Please arrive early.
Start seating at least 15 minutes before the show starts.

Let's Go Science Show
Study Materials for Grades 4 to 8

www.letsgoscienceshow.com

The Let's Go Science Show Goals:
Have fun learning about science.
Increase your students' science vocabulary.
Learn several physics concepts.
Have students grasp the scientific method.
Encourage kids to study science.

FOR THE TEACHER

BEFORE THE SHOW
- Introduce the following science vocabulary words (60 minutes).
- Please remind students about good audience behavior;
  no talking to their neighbors, hands to themselves, and participate
- Have fun discovering how things work and get ready for a great show!

ENJOY THE SHOW!

AFTER THE SHOW
- Review Vocabulary. Ask students which words relate to each demonstration.
- Review science demos with class and have them pick 3 to do.
- Using book/website lists, have students report back their findings to the class.
- Written Let's Go Science Show Quiz on Page 20 (best ungraded)
- Evaluate the science show and turn in the attached form to the office.

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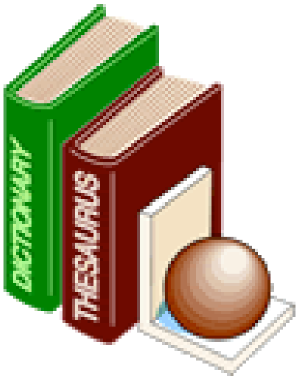
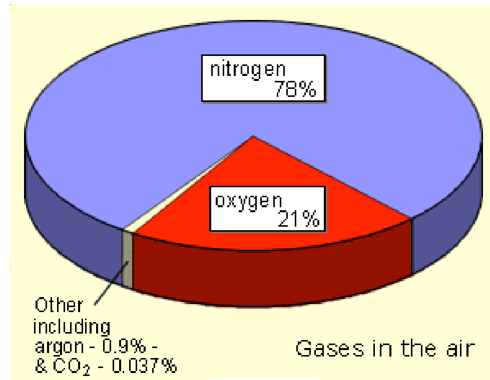


VOCABULARY

(60 Minutes)

Atom: The basic unit of a chemical element.
Example: A person weighing 150 pounds is made up of approximately 7,000,000,000,000,000,000,000,000,000 atoms

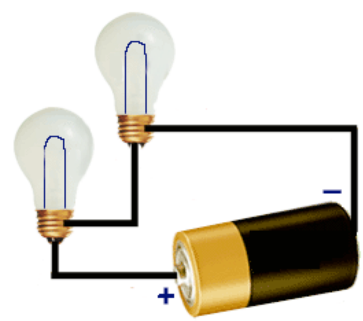


Atmosphere: The mixture of gases that surrounds the earth and other planets.
Example: The earth's atmosphere is made up of 78% nitrogen, 21% oxygen, and 1% argon, carbon dioxide, and other trace gases.

Attract: To pull or draw someone or something towards oneself.
Example: A magnet is attracted to objects with iron in them

Balance: The point where two things are equal in weight or force.
Example: Two teams pulling on a rope with equal force.

Center of Gravity: The center of mass of an object or thing. Also known as the point where gravity can be said to act.
Example: In the human body, the center of gravity is an imaginary point that would exist if you crushed your body into a single, centrally located point. This point lies behind and just below the navel.



Circuit: A path that ends at its beginning.
Example: A path where electrical current can flow in a circle.

Column: An upright shaft or pillar, or a vertical, roughly cylinder-shaped thing.
Example: A great column of smoke.

Compression: To press something into a smaller space.
Example: Your lungs can compress air into a balloon.

Data: A collection of facts and statistics collected together for reference or analysis.

Demonstrate: To show something and explain how it works.

Dimension: A measurement of the length, depth or height of an object.

Drag: To pull something across a surface with force.
Example: The wings of an airplane have flaps that lift up to create a drag in the air that slows down the plane before it lands.

Effort: The physical or mental energy needed to accomplish a task.

Electricity: Electricity is the flow of electrical power.
Example: Lights are powered by electricity. The computers, printers, and video games in your houses use a lot of the electricity in your home (13%).

Electrical Energy: The movement of charged particles, negative (-) and positive (+).
Example: Power plants burn fuel to make electricity that is then sent to homes and businesses through wires.

Electrons: Electrons orbit the positively charged nuclei of atoms and are responsible for binding atoms together in molecules and for the electrical, thermal, optical, and magnetic properties of solids. Electric currents in metal and in semiconductors consist of a flow of electrons and light, radio waves, x-rays and much heat radiation are all produced by accelerating and decelerating electrons.

