are the same height, elevate the full glass above the empty one by placing a book or something else underneath it.
(3) Place the two sheets of paper towel on top of each other.
(4) Twist the sheets of paper towel tightly together and bend them slightly in half once you have completed twisting them.
(5) Place one end of the paper towels into the full glass and the other end into the empty glass.
(6) Observe what happens while being patient as it may take a while to complete.

This demo should be done in a sink or basin to avoid a wet mess if the towels leak

Science Behind It: This demo illustrates the process of capillary action as the water moves from the full glass up into the paper towel and down into the empty glass. Within a minute or two, the paper towels begin acting as a wick as the water begins to seep up and across it. Once a few minutes have passed, water will appear in the empty glass. The water does not flow, however, from one glass to the next. Instead of flowing, the water "oozes" into the empty glass. This happens because the water travels into and between the thousands, and maybe millions, of spaces between the fibers of the paper towel. This movement of water is capillary action. Capillary action is one way that moisture gets from the soil into many plants, as it moves up through the plant roots. Capillary action is a slow, oozing process because the movement of water must fight gravity. It is made possible by the strong surface tension of water. good

44. How Many Pins?



E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page page 112.

Objective: To demonstrate water's property of surface tension.

Standards: Properties of Earth Materials (physical and chemical properties of water) and Structure and Properties of Matter (atoms interact with each other by sharing or transferring electrons; the physical properties of compounds reflect molecule interaction).

Materials: Drinking glass, several straight pins, and water.

Procedure:

(1) Place the glass on a countertop or in a sink.
(2) Fill the glass with water until it is full to the brim.
(3) Ask the class how many straight pins you will be able to add to the glass before the water overflows.
(4) Carefully hold one pin over the glass so that its point just touches the surface of the water.
(5) Carefully let go of the pin so that it slides down into the water.
(6) Continue adding one pin at a time, in the same fashion as steps four and five, until the water finally overflows.

Science Behind It: By the time the water overflows, you will have added more pins than what was probably expected from the class. As you look sideways at the glass, you will observe that the level of the water is actually above the edge of the glass. The property of surface tension keeps the water from overflowing even after it seems impossible for the glass to hold any more pins. Surface tension is caused by the attraction of the water molecules to each other and their various intermolecular forces. Surface tension is the reason why it hurts when you perform a "belly flop" in a pool or body of water because it takes a lot of force to break the strong molecular bonds of water molecules.

45. **The Reappearing Penny**

Judy Breckenridge, Anthony D. Fredericks, and Louis V. Loeschnig: <u>365 More Simple Science Experiments with Everyday Materials (1998)</u>, page 54.

Objective: To demonstrate how light is reflected and refracted by water.

Standards: Properties of Earth Materials (physical and chemical properties of water), Light, Heat, Electricity, and Magnetism (light reflectance, refraction, and absorption) and Transfer of Energy (light transmission, refraction, absorption, reflection, and scattering).

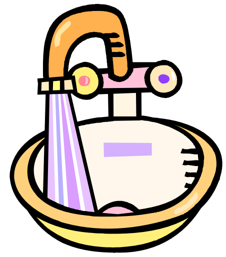
Materials: Small dish, one penny, and water.

Procedure:

(1) Place the penny in the middle of the empty dish.
(2) Set the dish on a flat table or desktop.
(3) Have a student carefully keep their eyes focused on the penny as they slowly back up from the dish until its edge just blocks the view of the penny.
(4) Instruct the student to not move as you promise them that you will make the penny “magically” reappear.
(5) Slowly fill the dish with water.
(6) Repeat above process with more students.

Science Behind It: As you add water to the dish, the penny will gradually come back into the view of the student. However, magic is not the reason this happens. Adding the water to the dish causes the light to be refracted, or bent from the penny around the edge of the dish. This allows the light from the penny to reach the eye of the viewer. Water causes light to be refracted in various ways that help or hinder our view of many objects.

46. **Homemade Hydroelectric Power**



Judy Breckenridge, Anthony D. Fredericks, and Louis V. Loeschnig: 365 More Simple Science Experiments with Everyday Materials (1998), page 49.

Objective: To model a waterwheel and demonstrate how they are used to generate power and electricity.

Standards: Properties of Earth Materials (physical and chemical properties of water), Understanding About Science and Technology (scientists use tools; technological designs have constraints; technological solutions have intended benefits and unintended consequences; scientists from different disciplines must work together), Types of Resources (types of resources: air, water, soil, food, fuel, quiet places, beauty, and security), Changes in Environments (good, bad, neutral changes in environments – impact of pollution), Science and Technology in Local Challenges (benefits of science and technology are not available to all people), Environmental Quality (natural ecosystem importance – human impact on ecosystems; many factors influence environmental quality; human materials affect both physical and chemical cycles of the Earth), and Natural and Human – Induced Hazards (human activities can enhance potential for hazards). (good comprehensive list)

Materials: One plastic-foam or plastic-coated plate, scissors, pencil, and water faucet.

Procedure:

(1) Using the scissors, cut six one – inch slits that are evenly spaced around the outside edge of the plate.
(2) Use these cuts to form blades as you bend them away from the plate.
(3) Push a pencil through the middle of the plate and work it back and forth until the pencil moves easily.
(4) Turn the water faucet on and adjust it so that a fast stream of water flows out.
(5) Hold the pencil so the one of the blades from the wheel catches the stream of water.

Science Behind It: As the water comes out of the faucet, it pushes against one blade of the wheel, then another, and another blade until the wheel is set in motion. This motion can be used to generate large amounts of power and produce a type of electricity known as hydroelectric power. Large scale waterwheels and electricity plants are typically built near dams or on fast flowing rivers so that a large amount of rapid moving water is used to generate lots of power. While this technology can used beneficially for power and electricity, it may also have drawbacks and consequences in terms of the environmental quality and possible increased risk of hazards. Teachers may wish to review the many objectives above while performing this demo and use them to interconnect science/technology and the environment and risks, etc. in future lessons.

47. “Freeze Me and I’ll Burst”

Judy Breckenridge, Anthony D. Fredericks, and Louis V. Loeschnig: 365 More Simple Science Experiments with Everyday Materials (1998), page 41.

Objective: To demonstrate the properties of water as it changes state.

Standards: Properties of Earth Materials (physical and chemical properties of water) and Properties of Objects and Materials (states of matter).

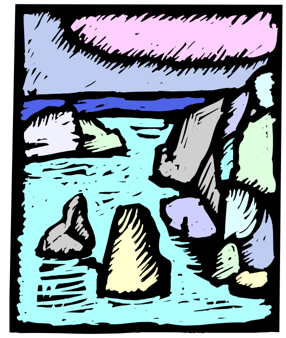
Materials: small jar, piece of cardboard, freezer, and water.

Procedure:

(1) Fill the jar to its rim with water.
(2) Cover the top of the jar with the piece of cardboard, ensuring the top of the jar is completely covered.
(3) Carefully place the jar (with cardboard on top) in the freezer.
(4) Wait until the water completely freezes and observe what happens.

Science Behind It: Once the water freezes inside the jar, the cardboard will be “lifted” above the top of the jar by the water. This happens because when water freezes, it expands in order to create more space for its molecules to spread out. This is also similar to the way water behaves when it is heated, as its molecules spread out and expand. The frozen water molecules push their way out of the jar in an attempt to create more space for themselves. This same principle is what causes water pipes to break in the winter. If the jar had been sealed, the expanding water would have broken the jar because it had nowhere else to go. In order to prevent water pipes from bursting, some people chose to leave their faucets on during extremely cold days and nights. The constant flow of water through the pipes helps to prevent it from freezing because its molecules are in constant motion.

48. **Ice Boat Float**



Judy Breckenridge, Anthony D. Fredericks, and Louis V. Loeschnig: 365 More Simple Science Experiments with Everyday Materials (1998), page 40.

Objective: To demonstrate density differences between states of water and to explain why all water in lakes does not freeze in the winter.

Standards: Properties of Earth Materials (physical and chemical properties of water), Structure of the Earth System (water cycle), Properties of Objects and Materials (states of matter), Properties and Changes in Matter (substance density).

Materials: large jar filled with very cold water and one ice cube.

Procedure:

(1) Place the ice cube in the jar of water

Science Behind It: The ice cube floats on the water just like a boat does. This simple demo proves that ice is less dense than water because it floats on it. As water molecules freeze, they expand and spread out causing them to become less dense than molecules in liquid water. Because of these laws of density, water freezes from the top down. This is why lakes do not completely freeze in the winter but instead only freeze on the surface and a small distance below. The surface layer of ice may help to prevent fish and other lake species during the colder times of the year.

49. **The Floating Glass**

Judy Breckenridge, Anthony D. Fredericks, and Louis V. Loeschnig: 365 More Simple Science Experiments with Everyday Materials (1998), page 40.

Objective: To demonstrate that water is displaced by floating objects.

Standards: Properties of Earth Materials (physical and chemical properties of water).

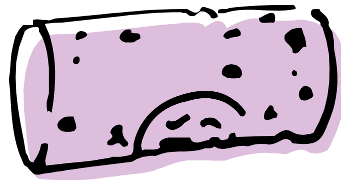
Materials: two drinking glasses that float inside each other (glass works the best) and water.

Procedure:

(1) Pour just enough water to cover the bottom of one of the drinking glasses.
(2) Place the second glass inside of the first.
(3) If the second glass does not float, remove it and add some more water to try again.

Science Behind It: The second glass should float on the water inside of the first glass because the weight of the water in the first glass is heavier than the weight of the second glass. This happens because Archimedes, a Greek mathematician, discovered that floating objects displace (or pushes out of its way) an amount of liquid that is equal to its own volume.

50. **Center the Cork**



Martin Gardner, Science Puzzlers, Website: http://64.233.167.104/search?q=cache:zVGnQA9cniEJ:www.vidyaonline.net/arvindgupta/martingardner.pdf+%22the+invisible+leg%22+experiment&hl=en&ct=clnk&cd=2&gl=us.

Objective: To demonstrate water's property of surface tension.

Standards: Properties of Earth Materials (physical and chemical properties of water) and Structure and Properties of Matter (atoms interact with each other by sharing or transferring electrons; the physical properties of compounds reflect molecule interaction).

Materials: one drinking glass, one small cork, and water.

Procedure:

(1) Fill the drinking glass almost completely full.
(2) Drop the small cork into the glass.
(3) Challenge your students to make the cork float in the center of the water without touching any side of the glass.
(4) After the students determine that it is impossible to do so, proceed with the demo.
(5) Carefully add more water to the glass until the water slightly rises above the rim.
(6) Observe what happens.

Science Behind It: As you look sideways at the glass, you will observe that the level of the water is actually above the edge of the glass. The property of surface tension keeps the water from overflowing the glass. Surface tension is caused by the attraction of the water molecules to each other and their various intermolecular forces, chiefly hydrogen bonding. Surface tension is the reason why it hurts when you perform a "belly flop" in a pool or body of water because it takes a lot of force to break the strong molecular bonds of water molecules. In this demo, the cork will automatically move to the center of the glass where the water is the highest, and remain there.

51. **Brim to Brim**

Martin Gardner, Science Puzzlers, website:
http://64.233.167.104/search?q=cache:zVGnQA9cniEJ:www.vidyaonline.net/arvindgupta/martingardner.pdf+%22the+invisible+leg%22+experiment&hl=en&ct=clnk&cd=2&gl=us.

Objective: To demonstrate and interrelate the properties of surface tension and air pressure on how they affect water and water movement.