Energy: The ability to do work, power.
Example: There are many types of energy that we use in our everyday life. Gasoline, petroleum, natural gas and electricity are some examples. In the United States we use 33% of our energy for manufacturing and industry, 28% for transportation, 21% for residential, and 18% for commercial.

Experiment: A test done in order to learn or discover whether something works or is true.

Flight Theory: The theory that describes how forces act on a airplane in flight including; physical descriptions, laminar airfoils, fluid dynamics, flow equations, and the axis of an airplane.
Example: A number of incorrect theories have been challenged by the scientists at NASA see: http://www.grc.nasa.gov/WWW/K-12/airplane/wrong1.html

Force: A push or pull capable of moving or changing an object.
Example: Racing dragsters leave the starting line of a race with a force nearly five times that of gravity. That is the same force used by the space shuttle when it leaves the launch pad at Cape Canaveral!

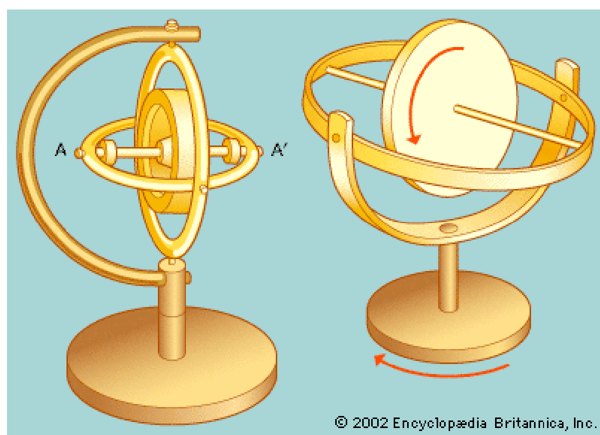
Friction: The tension created when one object or thing slides against another object or thing.
Example: By rubbing two sticks together quickly, you can create enough friction to cause heat. The heat generated by the friction can light a fire.

Fulcrum: The point at which a bar or object is balanced or supported.
Example: The pivot point on a seesaw.

Gas: The state in which a substance does not have a definite shape or volume.
Example: Air, helium, and natural gas. Did you know that helium is lighter then air? That is why a balloon filled with helium floats but a balloon that you blow up with air from your lungs falls to the ground.

Gram: A unit of measurement equal to 1 thousandth of a kilogram.
Example: There are 453.59 grams per pound. That means that a person weighing 150 pounds would weigh 68,038.5 grams.

Gravity: A force that attracts objects toward one another.
Example: Gravity at the equator is slightly less than at the North Pole because the Earth bulges at the equator making it farther from the center of the Earth.



Gyroscope: A thing that has a disc or a wheel, which spins freely within it. Gyroscopic: Having the characteristics or qualities of a gyroscope.
Example: The first gyroscope was invented in 1743 and was used at sea to measure where the horizon was in foggy and low-visibility conditions. For more information about gyroscopes go to: http://www.gyroscopes.org/index.asp

Hypothesis: An idea or explanation for something that is based on facts but has not yet been proven.
Example: A guess as to why or how something happens.

Imagination: The ability to form mental images or the ability to spontaneously generate images within one's own mind.

Inertia: The property that keeps an object motionless unless a force is applied to it, or, keeps an object moving in a straight line unless a force is applied to it.

Examples: Your parents sleeping on the couch. A thrown ball would keep going straight if gravity and air-friction did not act on it.

Invent: To make or create something that no one else has.
Example: To create the first cell phone.

Inventor: A person who has invented something that no one else has.
Examples: Thomas Edison invented the light bulbs that we use in our houses. Ellen Ochoa invented optical analysis systems and was also the first Hispanic female astronaut. Read more about Ellen Ochoa at: http://inventors.about.com/library/inventors/blochoa.htm