Standards: Properties of Earth Materials (physical and chemical properties of water and gas), Structure of the Earth System (atmospheric composition and properties at different elevations), and Structure and Properties of Matter (atoms interact with each other by sharing or transferring electrons; the physical properties of compounds reflect molecule interaction).

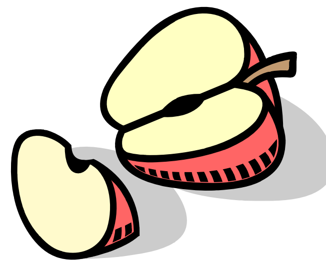
Materials: two drinking glasses and one drinking straw.

Procedure:

(1) Place the two drinking glasses completely filled with water brim to brim so that the mouths of both glasses are touching each other. (So the two glasses are touching one another?) If you have trouble doing this, submerge both of them underwater in a sink, put them together and lift out so that one glass is upside down on top of the other (the drinking glasses should be placed in an empty sink or basin to catch water if and when it spills).
(2) Carefully move the upper glass (Aren't they side by side?) to make a small, barely visible opening between the rims of the glasses.
(3) Ask the class if they think that you will be able to remove any of the water without touching the glasses and briefly discuss their ideas.
(4) Hold one end of the straw close to the opening between the rims of the glasses and blow through the straw.

Science Behind It: At first when the top glass is moved to create a small opening, the properties of surface tension and air pressure keeps the water in the glass. This happens because the air pressure outside of the glasses is greater than the air pressure inside of the glasses. However, when air is added to the glass through the straw, the air pressure inside the glass becomes greater than the air pressure outside of the glass and water flows out of the top glass. The air blown into the glass displaces the water in the glass. The surface tension of the water in the top glass is also broken due to the increased air pressure and the downward force of gravity. Because gravity overpowers the surface tension, water escapes from the top glass. This demo shows how air or other objects in water can displace water and affect its movement.

52. **Water, Water Everywhere**



Erin Rittenhouse, Spring 2001, Students' Science Demonstrations:
http://www.csulb.edu/~lhenriqu/300demo.htm#Erin%20Rittenhouse.

Objective: To demonstrate the proportion of the Earth's fresh versus salt water and to discover how much of this is usable by certain organisms while relating this to human influence and impact around the world.

Standards: Structure of the Earth System (water cycle), Geochemical Cycles (cycling of elements between Earth, water, atmosphere, and organisms), Types of Resources (types of resources: air, water, soil, food, fuel, quiet places, beauty, and security), Changes in Environments (good, bad, neutral changes in environments – impact of pollution), Natural Resources (natural resources will continue to be used to maintain human populations; impact of increasing human consumption on the environment), and Environmental Quality (natural ecosystem importance – human impact on ecosystems; many factors influence environmental quality; human materials affect both physical and chemical cycles of the Earth).

Materials: one apple and one knife.

Procedure:

(1) Cut the whole apple into equal quarters.
(2) Cut one of the four quarters in half so that each new half represents approximately 12% - 13% of the whole.
(3) Cut one of these new halves in half to represent 6%.
(4) Cut one these halves in half again to show 3%.
(5) Cut this half into a 1/3 and 2/3 section, producing a 1% and 2% piece of apple.
(6) Discuss with the class.

Science Behind It: The whole apple in the beginning of the demo represents all of the water in the world, both fresh and salt. In step four, one of the 3% pieces represents all of the fresh water in the world while the entire rest of the apple represents the oceans. When the 3% slice of apple is cut in step five, the 1% slice represents all of the usable fresh water to all of the organisms in the world. Students will be shocked when they discover that only such a small portion of the world's water is fresh and usable. This demo is a good one to use at the very beginning of a unit on the hydrosphere and can be used to spark discussions on a variety of topics related to resource use and limitation, pollution, human impact on resources, environmental quality or any other topic of the teacher's choice.

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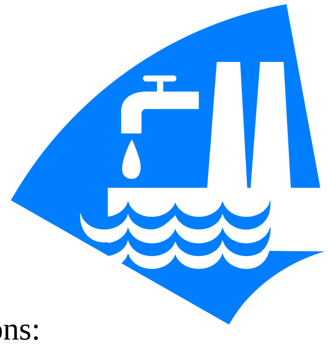
53. **The Effects of Stream Pollution, in a Jar**



Erin Bender, Spring 2004, Students' Science Demonstrations:
http://www.csulb.edu/~lhenriqu/300demo.htm#ErinBender.

Objective: To observe the lasting effects of a small amount of pollution on a stream and its wildlife.

Standards: Structure of the Earth System (water cycle), Geochemical Cycles (cycling of elements between Earth, water, atmosphere, and organisms), Types of Resources (types of resources: air, water, soil, food, fuel, quiet places, beauty, and security), Changes in Environments (good, bad, neutral changes in environments – impact of pollution), Natural Resources (impact of increasing human consumption on the environment), and Environmental Quality (natural ecosystem importance – human impact on ecosystems; many factors influence environmental quality; human materials affect both physical and chemical cycles of the Earth).

Materials: One gallon glass jar, water, and red food coloring.

Procedure:

(1) Pour about one half cup of water into the jar.
(2) Add and stir in two drops of food coloring to the jar.
(3) Add about one cup of water at a time to the jar until all the food coloring disappears.

Science Behind It: The red dye represents industrial discharge, spillage, or dumping of pollution into a water source such as a stream or river (the jar). After about seven cups of added water, the food coloring will disappear. The red coloring is at first very visible because the molecules of the dye are close enough together to be seen. However, as more water is added, the molecules spread themselves out, becoming less visible and eventually invisible. This is a very realistic demonstration of many pollution events. As the pollutant initially enters the water, it may be easily visible and the source may be easily determined. However, as it flows downstream and continues to be mixed with more water and ingested by organisms, the pollutant may not be visible any longer. The students should realize at this point that just because a pollutant is invisible, does not mean that it is gone from the water. Animal and plant life in and around the water may be affected by a pollutant several miles from the original source.

54. **Float Your Metal Boat**

Randy Drumm, Spring 2004, Students' Science Demonstrations: http://www.csulb.edu/~lhenriqu/300demo.htm#RandyDrumm.

Objective: To demonstrate surface tension of water, that certain things can break the surface tension and what happens to objects in the water as a result of surface tension breakage.

Standards: Properties of Earth Materials (physical and chemical properties of water) and Structure and Properties of Matter (atoms interact with each other by sharing or transferring electrons; the physical properties of compounds reflect molecule interaction).

Materials: a piece of aluminum foil two inches wide and four inches long, a bottle of dishwashing soap, and a sink full of water.

Procedure:

(1) Fill a sink with water.
(2) Fold the aluminum foil into the shape of a "powerboat." The shape doesn't really matter as long as it does not exceed the above dimensions of length and width.
(3) Place the boat into the sink of water.
(4) Squeeze a drop of dishwashing soap onto the water directly behind the boat.
(5) Observe.

Science Behind It: When the soap is added to the water, the boat will move forward. This happens because the introduction of the soap to the water breaks the water's surface tension behind the aluminum foil and the surface tension in front of the boat pulls it forward. The water molecules are held together by intermolecular forces; hydrogen bonds. These bonds hold the water molecules tightly together giving it its surface tension. The soap molecules "squeeze" between the water molecules, increasing the distance between them. Because of the increased distance, the intermolecular forces are weakened and the hydrogen bonds become less efficient in keeping the surface tension.

55. **Why Turbidity Affects Visibility**

Cara Snellen, Fall 2000, Students' Science Demonstrations:
http://www.csulb.edu/~lhenriqu/300demo.htm#cara.

Objective: To demonstrate water turbidity and show how it affects visibility in bodies of water.

Standards: Properties of Earth Materials (physical and chemical properties of rocks, soils, and water), Structure of the Earth System (water cycle; water as a solvent), Energy in the Earth System (heating of Earth's surface and atmosphere drives weather and ocean currents), and Geochemical Cycles (cycling of elements between Earth, water, atmosphere, and organisms).

Materials: two beakers or clear jars, a handful of sand, and a piece of paper with something written on it.

Procedure:

(1) Fill both jars with clean water.
(2) Add the handful of sand to one of the jars.
(3) Place the jar with all water over the word on the paper.
(4) Look through the top of the jar and observe the visibility of this water sample.
(5) Place the jar with sand over the word on the paper.
(6) Look through the top of the jar and observe the visibility of this water sample.

Science Behind It: Turbidity is known as the degree of cloudiness or haziness of a fluid or of air caused by sediments or other particles being suspended within the fluid or air. Turbidity has a direct influence on visibility, which is the distance that one can see underwater or through air to clearly distinguish an object. Areas of water with high water movement (surf zone, river mouth, or white water rapids) will mix up sediments much more frequently, therefore having higher turbidity, and resulting in decreased visibility. This demo shows how turbid water has low visibility compared to cleaner, calmer water as the word on the paper could be easily read through the clear water but not read or barely read through the jar with the turbid water.

56. The Fireproof Balloon

Filiz Rende and Allan Glover, Spring 2003, Students' Science Demonstrations: http://www.csulb.edu/~lhenriqu/300demo.htm#FilizRende.

Objective: To demonstrate that water is a good absorber of heat and how this may affect other materials.

Standards: Properties of Earth Materials (physical and chemical properties of water and gas), Earth in the Solar System (sun's weather and water cycle), Energy in the Earth System (heating of Earth's surface and atmosphere drives weather and ocean currents), Transfer of Energy (heat flows from warmer objects to cooler objects), and Interactions of Energy and Matter (what accounts for insulating, semiconducting, and superconductor materials).

Materials: two round balloons, a lighter, and water.

Procedure:

(1) Inflate one balloon and tie it closed.
(2) Place about ¼ cup of water in the second balloon, inflate it, and tie it closed.
(3) Hold the lighter under the first balloon and observe.
(4) Hold the lighter under the second balloon and observe.

Science Behind It: The first balloon breaks because it becomes very hot, the rubber becomes too weak, and the balloon cannot resist the expanding air pressure inside. The second balloon does not become very hot and does not break. While the rubber of both balloons was heated, the water in the second balloon absorbed most of the heat from the flame. This allows the heat to be transferred from the rubber of the balloon to the water. Because of this, the rubber does not weaken and the balloon stays inflated. This demo shows that water is a good absorber of heat and a better absorber than air.

57. **Falling Test Tubes?**

Mia Brandy, Spring 2000, Students' Science Demonstrations:
http://www.csulb.edu/~lhenriqu/300demo.htm#mia.

Objective: To demonstrate adhesion and cohesion.

Standards: Properties of Earth Materials (physical and chemical properties of water) and Structure and Properties of Matter (atoms interact with each other by sharing or transferring electrons; the physical properties of compounds reflect molecule interaction).

Materials: two glass test tubes (one small, one large), water, and something to catch water.

Procedure:

(1) Make sure that both test tubes are clean and that the smaller tube fits inside the larger one. It may be a good idea to experiment with different pairings of sizes to determine which ones work the best.
(2) Fill each test tube full with water.
(3) While holding both of the test tubes over the catch pan/container lower the smaller one inside of the larger one and release your grip on the small test tube.
(4) Invert the larger test tube.
(5) Observe.