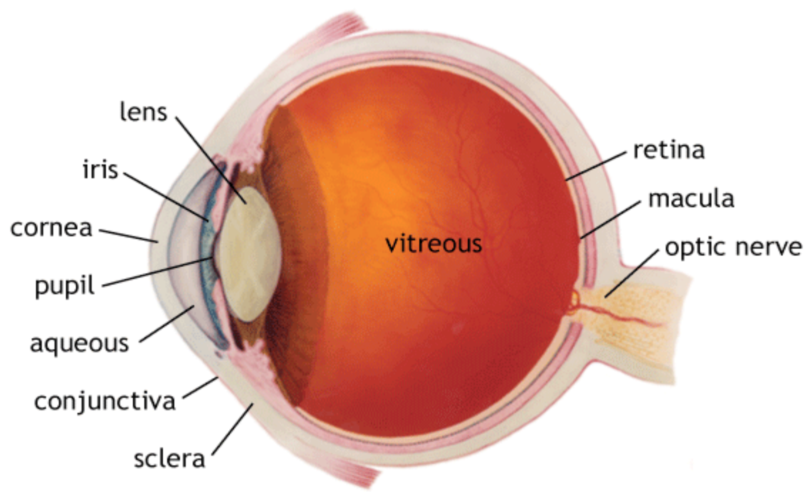
Kilo: Kilo means 1000 when put in front of another word.
Example: 1 kilogram equals 1000 grams.

Kinetic Energy: Energy that pushes or pulls.
Example: Sound, motion, heat, and electricity are all examples of kinetic energy. Water boiling is an example of heat kinetic energy.

Laws of Motion: Otherwise known as Newton's Laws of Motion. Three physical laws which provide relationships between the forces acting on a body and the motion of the body.

I. Every object in the state of uniform motion tends to remain in that state of motion unless an external force is applied.
II. The relationship between an object's mass (m), its acceleration (a), and an applied force (F) is F=ma.
III. For every action there is an equal and opposite reaction.

Lens: A piece of glass or transparent substance with curved sides for concentrating or dispersing light.
Example: A magnifying glass, camera lens, or telescope lens. Also, the part of the eye behind the pupil that focuses light into the retina so you can see.



Lever: A simple machine consisting of a rigid bar pivoted on a fixed point (fulcrum) used to move an object or thing.

Leverage: To use a lever to exert force on an object.
Example: The great pyramid of Giza was built in 2575 BC. It was over 50 stories tall. Levers were used to lift the stone blocks to the top of the structure. These blocks weighed up to 80 tons or 160,000 pounds, the same as 50 cars!

Lift: To raise to a higher position or level.
Example: The Liebherr LTM 11200-9.1 crane can lift objects up to 328 feet in the air. That is taller then a 30 story building. Jet airplane wings with the help of the jet engines can lift the largest airplane An-225 Mriya weighing 1,411,000 pounds.

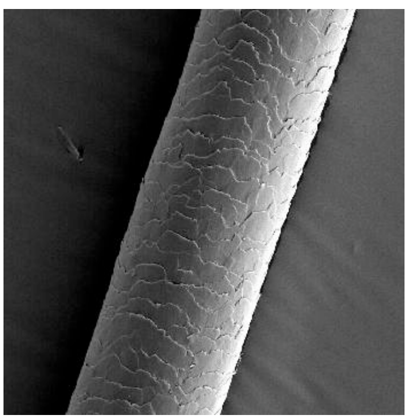
Liquid: The state in which a substance has a definite volume but does not have a definite shape.
Example: Water, milk, and oil are examples of liquids. Did you know that the earth has over 326 million trillion (326,000,000,000,000,000,000) gallons of water on it?

Machine: Any device that transmits or modifies energy.
Example: Some of the simplest machines are inclined planes. wheels and axles, levers, pulleys, wedges, and screws.

Mass: The quantity of matter that any body contains.
Example: On Earth we weigh our mass against the forces of the Earth's gravity.

Massive: Very large in amount, size, or number.
Example: The tallest mountain in the world is Mount Everest. It is so massive it measures 29,035 feet tall.

Matter: Any substance that has mass, including gases, liquids, and solids which describe the three states of matter. Plasma is considered the fourth state of matter and is made up of free electrons and ions also known as ionized gas. To find out more about plasma go to: www.chem4kids.com/files/matter_plasma.html



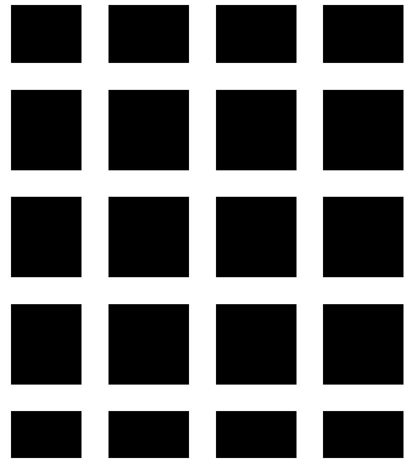
Microscope: A machine that is used to make small objects look bigger.
Example: This is how a human hair looks under a microscope.