Science Behind It: The smaller test tube will not fall out of the larger one. Water will drop out of both of the tubes and the smaller one will "rise" up into the larger one. This demo is made possible by the principles of adhesion and cohesion. Because water molecules are polar and attracted to each other, water forms beads and drops and has surface tension. This type of intermolecular force is known as cohesion. Cohesion occurs when the same type of molecules or materials are attracted to each other. An attraction that occurs between different types of molecules is known as adhesion. This is demonstrated by the attraction between the water and the glass of the test tube. Both forces of cohesion and adhesion are seen when the water is bulged and hanging out over the glass lip of the test tube (when they are inverted). In this demo, both attractive forces of cohesion and adhesion are stronger than the force of gravity and this is the reason why the small test tube does not fall when inverted.

58. **A Glacier in a Milk Jug**

Michigan Historical Center, Department of History, Arts, and Libraries, 2007: http://www.michigan.gov/hal/0,1607,7-160-17451_18670_18793-94369--,00.html.

Objective: To visually demonstrate how retreating glaciers affect the formation of landforms on the surface and vegetation of an area.

Standards: Properties of Earth Materials (soil properties), Changes in Earth and Sky (slow erosion, weathering), Structure of the Earth System (landforms are created by a balance of constructive and destructive forces; water cycle), and Earth's History (fossils – how life and environmental conditions have changed).

Materials: Plastic milk jug with top cut off, sand and gravel, water, and a refrigerator.

Procedure:

(1) Freeze a mixture of sand, gravel, and water in the milk jug.
(2) After the mixture has been frozen, allow it to thaw around its edges so that it can be removed from the milk jug. You may also choose to cut the milk jug away from the mixture instead of thawing it.
(3) Have the class examine the glacial mixture and discuss how the glacier would have accumulated its contents.
(4) Place the mixture block in an undisturbed, near location (sidewalk, playground, or large pan in the classroom) and allow it to melt.
(5) As the mixture melts, discuss what happens to the water runoff and sediments of the mixture with the class.

Science Behind It: This demo provides a visual representation of a retreating glacier for students. As it melts, the students are able to see the water runoff and the deposition of the sand and gravel. These deposits represent the formation of hills and glacial moraines while the runoff simulates actual water that may runoff from a glacier into a lake or river. As the students observe how the surface of an area may be altered by the retreating glacier, they can predict and estimate how these depositions and runoff will alter such things as vegetation and species numbers in the area. The students will also realize that scientists may observe these similar types of features in the field to also gain insight towards the history of an area's soil properties, vegetation, and speciation.

59. London Fog – Anywhere You Want It

Funburst Media LLC, 2005, Website: http://www.funology.com/laboratory/lab015.htm.

Objective: To demonstrate the formation of fog and how it relates to the water cycle.

Standards: Properties of Earth Materials (physical and chemical properties of water and gas), Structure of the Earth System (water cycle; atmospheric composition and properties at different elevations) and Energy in the Earth System (heating of earth's surface and atmosphere drives weather).

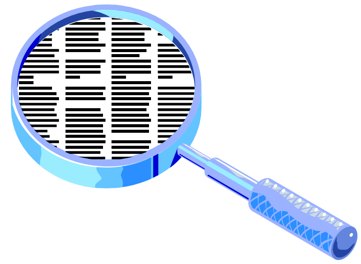
Materials: A large jar, strainer, water, and ice cubes.

Procedure:

(1) Fill the jar up with hot water.
(2) Pour out all of the water except for about an inch.
(3) Put the strainer over the mouth of the jar and place a few ice cubes in it.

Science Behind It: The cold air from the ice cubes will cause the warm moist air inside of the bottle to condense and therefore form fog. In order for fog to occur, air must become saturated or have a relative humidity of about 100%. Fog frequently happens when warm moist air travels over land, water, or by another air mass that is cooler than it is. Understanding the process of fog formation is important in understanding the water cycle, conditions of the atmosphere, and why some plants can survive in extremely dry areas (these plants, rely on condensation from fog as an important source of moisture). Fog can lead to condensation or even rain, which alters the water levels of areas and may influence that area's water cycle.

60. **Now I Can See It!**



Judy Breckenridge, Anthony D. Fredericks, and Louis V. Loeschnig: 365 More Simple Science Experiments with Everyday Materials (1998), page 54.

Objective: To demonstrate how light reflects water and can enhance vision by changing the path of light.

Standards: Properties of Earth Materials (physical and chemical properties of water), Light, Heat, Electricity, and Magnetism (light reflectance, refraction, and absorption) and Transfer of Energy (light transmission, refraction, absorption, reflection, and scattering).

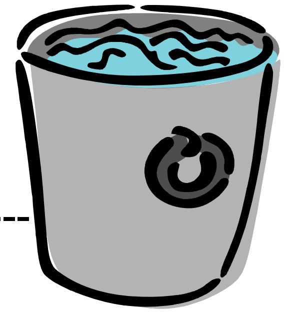
Materials: vegetable oil, page from magazine, and water.

Procedure:

(1) Place one dab of vegetable oil on a word from the magazine page, using your finger.
(2) Rub the oil into the word.
(3) Place one drop of water on top of the oil covered word.

Science Behind It: When the word is read through the water it appears larger. This happens because the water sits on top of the oil (since they do not mix) and forms a lens. This lens alters the path of light that reflects off of the page and reaches your eye. Because of this, the image appears fatter and larger. This is the same principle that is used in making eyeglasses. In eyeglasses, the glass forms the lens that bends the light in a particular way, allowing it to reach the eye at the correct angle to see well.

61. How Much Can it Hold?



Mary Elizabeth Dowse, Department of Natural Sciences, Western New Mexico University, Silver City, NM 88062, Journal of Geoscience Education, v. 48, 2000, p. 581.

Objective: To demonstrate the concepts of porosity and permeability.

Standards: Properties of Earth Materials (soil properties), Changes in the Earth and Sky (slow erosion, weathering), and Structure of the Earth System (water cycle).

Materials: large jar, larger sized pebbles or cobbles, and water.

Procedure:

(1) Fill the jar with the pebbles.
(2) Ask the students if they believe the jar is full and have them predict how much water can be added to the jar.
(3) Slowly add water to the jar.
(4) Have students observe the water movement through the jar.
(5) Repeat this demo (if desired) with the same size jar filled with well sorted, fine grained sand.

Science Behind It: Students will be able to observe how easily the water moves through a porous medium when water is added to the jar with large pebbles. The students should be aware that larger materials have higher porosity which is known as the void or empty spaces in a material. When water is added to the jar with sand, the concept of permeability is highlighted, which is the ability of a material to transmit fluids. The water takes a longer time to flow into the sand than into the pebbles. Porosity and permeability of materials are extremely important in regards to the flow of groundwater and surface runoff. Certain materials (as seen above) have different levels of porosity and permeability which greatly affects the amount of water received by plants, animals, and the overall flow of water in the water cycle. (Please do this experiment and see if more water actually fits, with time, in the sand. What do you predict, based on what you learned in Soils?)

SPACE/ASTRONOMY DEMONSTRATIONS:

62. What Do You Mean the Sun is Already Set?

E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 212.

Objective: To understand why the sun can be seen a few minutes before it actually rises and a few minutes after it sets below the horizon.

Standards: Objects in the Sky (sky object properties, locations, and movements), Earth in the Solar System (position, properties of the sun and earth), Light, Heat, Electricity, and Magnetism (light refraction), and Transfer of Energy (light transmission, refraction).

Materials: a tightly covered jar filled completely with water, unshaded lamp, and a few textbooks.

Procedure:

(1) Place a stack of a few textbooks on one side of a table.
(2) Put the lamp behind this stack of books. Make sure that the stack of books is high enough so that you cannot see the light from where you are sitting or crouching at the table.
(3) Place the filled jar on its side in front of the stack of books. The jar should be about level with the stack of books so you will probably need to place the jar on top of a smaller stack of books.
(4) Remaining eye level with the jar and stack of books, look at both of them.

Science Behind It: Even though the level of the light is below the stack of books, you should still be able to see the light. This happens because the rounded side of the jar acts like the Earth's atmosphere by bending or refracting the light. By doing this, it brings the light into view. If this does not happen, carefully adjust the level of the jar so this can occur. In refracting the light, the jar creates a mirage similar to those observed in the desert, at sea, on hot pavement, and in the sky. The light waves from the rising or setting sun must pass through a greater thickness of atmosphere than they do at noon. Because of this, the rays of sun are bent and at sunrise when the sun appears to moving up and over the horizon, an image or mirage of the sun can be seen on the horizon before the sun actually reaches it. Similarly at sunset, we continue to see an image of the sun briefly after the sun has technically set.

63. **Equator is Hot, North Pole is Not**

E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 207.

Objective: To demonstrate why direct rays of sun are hotter than slanted rays of sun and relate this to latitudinal temperature differences and the reason for seasonal changes in temperature.

Standards: Objects in the Sky (sky object properties, locations, and movements) and Earth in the Solar System (position, properties of the sun and earth; predictable motions explain day and year; cause of the seasons).

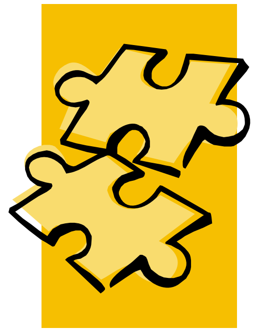
Materials: flashlight and dark sheet of paper.

Procedure:

(1) Shine the flashlight straight down on the sheet of paper.
(2) Observe.
(3) Angle the flashlight so that its light hits the paper at a slant.
(4) Observe.

Science Behind It: When the flashlight is pointed straight down on the paper it creates a small circle. When the flashlight is slanted on the paper, a larger, dimmer oval shape is created. It is important for students to first understand that both the oval and circle were created by the same light source and therefore both contain the same amount of light. However, because the oval is larger, the light within it is spread more thinly on the paper. In similar fashion, an actual ray of light from the sun spreads out more thinly than one that shines directly down. Both the rays of sun have the same amount of heat, but the heat carried by the slanted ray is spread out more and therefore less intense. Locations at or near the equator receive about two and one half times as much heat as the North and South Poles do because the sun's rays shine directly rather than on a slant. This is also the same principle that contributes to temperature changes associated with the seasons.

64. **Parallax Puzzle**



E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 159.

Objective: To demonstrate and understand the principle of parallax.

Standards: Objects in the Sky (sky object properties, locations, and movements).

Materials: one pencil.

Procedure:

(1) Hold the pencil out vertically right in front of your eyes.
(2) Close your left eye and then quickly open it and close your right eye.
(3) Continue to open and close your eyes, alternating them rapidly and observe what happens to the pencil.

Science Behind It: The pencil appears to jump and move side to side. This happens because the angle you view the pencil from changes. Our brain and eyes fool us into thinking that the pencil is changing position when it is in fact stationary in your hand. This is an important concept that scientists use when calculating the distances of different stars from Earth. When observing parallax, scientists measure angles and use geometry to determine the distance of objects. Specifically, the principle of triangulation is used to determine the distance to an object. Scientists observe something like a star for example at two different times at the same location. These two points and the spot on Earth form a very long and narrow triangle. They then calculate the difference in distance between the star (motion of the observer) from the two times. Using this distance, scientists can determine the acute angle at the top of the triangle and use these measurements to determine the long baseline side of the triangle which is the distance the star is from Earth.

65. **Moving Picture**

E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 159.

Objective: To further understand the concept of parallax and how scientists use it while measuring the distances of stars from Earth.

Standards: Objects in the Sky (sky object properties, locations, and movements).

Materials: a pencil and another fixed object such as a lamp or table.

Procedure:

(1) Hold the pencil out vertically right in front of your eyes.
(2) Ensure the fixed background object is in your direct line of view with the pencil.
(3) Close your left eye and then quickly open it and close your right eye.
(4) Continue to open and close your eyes, alternating them rapidly and observe what happens to the pencil and the fixed background object.

Science Behind It: The pencil will appear to shift position from side to side while the background object stays in its fixed position. The pencil obviously did not move, but the angle at which it was viewed did change. This is parallax and is the cause for the apparent position change of the pencil. Parallax is a key concept that is crucial in determining distances. The closer an object is to the viewer, the more it will appear to shift position, while objects that are farther away do not. In the same manner, parallax causes closer stars to seem to move and those farther away seem fixed. In order to attempt to calculate a star's exact distance from Earth, astronomers measure the different positions of stars at least two different times during a year as the Earth moves through its orbit around the sun. Measuring a star multiple times throughout a year helps to pinpoint its exact location while taking parallax into consideration.

66. **Meteor Burnout**

E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 157.

Objective: To simulate what happens when meteors enter Earth's atmosphere and to understand why this happens.

Standards: Objects in the Sky (sky object properties, locations, and movements) and Structure of the Earth System (atmospheric composition and properties at different elevations).

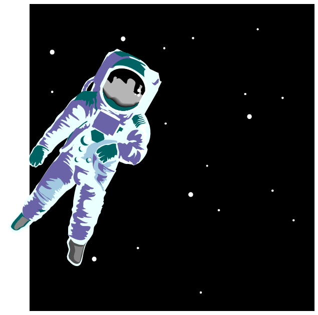
Materials: Large pop bottle filled with water and ½ of a seltzer tablet.

Procedure:

(1) Drop the tablet into the bottle of water.
(2) Observe what happens to the tablet as it descends to the bottom of the bottle.

Science Behind It: The tablet will dissolve and break into several small pieces that disappear on the way to the bottom of the bottle. This is a simulation of what happens to a meteor traveling through the atmosphere. In this demo, the water represents the atmosphere, the tablet represents a meteor, and the bottom of the bottle represents Earth's surface. In reality, meteors travel much faster than seltzer tablets do. The tremendous speed that meteors travel at creates friction between its surface and the atmosphere. This intense friction causes the meteor to become extremely hot, break up, and explode into cosmic space dust. While the size of a meteor may be very large in the beginning, by the time it reaches Earth's surface it is usually about the size of a small stone. However, larger chunks of meteors do sometimes make it through the atmosphere and to the surface. These larger pieces of meteors are known as meteorites.

67. **Space, The Dark Frontier**



Janice VanCleave: Janice VanCleave's 200 Gooey, Slippery, Slimy, Weird, and Fun Experiments (1992), page 20.

Objective: To demonstrate why space is dark.

Standards: Earth in the Solar System (position, properties of sun, earth, its moon, and the planets), Light, Heat, Electricity, and Magnetism (light reflection), and Transfer of Energy (light transmission, reflection).

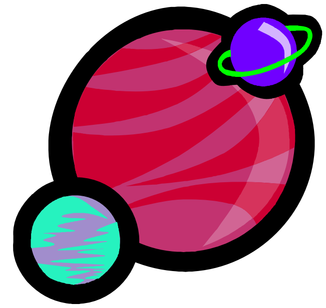
Materials: flashlight and a table.

Procedure:

(1) Place the flashlight on the edge of the table.
(2) Completely darken the room while keeping only the flashlight turned on.
(3) Observe the beam of light from the flashlight and attempt to follow it across the room.
(4) Put your hand about twelve inches away from the end of the flashlight.

Science Behind It: Students should observe a circular shape of light on your hand with little or no light being seen between the flashlight and your hand. The light was visible on your hand because your hand reflected the light to your eyes. Light was not observed between your hand and the flashlight because there was "nothing" to reflect the light. This is the reason space is dark, even though the sun's light continuously shines through it. Light is only seen when there is something like a planet, moon, or other object to reflect it to your eyes.

68. **I'm Glad I Don't Live on Jupiter**



Janice VanCleave: Janice VanCleave's Astronomy for Every Kid: 101 Easy Experiments that Really Work (1991), page 42.

Objective: To determine why Jupiter experiences continuous lightning.

Standards: Earth in the Solar System (position, properties of sun, earth, its moon, and the planets) and Structure and Properties of Matter (atoms interact with one another by transferring or sharing electrons; the physical properties of compounds reflect molecule interaction).

Materials: 2 x 8 inch thin sheet of plastic (such as plastic report cover) and a wool cloth (any 100% wool item).

Procedure:

(1) In a darkened room, hold the end of the plastic strip while you wrap the wool cloth around it.
(2) Quickly pull the plastic through the cloth.
(3) Repeat steps one and two about five or six times as quickly as possible.
(4) Observe the cloth as you pull the plastic through it.

Science Behind It: A bluish colored light will be seen in the folds of the wool item that touches the plastic. This happens because electrons are transferred between the plastic and the wool. During the procedure, some of the electrons are rubbed off of the wool and onto the plastic strip. The wool then becomes positively charged while the plastic becomes negatively charged. As the electrons jump from the plastic back to the wool, an electric spark is created. This occurs continuously in the clouds of Jupiter's atmosphere. Lightning occurs constantly because the winds in the atmosphere of Jupiter blow up to 800 miles per hour, causing the molecules in the atmosphere to be vigorously rubbed together at all times, just as the wool and plastic were rubbed together.

69. **Blackout**

Janice VanCleave: Janice VanCleave's 201 Awesome, Magical, Bizarre, and Incredible Experiments (2002), page 12.

Objective: To demonstrate a solar eclipse.

Standards: Objects in the Sky (sky object properties, locations, and movements) and Earth in the Solar System (position, properties of sun, earth, and its moon; predictable motions explain day, year, moon phases and eclipses).

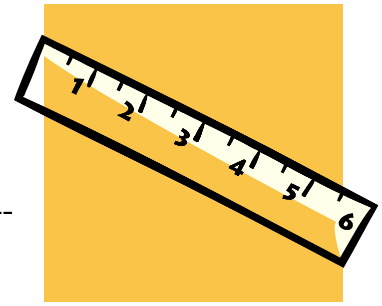
Materials: coin and a large stationary object outside or across the classroom.

Procedure:

(1) Close one eye and look at the object with your open eye.
(2) Hold the coin at arm's length in front of your open eye.
(3) Slowly move the coin closer towards your open eye, until it is directly in front of your eye.

Science Behind It: As the coin is brought closer to your eye, less of the object is visible until it is completely blocked by the coin. This demo accurately simulates a solar eclipse. The coin represents the moon and the object represents the sun. Both the coin and the moon are capable of blocking out light when they are close to the observer. As the moon passes between the sun and Earth during its orbit, it blocks out light from the sun just as the coin blocks your view of the stationary object. The moon orbits the Earth about once a month but does not always cause a solar eclipse. Because the moon does not orbit the Earth at the equator and the Earth's axis is tilted, the direct shadow of the moon misses the surface of the Earth most of the time.

70. **Quicker Ruler Fall and the Planets**



Janice VanCleave: Janice VanCleave's Astronomy for Every Kid: 101 Easy Experiments that Really Work (1991), page 14.

Objective: To show how distance affects a planet's period of revolution around the sun.

Standards: Objects in the Sky (sky object properties, locations, and movements) and Earth in the Solar System (position, properties of sun, earth, its moon, and the other planets).

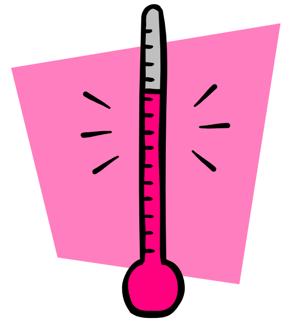
Materials: a yardstick and a ruler.

Procedure:

(1) Hold the yardstick and ruler vertically side by side on the ground or a flat table top.
(2) Slightly lean both the yardstick and ruler forward so that they fall in the same direction.
(3) Release both at the same time.

Science Behind It: The shorter ruler will hit the surface first because it had less distance to fall. This is similar to the movement of the planets around the sun. Mercury is the shortest distance from the sun and only takes eighty eight Earth days to orbit the sun. Pluto is the farthest planet from the sun and therefore has the longest period of revolution, 248 Earth years.

71. **Hot Box**



Janice VanCleave: Janice VanCleave's Astronomy for Every Kid: 101 Easy Experiments that Really Work (1991), page 22.

Objective: To demonstrate why Venus has such a high temperature.

Standards: Objects in the Sky (sky object properties, locations, and movements), Earth in the Solar System (position, properties of sun, earth, its moon, and the other planets), Interactions of Energy and Matter (waves have energy and can transfer energy when they interact with matter), Light, Heat, Electricity, and Magnetism (light absorption), and Transfer of Energy (light transmission and absorption).

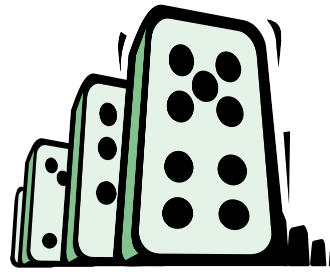
Materials: two thermometers and one jar with lid that is large enough to hold one of the thermometers.

Procedure:

(1) Place one of the thermometers in the jar and secure the lid.
(2) Place the second thermometer and the jar near a window receiving direct sunlight.
(3) Observe the temperatures of both thermometers after about twenty minutes.

Science Behind It: The temperature of the thermometer inside the jar will be higher than the thermometer outside of the jar. Solar radiation given off by the sun contains both visible and infrared light waves. Infrared light waves are given off by objects that are hot. In this demo, the jar represents the atmosphere of the planet Venus. The majority of the light reaching the surface of Venus becomes absorbed, therefore heating the planet. The surface then radiates this heat energy as infrared waves, but because the atmosphere is extremely thick, the infrared waves become trapped. These trapped infrared waves heat the surface of Venus to more than 800°F and because of the extremely high temperatures, rocks on the surface glow red.

72. **Who is that Man on the Moon?**



Janice VanCleave: Janice VanCleave's Astronomy for Every Kid: 101 Easy Experiments that Really Work (1991), page 122.

Objective: To demonstrate the cause of the "Man in the Moon" image on the Moon's surface.

Standards: Objects in the Sky (sky object properties, locations, and movements), Earth in the Solar System (position, properties of sun, earth, its moon), Light, Heat, Electricity, and Magnetism (light reflection), and Transfer of Energy (light transmission and reflection).

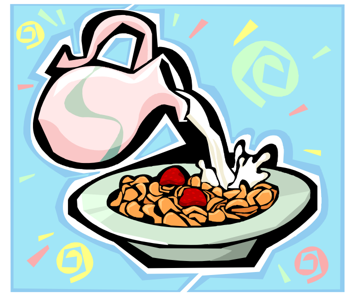
Materials: dominoes and a flashlight.

Procedure:

(1) Stand about six to eight dominoes on a table.
(2) Darken the room and hold the flashlight at an angle about one foot from behind the dominoes.

Science Behind It: The dominoes block out the light from the flashlight and form shadows on the table. This is the same thing that the mountainous regions on the Moon, called highlands, do to the Sun's light. The shadows produced by the highlands are cast across the flat plains of the Moon, called the Maria. The highlands appear brighter than the Maria because they reflect the light from the sun while the Maria are covered by the dark shadows. The insides of the craters on the Moon also appear dark. This lighter and darker combination of the highlands, Maria, and the craters create the "Man in the Moon" image on the surface of the Moon.

73. **Cereal Bowl Craters**



Janice VanCleave: Janice VanCleave's Astronomy for Every Kid: 101 Easy Experiments that Really Work (1991), page 124.

Objective: To demonstrate how craters form on moons and planets and to discuss why Mercury and the Moon have different crater characteristics.

Standards: Objects in the Sky (sky object properties, locations, and movements), Earth in the Solar System (position, properties of sun, earth, its moon, and other planets), and Motions and Forces (gravitation properties and predicting its strength).

Materials: Bowl, spoon, soil, and water.

Procedure:

(1) Fill the bowl about halfway with soil.
(2) Carefully add small amounts of water while stirring to create a muddy mixture that slowly drips off the spoon when it is tilted.
(3) Shake the bowl gently so that the surface of the mud becomes smooth.
(4) Allow mud to drip from the tilted spoon held about two feet above the bowl.
(5) Move the spoon so that the mud drops onto different areas of the surface of the mud.
(6) Observe the formation of "craters."

Science Behind It: The dripping mud hits the surface of the mixture in the bowl and the liquid splatters. The splattered liquid is quickly pulled back down to the surface by Earth's gravity. As the liquid strikes the surface again, separate craterlike depressions form where each drop of mud struck the surface. In this demo, the falling mud simulates meteorites striking the surface of a moon or planet in the solar system. When large meteorites strike the surface, immense amounts of heat are produced which quickly melts the surface. The surface becomes liquid lava and splatters upward just as the mud did in this demo. Differences in crater formations and their characteristics are caused by the rate at which the liquid fell. The rate at which the liquid falls is determined by the body of impact's gravitational pull. Because Mercury has a greater gravitational pull, it is believed that its craters are separate from each other with smooth planes between them because the splattered liquid fell back to the surface very rapidly. However, the craters formed on the surface of the Moon are much different characteristically because of the Moon's decreased gravity. Because of this, the splattered liquid was blown higher and spread out more therefore forming craters with rims that overlap each other and are separated by rough areas.

74. **"Honey, I Shrunk the Balloons!"**

Janice VanCleave: Janice VanCleave's Astronomy for Every Kid: 101 Easy Experiments that Really Work (1991), page 132.

Objective: To demonstrate how a black hole may be formed.

Standards: Objects in the Sky (sky object properties, locations, and movements), Origin and Evolution of the Universe (star and galaxy formation; how stars produce energy and the formation of all elements), and Motions and Forces (gravitation properties and predicting its strength).

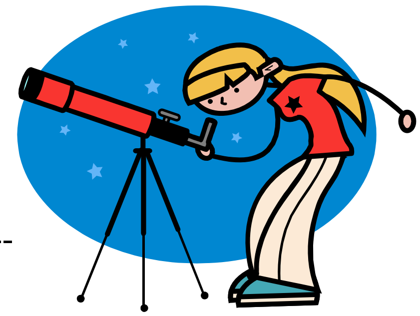
Materials: two small, round balloons, two large mouthed glass jars, a marker, and a refrigerator.

Procedure:

(1) Hold each balloon so that its mouth is above the edge of the jar and the rest of the balloon is inside the jar.
(2) Inflate the balloons inside the jar and tie them shut.
(3) Mark the balloons just above the rim of each jar.
(4) Put one jar inside the freezer for thirty minutes and keep the other jar at room temperature.
(5) After thirty minutes, remove the jar from the freezer.
(6) Observe and compare the markings on the balloons.

Science Behind It: The balloon left at room temperature will remain unchanged while the balloon from the freezer will shrink and sink into the jar. The balloon in the freezer shrank and sank into the jar because its balance between the pressure of the elastic of the balloon pushing in and the gases inside the balloon pushing out was changed by the cold temperature. Gases condense at lower temperature and thus produce less outward pressure. If the gases in the balloon continued to decrease in pressure, the forces of the elastic balloon material would cause the balloon to become smaller and smaller. It is the balance between these pressures that can explain why a black hole may form. The nuclear reactions that occur at the center of a star produce an outward pressure. The star will remain stable in size, just like the room temperature balloon, if the gravity of the star pulling in equals the outward pressure of the star. However, when the nuclear reactions stop, this balance between the gravity and outward pressure are altered, and the star's gravity pulls its materials towards the center of the star. It is hypothesized that this type of shrinking could continue until the star is no longer visible, thus forming a black hole.

75. Flashlight, Star Bright – Why I See Certain Stars at Night



Janice VanCleave: Janice VanCleave's Astronomy for Every Kid: 101 Easy Experiments that Really Work (1991), page 136.

Objective: To show how distance affects a star’s apparent brightness.

Standards: Objects in the Sky (sky object properties, locations, and movements).

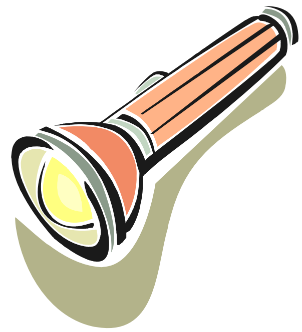
Materials: flashlight and a wall.

Procedure:

(1) Stand in the middle of a darkened room and shine the flashlight at the wall.
(2) Slowly walk towards the wall and instruct students to observe changes in the light pattern on the wall.

Science Behind It: The light pattern on the wall becomes more concentrated and brighter as you get closer to the wall. This occurs because the light has less opportunity to spread out and leave the light source from angles. When the flashlight is further from the wall, the light continues to spread out until it hits the wall. Stars also behave in this same manner. Two different stars may give off the same amount of light but have different apparent brightness because they are located at different distances from Earth. The spreading of light from the more distant star results in less light reaching Earth and therefore a lower magnitude or degree of brightness.

76. **Bigger Means Brighter**



Janice VanCleave: Janice VanCleave's Astronomy for Every Kid: 101 Easy Experiments that Really Work (1991), page 138.

Objective: To demonstrate how size affects a star's apparent brightness.

Standards: Objects in the Sky (sky object properties, locations, and movements).

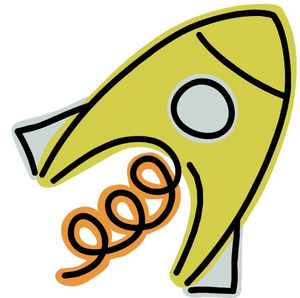
Materials: two flashlights, aluminum foil, pencil, two sheets of blank paper.

Procedure:

(1) Cover the lens end of one of the flashlights with a piece of aluminum foil.
(2) Using the pencil, make a hole in the middle of the piece of aluminum foil about the size of your index finger.
(3) Place the sheets of paper on a table a few inches apart.
(4) Darken the room and hold one flashlight about six inches above each sheet of paper.
(5) Observe the differences in the light patterns on the paper.

Science Behind It: The uncovered flashlight produced a bigger and brighter circle of light on the paper. The size of a star, just like the size of the flashlight opening, affects the brightness of that star. Therefore, the larger the star, the brighter the light seen on Earth will be. Stars have many different sizes and their overall magnitude or brightness is determined by the size, temperature, and distance from Earth.

77. **Blast Off!**



Janice VanCleave: Janice VanCleave's Astronomy for Every Kid: 101 Easy Experiments that Really Work (1991), page 194.

Objective: To demonstrate the laws of motion that causes rockets to move in space.

Standards: Motions and Forces (laws of motion) and Understanding About Science and Technology (scientists use tools).

Materials: One balloon.

Procedure:

(1) Inflate the balloon and hold the mouth of hit between your fingers.
(2) Count "three, two, one, blast off!" and release the balloon.
(3) Observe the movement of the balloon.

Science Behind It: In the beginning of this demo when the balloon was held closed, the air inside the balloon pushes equally in all directions. As the air leaves the balloon, the opening of the balloon moves back and forth as it acts like a rudder directing it through the air. The balloon and rockets move in this manner as a result of Newton's Third Law of motion. This law states that for every action there is an opposite an equal reaction. In terms of the balloon, the rubber pushes on the air inside the balloon (action), forcing the air to be pushed out of the balloon (reaction). The reaction force pushes the balloon in the opposite direction of the action force. Spacecraft also move forward by action-reaction forces. The engines of a rocket produce gases that are pushed out of the exhaust portion of the craft (action) and the gases then apply a reaction force on the rocket, pushing it upward and creating a lift off.

78. **The Importance of Space Suits**

Janice VanCleave: Janice VanCleave's Astronomy for Every Kid: 101 Easy Experiments that Really Work (1991), page 214.

Objective: To demonstrate how space suits affect an astronaut's blood.

Standards: Properties of Earth Materials (physical and chemical properties of gas) and Understanding About Science and Technology (scientists use tools).

Materials: sealed bottle of pop and clear drinking glass.

Procedure:

(1) Observe the pop in the sealed bottle.
(2) Open the bottle of pop.
(3) Fill the drinking glass with pop.
(4) Taste the pop in the glass.
(5) Observe the pop in the glass.
(6) Allow the glass to remain undisturbed for five minutes.
(7) Taste the pop in the glass.

Science Behind It: The students should observe gas bubbles rising to the surface of the pop in the glass but not in the sealed container. Gas bubbles rise to the surface of the pop when it is in the glass because the pressure that the pop was under is decreased when the bottle becomes unsealed. When the pop was bottled, carbon dioxide was dissolved under high pressure but when the bottle is opened the carbon dioxide escapes into the air. While gases do not always dissolve easily, they can be forced to dissolve when the pressure is increased. This happens inside a space suit where the pressure remains at one atmosphere so that the gases in the astronaut's blood stays dissolved. If the space suit were punctured or not working properly, pressure inside the suit would decrease and cause gases within the blood to bubble and come out of the blood, just like the bubbles came out of the pop when its pressure was decreased. This would further result in not only bubbles boiling out of the blood, but the bubbles inside of blood vessels to expand therefore rupturing the vessels and killing the astronaut. As a potential aid to this problem, astronauts breathe a helium-oxygen mixture instead of the normal nitrogen-oxygen mixture of Earth. This is done because helium is less soluble in liquids and would therefore result in fewer bubbles being present to escape or expand the blood vessels.

79. **Homemade Nebula**

Janice VanCleave: Janice VanCleave's 201 Awesome, Magical, Bizarre, & Incredible Experiments (2002), page 19.

Objective: To simulate an absorption nebula.

Standards: Objects in the Sky (sky object properties, locations, and movements), Light, Heat, Electricity, and Magnetism (light absorption), Transfer of Energy (light absorption), and Origin and Evolution of the Universe (star and galaxy formation).

Materials: table lamp, one sheet of white paper, and a pencil.

Procedure:

(1) Darken the room.
(2) Turn on the lamp.
(3) Hold the sheet of paper about one yard in front of the lamp.
(4) Place the pencil about two inches in front of the paper on the side facing the lamp.
(5) Observe the paper.

Science Behind It: A silhouette of the pencil will form on the paper. This silhouette simulates an absorption nebula. A nebula is known as a large cloud of dust and gas in outer space. A nebula belongs to one of three classes: absorption nebulae that block light, emission nebulae which glow, or reflection nebulae that reflect light from other objects. The nebula simulated in this demo belongs to the absorption class because it blocks the light coming from behind it. The specific shapes of these nebulae clouds are the result of the degree to which the particles making up the nebula are concentrated.

80. **The Planet Race**

Janice VanCleave: Janice VanCleave's Astronomy for Every Kid: 101 Easy Experiments that Really Work (1991), page 52.

Objective: To show the effect of distance on the orbiting speed of various planets.

Standards: Objects in the Sky (sky object properties, locations, and movements) and Earth in the Solar System (position, properties of sun, earth, and the other planets).

Materials: one metal washer and a piece of string one meter in length.

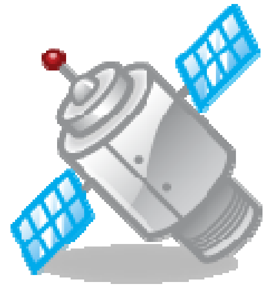
Procedure:

(1) Secure the washer to the end of the string by tightly tying it.
(2) Hold onto the end of the string and extend your arm outward.
(3) Swing your arm in a circular motion.
(4) Spin the washer as slowly as you can while still keeping the string extended tightly.
(5) Hold the string in the center and repeat step four.
(6) Hold the string about ten inches away from the washer and repeat step four.

This demo should be performed outside or in an open area where nothing will be interfered with by the washer and string

Science Behind It: Students will have observed that as the length of the string decreases, the washer must be spun faster to maintain the tightness of the string. The students should also notice that the washer spins lethargically around in its path when the string is longer but spins much faster when the string is shorter. This demo directly relates to the slower and faster movement of planets that differ in distance from the sun. As the distance of a planet increases from the sun, the affects of the sun's gravity on that planet decrease, therefore causing a decrease in orbital speed because of less pull towards the sun. Mercury has the fastest orbit around the sun as it is the closest one, while Pluto has the longest orbit being that it is the furthest planet from the sun.

81. **Is that Satellite Moving or Not?**



Janice VanCleave: Janice VanCleave's 201 Awesome, Magical, Bizarre, & Incredible Experiments (2002), page 10.

Objective: To understand why satellites appear to be stationary in the sky.

Standards: Objects in the Sky (sky object properties, locations, and movements) and Understanding About Science and Technology (scientists use tools).

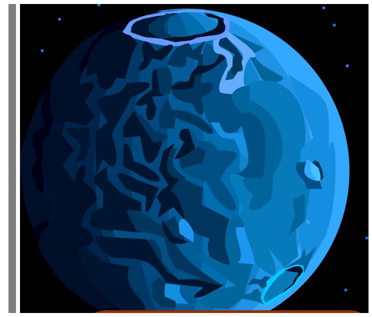
Materials: a piece of rope about three yards long and a helper.

Procedure:

(1) In an open area outside or in the commons area inside, delegate a tree or other stationary object that will represent the Earth.
(2) Have the helper hold one end of the rope while you hold the other end of the rope.
(3) Instruct the helper to stand against the stationary object.
(4) Begin walking at a pace that keeps the rope tightened and also in a position so that you remain in line with the same point on the stationary object as your helper.

Science Behind It: Students should observe that you must move at a fast pace in order to stay in line with the person moving in the smaller inside circle (around the stationary object). This happens because the distance of the outside circle is larger than the distance of the inside circle and therefore a faster speed is needed to travel around the outside circle in the same amount of time that the person travels around the inside circle. Satellites are placed at about 22,500 miles above the Earth and require extremely fast speeds to stay in the Earth's orbit. These satellites have an orbital period of 24 hours, which is the same orbital period of Earth. Because the periods are the same, the satellites appear stationary above the Earth.

82. **Why Can't We See Venus?**



Janice VanCleave: Janice VanCleave's Astronomy for Every Kid: 101 Easy Experiments that Really Work (1991), page 20.

Objective: To demonstrate why Venus's atmosphere is so difficult to see through.

Standards: Objects in the Sky (sky object properties, locations, and movements) and Earth in the Solar System (position, properties of sun, earth, and the other planets).

Materials: flashlight and sheet of wax paper.

Procedure:

(1) Turn the flashlight on and place it on the edge of a table or desk.
(2) Stand back about two yards from the flashlight.
(3) Face the light and observe its brightness and any other characteristics of it.
(4) Hold up the sheet of wax paper in front of your face.
(5) Look through the wax paper at the light and observe.

Science Behind It: As you try to look through the wax paper at the light, you will observed that the light is blurred. This happens because the light refracts and bounces off of the paper. This is also what happens in the atmosphere of Venus, as the sun's rays refract and bounce off of its extremely thick clouds. The clouds in Venus's atmosphere are not especially dark, just particularly thick. In the thickest part of the atmosphere and clouds, visibility is estimated at only about 0.6 miles.

83. Expanding the Universe on a Balloon

Janice VanCleave: Janice VanCleave's 201 Awesome, Magical, Bizarre, & Incredible Experiments (2002), page 8.

Objective: To demonstrate how scientists think that galaxies may be moving and that because of this the universe is expanding.

Standards: Objects in the Sky (sky object properties, locations, and movements) and Origin and Evolution of the Universe (star and galaxy formation).

Materials: round balloon, mirror, and black marker.

Procedure:

(1) Inflate the balloon a small amount until it is about the size of a softball.
(2) While holding the partially inflated balloon, place about twenty random dots on the balloon.
(3) Stand in front of the mirror and observe the balloon as you continue to inflate it to a larger size.

Science Behind It: As you inflate the balloon in front of the mirror, the dots all move away from each other. Students will observe that some dots move more or farther apart than others, but they will see that no dots get closer together. Most astronomers believe that the galaxies in the universe are moving away from each other in a similar fashion to the dots on the balloon. Also similarly to the balloon, astronomers know that not all galaxies are moving apart at the same rate. It was determined by Dr. Edwin Hubble in 1929 that the farther away a galaxy is, the faster it appears to move away from Earth. Because no two galaxies appear to be getting closer as they move (just like the dots on the balloon), scientists hypothesize that the universe is expanding.

84. **Where's Mercury?**

Janice VanCleave: Janice VanCleave's 200 Gooey, Slippery, Slimy, Weird and Fun Experiments (1992), page 5.

Objective: To demonstrate how Mercury's close position to the Sun affects the observation of the planet's surface.

Standards: Objects in the Sky (sky object properties, locations, and movements) and Earth in the Solar System (position, properties of sun, earth, and the other planets).

Materials: desk lamp and pencil.

Procedure:

(1) Turn on the desk lamp with the bulb facing you.
(2) CAUTION: Do not look directly into the lamp!
(3) Hold the pencil in its middle with the print on the pencil facing you.
(4) Extend your arm so that the pencil is out at arm's length and about six inches away from the bulb.
(5) Try to read the print on the pencil.

Science Behind It: In this demo, the print on the pencil cannot be read and the color of the pencil becomes difficult to determine. This happens because the light behind the pencil is so bright that it becomes difficult to even see the pencil, especially because it is a small object and does not block out much of the bulb's light. This is the same reason why the sun's glare makes it very difficult to study the surface of Mercury. Just like the pencil, Mercury is a small planet that is very close to the Sun. When astronomers attempt to view Mercury, they are basically looking directly into the Sun, making it extremely difficult to clearly view Mercury.

85. **Red Spot Movement**

Janice VanCleave: <u>Janice VanCleave's 200 Gooey, Slippery, Slimy, Weird and Fun Experiments</u> (1992), page 4.

Objective: To demonstrate the movement of Jupiter’s red spot and to understand why it moves in the manner that it does.

Standards: Objects in the Sky (sky object properties, locations, and movements) and Earth in the Solar System (position, properties of sun, earth, and the other planets).

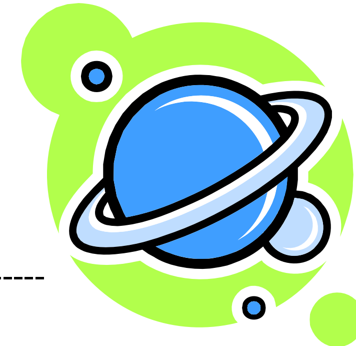
Materials: wide – mouthed one gallon jar, one tea bag, water, and a pencil.

Procedure:

(1) Fill the jar with water.
(2) Pour the tea bag into the water.
(3) In the center of the water, quickly move the pencil in a small circle until the tea leaves group together and swirl in the center area of the water.

Science Behind It: The swirling in the water creates a vortex which forms a cavity in the center of the jar towards which the tea leaves are pulled. It is hypothesized by scientists that the red particles seen in Jupiter’s giant red spot are swirled together by moving gases in a similar vortex fashion to that of the tea leaves’ movement. This movement in the red spot of Jupiter has created a massive hurricane that is believed to be large enough to ingest three Earths.

86. Now I See the Planet Rings!



Janice VanCleave: Janice VanCleave's 200 Gooey, Slippery, Slimy, Weird and Fun Experiments (1992), page 4.

Objective: To demonstrate why the ring of Jupiter shines.

Standards: Objects in the Sky (sky object properties, locations, and movements), Earth in the Solar System (position, properties of sun, earth, and the other planets), Light, Heat, Electricity, and Magnetism (light reflectance), and Transfer of Energy (light reflectance).

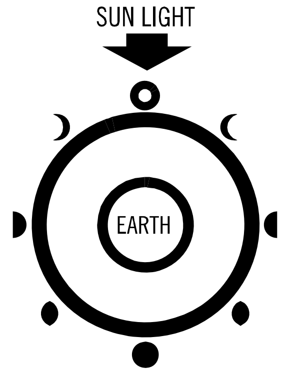
Materials: flashlight and baby powder in a plastic shaker.

Procedure:

(1) Darken the room and place the flashlight on the edge of a table.
(2) Hold the open powder contain just below the beam of light.
(3) Quickly squeeze the baby powder container.

Science Behind It: Students will observe that before the powder is squeezed, the beam of light is barely visible but when the powder is sprayed, the specks of powder glisten, making the beam of light visible. The light beam becomes visible because it was reflected to your eye by the baby powder particles. These powder particles represent the fine particles in the ring around Jupiter which also reflect the Sun's light. Jupiter's ring is located 34,000 miles above the planet's cloud tops. The particles in this ring are believed to have come from an active volcano on Lo, Jupiter's innermost large moon.

87. New to Full – The Phases of the Moon



Janice VanCleave: Janice VanCleave's Astronomy for Every Kid: 101 Easy Experiments that Really Work (1991), page 114.

Objective: To demonstrate the phases of the moon and to explain why the moon has these phases.

Standards: Objects in the Sky (sky object properties, locations, and movements), Earth in the Solar System (position, properties of sun, earth, the moon, and the other planets; predictable motions explain day, year, moon phases, and eclipses), and Changes in Earth and Sky (diurnal and seasonal sun and moon movement – changes in the moon's shape).

Materials: Styrofoam ball the size of an apple, lamp, and a pencil.

Procedure:

(1) Stick the pencil into the middle of the Styrofoam ball.
(2) Place the lamp in or near a doorway.
(3) Darken the room.
(4) Stand facing the lighted doorway and hold the ball in front of you at a level slightly higher than your head.
(5) Slowly turn yourself around while keeping the ball in front of you as you turn.
(6) Observe the ball at various points while you turn.

Science Behind It: During this demo you will observe that the ball is dark while facing the door but it begins to lighten as you turn and is fully illuminated when your back is facing the door. This is similar to what happens to the moon as it orbits around the Earth. The moon reflects the sun's light and its position between and around the sun and Earth determine how much of the moon is seen. When you face the lit doorway in this demo, the ball is dark and this represents the new moon. The moon is not visible in this phase because the side of the moon facing Earth is not receiving any light. Only one side of the moon faces the sun and reflects its light. When your back is to the lit doorway, the ball is fully illuminated, which represents the full moon phase. The ball and moon are completely seen because in this position, the side of the moon facing the Earth receives the most light. While turning around in a circle between facing and having your back towards the lit doorway, the ball is undergoing the various phases of the moon between new and full phases and between the full moon and the beginning of the next cycle.

88. Changing Weight with Your Fingertip

Martin Gardener, Science Puzzlers, Website: http://64.233.167.104/search?q=cache:zVGnQA9cniEJ:www.vidyaonline.net/arvindgupta/martingardner.pdf+%22the+invisible+leg%22+experiment&hl=en&ct=clnk&cd=2&gl=us.

Objective: To demonstrate the effects of water displacement and gravity and to have students discuss and explain their ideas with each other.

Standards: Properties of Earth Materials (physical and chemical properties of water), Motions and Forces (gravitation properties and the law for predicting its strength), and Abilities Necessary to do Scientific Inquiry (communicate investigations and explanations; scientific investigations involves questioning and comparing it to known; think critically and logically to make the relationships between evidence and explanations).

Materials: two drinking glasses, ruler, pencil, and water.

Procedure:

(1) Place the ruler on top of the pencil on a flat surface.
(2) Fill both glasses with water.
(3) Place one glass on each end of the ruler.
(4) Adjust the pencil to make the ruler almost, but not quite, balanced.
(5) Ask the class what they think would happen if a goldfish was placed in the raised glass and if they think the glass would weigh more.
(6) Ask the class if they think that placing a fingertip inside the water filled glass (without touching the glass) would increase the weight of the glass and cause the balance to move.
(7) Allow several minutes for students to discuss their ideas to the above questions in small groups and instruct them to write down their hypotheses to the question in step six.
(8) Plunge your finger into the water in the water filled glass, being careful to not touch the glass itself.
(9) Observe, discuss, and explain the results to the class.

Science Behind It: When the finger is placed inside the glass, the balance will change and tip towards the side with the finger. This happens because the weight of the glass is increased by the weight of the water that your finger displaces.

89. How Many Folds?

William Johnston

Objective: To illustrate and have students explore with the scientific method.

Standards: Abilities Necessary to do Scientific Inquiry (identify questions that can be answered through scientific investigation; design and conduct a scientific investigation; develop descriptions, explanations, predictions, and models using evidence; use mathematics in scientific inquiry).

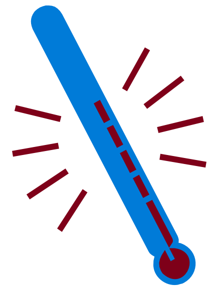
Materials: One piece of paper towel or sheet of paper (for each group of students).

Procedure:

(1) Give each pair or small group of students a piece of paper.
(2) Tell the students to lay their paper out flat on their table/desk.
(3) Ask the students how many times they think they will be able to fold the paper in half.
(4) After the groups have discussed their ideas and formulated their hypotheses, allow them to begin folding the paper in half to answer the proposed question from step three.
(5) Have students observe and record every step in the scientific method through doing this experiment.

Science Behind It: This demo is a simple way to introduce the scientific method and have students gain practice using it. The question of "how many times can the paper be folded in half" represents the problem or question of the scientific method. The students' guesses at how many folds they can make represent the hypothesis step in the method. The materials involved in the demo include one sheet of paper and a pencil to record data. The procedure students should follow in this demo is to fold the paper in half repeatedly until it is too difficult to make any more folds. Once the folding is complete, students will have their results and can write a brief conclusion as to why they think their maximum number of folds was reached or not. Students will find that they probably maxed out at around eight folds. This happens because after each fold, the number of layers of paper you must fold doubles. For example, after one fold you have two layers; two folds equal four layers; three folds equal eight layers and so on. Once the students approach 128 and 256 layers, it becomes very difficult to continue folding. An extension of this exercise is to use different types of paper: tissue, cardboard, or various grades of typing paper.

90. **Is it Hot or Not?**



Martin Gardener, Science Puzzlers, Website: http://64.233.167.104/search?q=cache:zVGnQA9cniEJ:www.vidyaonline.net/arvindgupta/martingardner.pdf+%22the+invisible+leg%22+experiment&hl=en&ct=clnk&cd=2&gl=us.

Objective: To illustrate that subjective measurement in scientific inquiry is an unreliable and incorrect method.

Standards: Abilities Necessary to do Scientific Inquiry (employ simple equipment and tools to gather data and extend the senses; use appropriate tools and techniques to gather data; technology used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigations) and Understanding About Scientific Inquiry (simple instruments provide more information than scientists obtain using only their senses).

Materials: three drinking glasses, hot water, ice water, and room temperature water.

Procedure:

(1) Fill one glass with hot water.
(2) Fill one glass with ice water.
(3) Fill one glass with water at room temperature.
(4) Place one finger from one hand in the hot water and one finger from the other hand in the ice water (at the same time) for at least one minute.
(5) Then using these two fingers one at a time, place them in the glass of water at room temperature.
(6) Observe the temperature differences by feeling with your fingers.

Science Behind It: When the finger from the hot water glass is placed in the room temperature glass, the water will feel cold. However, when the finger from the ice water glass is placed in the room temperature glass, the water will feel hot. These are subjective measurements relative to the fingers and where they were previously located. Students will understand that personal, subjective measurements are incorrect and unreliable because they tend to be relative to something else and also differ from person to person. The only correct way to measure the temperature of the water is with a thermometer. In doing this, the actual quantified temperature is recorded and can be used by other scientists.

91. **Where Did it Go?**

Janice VanCleave: Janice VanCleave's 201 Awesome, Magical, Bizarre, and Incredible Experiments (2002), page 48.

Objective: To demonstrate that there are pockets of space between water molecules.

Standards: Properties of Earth Materials (physical and chemical properties of water), Properties and Changes in Matter (compound formation, properties, and categorization), and Structure and Properties of Matter (bonds creation; the physical properties of compounds reflect molecule interaction).

Materials: one clear glass jar, three cups of tap water (250mL each), one cup of rubbing alcohol (250mL), masking tape, and a pencil or pen.

Procedure:

(1) Place a strip of masking tape on the outside of the jar.
(2) Pour one cup of water into the jar.
(3) Indicate the volume occupied by one cup of water by marking a "1" on the masking tape.
(4) Add a second cup to the jar and mark the water level again on the tape with a "2."
(5) Empty and dry the jar.
(6) Pour a third cup of water into the jar (it should be at the 1 marked on the tape).
(7) Add one cup of rubbing alcohol to the jar.
(8) Observe the height of the liquid.

Science Behind It: The total liquid level will be below the two cup marked level on the tape. This happens because when water molecules form, they leave small pockets between them. This is due to their polar nature and the angles at which they form. The rubbing alcohol fills these empty pockets which causes the combined volume to be less than two cups.

92. **Is One Cup Really One Cup?**

Janice VanCleave: Janice VanCleave's 201 Awesome, Magical, Bizarre, and Incredible Experiments (2002), page 48.

Objective: To illustrate the properties of matter and to show that materials occupy volume differently depending on their structure.

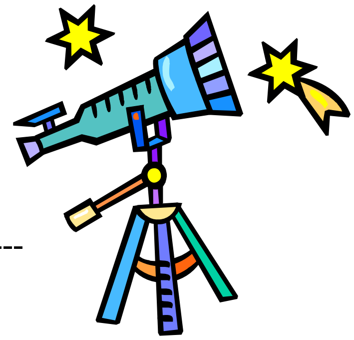
Standards: Properties of Earth Materials (physical and chemical properties of water), Properties and Changes in Matter (compound formation, properties, and categorization), Structure of Atoms (properties of matter, atoms, and smaller components), and Structure and Properties of Matter (bonds creation; the physical properties of compounds reflect molecule interaction).

Materials: one clear glass jar, three cups of tap water (250mL each), one cup of sugar (250mL), masking tape, and a pencil or pen.

Procedure:

(1) Place a strip of masking tape on the outside of the jar.
(2) Pour one cup of water into the jar.
(3) Indicate the volume occupied by one cup of water by marking a "1" on the masking tape.
(4) Add a second cup to the jar and mark the water level again on the tape with a "2."
(5) Empty and dry the jar.
(6) Pour the sugar into the jar, making sure that the top of the sugar is at the one cup mark on the tape.
(7) Add the third cup of water and stir the jar.
(8) Observe the height of the liquid in the jar.

Science Behind It: The total liquid level will be below the two cup marked level on the tape. This is a result of the structure of sugar. Sugar is not solid throughout and contains several spaces between the particles of sugar. The water moves into these void spaces which results in a volume of less than two cups. The water and sugar are both examples of different types of matter and students should be reminded that they cannot occupy the same space at the same time.



93. **Homemade Telescope**

Janice VanCleave: Janice VanCleave's Astronomy for Every Kid: 101 Easy Experiments that Really Work (1991) page 166-167.

Objective: To demonstrate how a refracting telescope works.

Standards: Light, Heat, Electricity, and Magnetism (light reflectance, refraction, and absorption), Transfer of Energy (light transmission, refraction, reflection, absorption, and scattering), and Understanding About Science and Technology (scientists use tools).

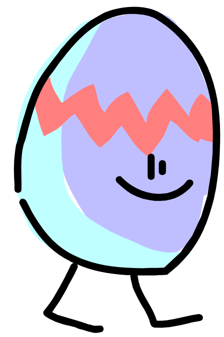
Materials: sheet of notebook paper, two magnifying lenses, and a window.

Procedure:

(1) Darken the room.
(2) Close one eye and look out the window through one of the magnifying lenses.
(3) Slowly move the lens back and forth until the objects outside of the window become clearly focused.
(4) Place the sheet of notebook paper between you and the lens, without moving the lens.
(5) Slowly move the paper back and forth until a clear image is displayed on the sheet.
(6) Replace the paper with the second magnifying lens.
(7) Move this lens back and forth until the image you are looking at becomes clear when looking through both of the lenses.

Science Behind It: Students will observe a small, inverted image of the objects outside the window displayed on the paper. When both lenses are used and properly focused, the image will appear upside down and will be larger than it was when observing with only one lens. This demo simulates how a refracting telescope works. The furthermost or first lens used, represents the objective lens of a telescope. The role of this lens is to capture light from distant objects and bring them into focus. The sheet of paper represents the focal point which is the location where an image or picture of the object exists and can be projected onto a screen. The second magnifying lens is analogous to the eyepiece lens of a telescope. The role of this lens is to collect the light from the focused image and bring an enlarged, inverted image into focus for your eyes.

94. **Underwater "Eggspert"**



Judy Breckenridge, Anthony D. Fredericks, and Louis V. Loeschnig: 365 More Simple Science Experiments with Everyday Materials (1998), page 33.

Objective: To have students inquire whether or not eggs contain air and how they would be able to test for it by considering the properties of air molecules and heat.

Standards: Properties of Earth Materials (physical and chemical properties of gases and water), Conservation of Energy and Increase in Disorder (heat consists of random vibrations and motions of atoms and molecules), and Abilities Necessary to do Scientific Inquiry (plan, design, and conduct a scientific investigation; develop descriptions, explanations, predictions, and models using evidence; think critically and logically to make the relationships between evidence and explanations; communicate scientific procedures and explanations).

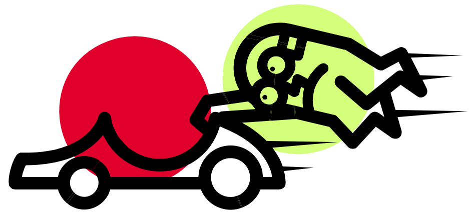
Materials: fresh egg, deep cereal bowl, and hot tap water.

Procedure:

(1) Carefully place the egg in the bottom of the bowl.
(2) Ask the class if they believe that eggs contain air and allow a few minutes for discussion and explanation of their ideas.
(3) Ask the class to think of ways that they could test an egg for air inside of it and why these ways would work or not work in testing the question. Allow for discussion and explanation.
(4) Review properties of heat and its influence on air molecules.
(5) Fill the bowl with hot tap water.
(6) Observe the egg for several minutes.

Science Behind It: After a few minutes or so, jets of air bubbles should rise to the top of the water from the egg. This proves that eggs do contain air because it has released it to the surface. This happened because the air inside of the egg was heated by the water and the air molecules therefore expanded. The expanded air molecules attempt to push themselves out of the egg through one of the approximately 7,000 pores that the egg's shell contains. Through questioning the class with something they may be unsure of and allowing them to discuss, explain, and relate scientific principles, they gain practice with the scientific method and further their experiences as an investigative scientist.

95. **Rapid Transit**



E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 183.

. ***Objective:*** To understand the concept of the force of inertia.

Standards: Motions and Forces (inertia as it applies to moving objects; what happens when more than one force acts on an object; laws of motion).

Materials: plastic drinking glass and a small sphere (ball of clay, small toy ball, or marble, etc).

Procedure:

(1) Place the small sphere in the drinking glass.
(2) With the open end of the glass facing forward, slide the glass rapidly across a flat, hard surface.
(3) Suddenly stop the movement of the drinking glass.
(4) Observe what happens to the sphere inside.

Science Behind It: When the movement of the glass is suddenly stopped, the ball will shoot out of it and continue to move forward in a straight line until something in its path stops it or changes its direction. This demo demonstrates Sir Isaac Newton's law of inertia. This law states that an object is at rest (not moving) and will stay at rest until another force acts on it, causing it to move. The object will then stay in motion until something else stops or alters this motion. The sphere remained in the glass while it was moving because its inertia was not overcome by another force. Once the glass had suddenly stopped, this became the force that overcame the inertia of the ball therefore shooting it out of the container.

96. **Canned Laughter**

E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 182.

Objective: To demonstrate how the center of gravity affects the movement and balance of objects.

Standards: Motions and Forces (laws of motion; gravitation properties and the law for predicting its strength).

Materials: two large, hard covered textbooks, an empty coffee can with lid, a clay ball (golf ball size), and a pen or marker.

Procedure:

(1) Place one end of a book on top of the other book to form a ramp.
(2) Place the clay ball inside the coffee can and press it down firmly so that it sticks to the side of the can. The ball should be centered on the can's wall evenly between the two ends.
(3) Mark the spot on the outside of the can where the ball is stuck to so that you are aware of where the ball's weight is concentrated.
(4) Place the lid on the coffee can.
(5) Place the can at the bottom of the book ramp and roll it upward. It will take a few practice runs to determine the proper force and speed you need to get the can to roll up the ramp, so you may want to do this before presenting it to the class.

Science Behind It: The can rolls up the incline because its center of gravity is changed by the clay ball being stuck to its inside wall. Naturally, all objects are pulled towards Earth's center by the force of gravity. An object's center of gravity is the position where all of its weight is concentrated or centered. At this center of gravity, objects will be balanced and not fall. The added, off-centered weight of the clay ball to the can allowed gravity to pull the can forward and up the ramp.

97. **Power-Lifting Fingers**

E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 100.

Objective: To understand the principles of weight distribution and how it affects force and movement of objects.

Standards: Motions and Forces (what happens when more than one force acts on an object; laws of motion).

Materials: a straight chair and six volunteers.

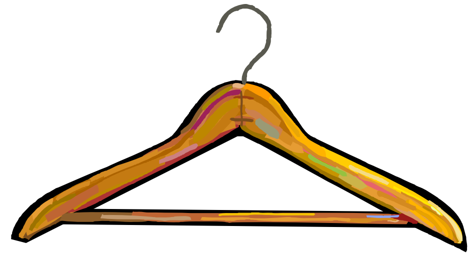
Procedure:

(1) Choose one volunteer to sit erect in the chair while clasping their hands, slightly bending their head forward, and keeping their neck stiff. This volunteer's body should be as unbending as possible.
(2) Have the other five volunteers extend one of their index fingers while steadying it with their other hand in a palm facing upward fist.
(3) Place one volunteer at the side of each knee of the sitting person. Instruct these volunteers to place their entire extended index finger under the person's knee.
(4) Place two other people behind the chair and have them place their index fingers underneath the sitter's armpits.
(5) The fifth volunteer can stand at the side or in front of the sitter and must place their index finger under the sitter's chin.
(6) Instruct the five volunteers to take a deep breath and to simultaneously lift upward on the count of "three." Ensure that the lifters lift straight up and do not jerk upwards.

When the sitter is suspended in the air, make sure that the lifters do not drop the person!

Science Behind It: As long as the sitter remains stiff throughout this demo, their weight will be evenly distributed among all five of the lifters. The weight should remain evenly divided as long as all five lifters move at the same instant. Since the weight of the sitter is evenly divided among the lifters, each lifter is technically lifting one-fifth of the person's bodyweight. Because each lifter has a small amount of weight to lift, their upward force is strong enough to overcome the force of gravity on the sitter and therefore raise them in the air.

98. **The Astounding Balancing Coin**



E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 98.

Objective: To demonstrate centrifugal force.

Standards: Motions and Forces (laws of motion).

Materials: plastic clothes hanger and a coin or washer.

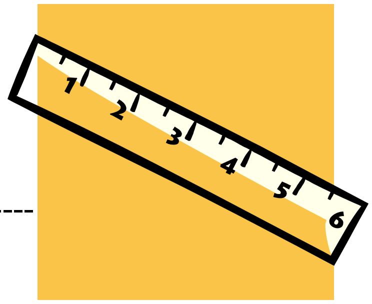
Procedure:

(1) Loop the hanger over your index finger.
(2) With your other hand, balance the coin or washer on the bottom of the hanger. The coin must be placed directly below your finger.
(3) When you are sure the coin is balanced, begin rocking the hanger back and forth on your finger, gradually increasing the speed.
(4) When the hanger is swinging well, begin spinning it in a circle around your finger.

It is a good idea to perform this demo outside in case the hanger or coin/washer go flying off of your finger so that you do not damage anything.

Science Behind It: As long as you continue spinning the hanger in a smooth motion, the coin/washer will remain on the hanger. This is made possible by centrifugal force, which is created when things rapidly spin. This force causes the spinning things to try and move away from the center around which they are spinning. In this demo, the coin is pressed against the bottom of the hanger by centrifugal force and is trying to free itself in this direction. Because it can not physically move through the bottom of the hanger, it will remain on the hanger unless you slow your rate of spin or break the smoothness of its motion.

99. **The Amazing Balancing Yardstick**



E. Richard Churchill, Louis V. Loeschnig, Muriel Mandell, and Frances Zweifel: 365 Simple Science Experiments with Everyday Materials (1997), page 91.

Objective: To demonstrate the principles of an object's center of gravity while relating this to friction and weight distribution.

Standards: Motions and Forces (laws of motion; gravitation properties and the law for predicting its strength).

Materials: one yardstick.

Procedure:

(1) Hold the yardstick near its ends with your outstretched index fingers.
(2) Slowly begin to move only one finger towards the center of the yardstick as you attempt to make the yardstick lose its balance and tip over. Make sure not to suddenly jerk your finger to the yardstick's center.

Science Behind It: As you only move one of your fingers towards the center of the yardstick, your other finger surprisingly moves along with it. Eventually, both of your fingers will be next to each other and the yardstick will be balanced. As you begin to move your finger towards the center of the yardstick, it begins to tip toward that finger because it is closer to the center of gravity (the middle of the yardstick). If the stick tips, the weight on the finger that is not moving is reduced. When the weight on the unmoving finger becomes reduced, this finger begins to slide along the yardstick. This happens because as there is less weight on the finger, there is also less friction. A larger amount of friction is present on the finger that you first began moving because more weight is on it. As friction impedes movement, the finger with less friction on it begins to move faster than the one with more on it. The yardstick will continue to rebalance itself as your fingers move towards each other.

100. **Hot Hands**

Janice VanCleave: Janice VanCleave's Astronomy for Every Kid: 101 Easy Experiments that Really Work (1991), page 38.

Objective: To determine if conservation of energy applies to friction between molecules in a dense atmosphere.

Standards: Structure of the Earth System (atmospheric composition and properties at different elevations), Earth in the Solar System (position, properties of sun, Earth, its moon, and the other planets), Light, Heat, Electricity, and Magnetism (ways to create heat), Motions and Forces (laws of motion), and Conservation of Energy and Increase in Disorder (energy conservation and transfer).

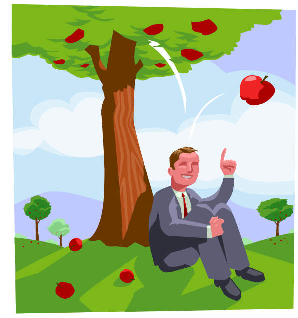
Materials: your hands.

Procedure:

(1) Place the palms of your hands together.
(2) Quickly rub your dry palms back and forth together several times.

Science Behind It: In this demo, your hands will feel warm after they are rubbed together. This happens because the friction between your palms produces heat energy. The force of friction tries to stop objects from sliding past each other and because of this, the closer and faster the objects in motion are to each other, the greater the amount of heat produced. With this principle in mind, one may assume that the dense atmosphere around such planets as Jupiter would cause a large increase in surface temperature on the planet. While the winds around Jupiter constantly blow at speeds of 800 miles per hour, vigorously rubbing the gases of its atmosphere together, the temperature on the planet does not increase continuously. Jupiter's surface temperature remains constant because of the concept known as conservation of energy. The conservation of energy states that the energy in the system remains constant with the heat gained by one substance equal to the heat lost by some other substance; in this case, the energy gained by gas molecule friction is equal to the energy radiated away from Jupiter's atmosphere.

101. **Gravity Race**



Judy Breckenridge, Anthony D. Fredericks, and Louis V. Loeschnig: 365 More Simple Science Experiments with Everyday Materials (1998), page 66.

Objective: To understand the principles of gravity by formulating a hypothesis, making observations, and drawing conclusions based on scientific ideas.

Standards: Motions and Forces (laws of motion; gravitation properties and the law for predicting its strength), Abilities Necessary to do Scientific Inquiry (ask questions about objects and events in the environment; identify questions that can be answered through scientific investigation; communicate investigations and explanations; think critically and logically to make the relationships between evidence and explanations; communicate scientific procedures and explanations; defend a scientific argument), and Understandings About Scientific Inquiry (scientists develop explanations based on evidence from investigations; scientists use scientific explanations until they are disproved).

Materials: ball of crumbled paper, shoe, and a sturdy chair.

Procedure:

(1) Stand on the chair with the crumbled paper in one hand and the shoe in the other.
(2) Hold them out at the same height and ask the class to formulate an educated hypothesis as to which object will hit the ground first. Allow the students to communicate their ideas and explain their reasoning to classmates for a few minutes.
(3) Drop both objects from the same height at the same time and instruct your students to make good observations.
(4) Discuss the results of the demo with the class.
(5) Have the students write down a conclusion explaining what happened and why it happened.

Science Behind It: Both objects will hit the floor at the same time. This happens because an object's weight does not influence the rate at which it falls. The rate at which an object falls is a constant, about 9.81 meters per squared second. A factor that does influence an object's speed at which it falls however, is its shape. For example, if the paper had not been crumbled up before it was dropped and remained a flat piece of paper, it would have fallen slower because air would hit its underside and create more friction. It may be a good idea to redo this demo with various sizes and shapes of objects to give students a more concrete understanding.