Molecules: The smallest unit of a substance made up of atoms.
Example: There are over 300 million molecules of hemoglobin in a single red blood cell.

Momentum: The force that keeps an object moving.
Example: A car traveling at 70 mph needs a stopping distance of 324 feet to completely stop its forward momentum. Even with applying the brakes!

Optic Nerve: The set of nerves that runs from the eyeball into the brain that tells your brain what you see.

Optical Illusion: Something you think you see, but you really don't.
Example: Look at the image to the right. Dark patches appear where the white lines meet, except the ones that you are directly looking at. Cover up some of the black patches and the dark patches disappear.
Here are some cool websites of Optical Illusions:
http://www.eyetricks.com/illusions.htm
http://www.exploratorium.edu/exhibits/f_exhibits.html
http://www.echalk.co.uk/amusements/OpticalIllusions/illusions.htm



Ounce: A unit used to measure weight, smaller then a pound.
Example: A man weighing 150 pounds also weighs 2400 ounces.

Particle: A very tiny piece of matter.
Example: The rings around Mars are not solid. They are made up of particles, some of which are as tiny as sand and some that are as large as a skyscraper.

Particle Accelerator: A machine that makes electrons move very fast.
Example: The largest electron accelerator in the world is called the LEP and is 16.6 miles in circumference! It is located underground near the Jura Mountains along the border between France and Switzerland. Built by a consortium of 14 European nations, LEP took eight years to construct and cost nearly $1 billion. Scientists use LEP to characterize different states of matter. http://www-zeuthen.desy.de/technisches_seminar/texte/blind/CERN-englisch.html

Physics: The study of matter and energy and how they interact.

Potential Energy: Energy that has built up or stored up but has not yet been used.
Example: Chemical energy, nuclear energy, stored mechanical energy, and gravitational energy are examples of potential energy. A sling shot pulled back about to be let go is an example of stored mechanical energy.

Pressure: The force used when something pushes against something else.
Example: Steam engines use the pressure from vaporizing water to produce energy that is used to move an object.

Properties: A quality or description of an item or thing.
Example: Gold is shiny and has a golden, butter yellow, metallic color.

Prove: Demonstrate the truth or the existence of something by evidence or argument.

Quantify: To measure the size or amount of something or an activity.
Example: You can quantify and compare two objects by measuring their length of action, temperature, speed, and size.

Repel: To push someone or something away from oneself.
Example: Skunks repel animals that are attacking them by spraying a foul odor from scent glands on their bodies. This keeps them from getting eaten by larger animals. Also, magnets can repel each other.

Research: A systematic study or investigation of sources and materials in order establish facts and reach new conclusions.
Example: Medical scientists are studying and researching cures for cancer with the hope that someday lives will be saved.

Resistance: A force that makes something slower or that stops its motion.
Example: A parachute is deployed on a drag race car. The parachute creates air resistance that causes the vehicle to slow down.

Scientific Method: The method by which scientific experiments are conducted. Usually consisting of a theory, hypothesis, designed experiments, and a conclusion of the results.

Scientist: A person who studies science.
Examples: Albert Einstein, Benjamin Franklin, Aristotle, Galileo, Benjamin Banneker, and Marie Currie are all famous scientists. Their studies and discoveries are still considered the basis of modern science.
Here are some websites of women in science:

- www.iwaswondering.org
- www.women-inventors.com
- www.astronautix.com/articles/womspace.htm

Skills: Having the ability or expertise to do something well.
Example: Tiger Woods has excellent golfing skills.
Solid: The state in which a substance has a definite shape and definite volume.
Example: Metal, wood, and rock are examples of solids

Static: When something is motionless or does not change.
Example: When you pause a movie the image remains static on the screen.

Static Electricity: The electrical charge that collects on the surface of something.
Example: When you rub a balloon on your hair the electrons that are on your hair jump to the balloon and stick, making your hair stand on end.

Subatomic Particle: A particle that is smaller in size than an atom.

Submarine: A ship designed to operate completely submerged in the sea for months.
Example: U.S. Navy submarines can submerge deeper than 800 feet and can travel faster than 25 knots (nautical miles per hour) underwater, which is approximately 29 miles per hour.

Surface: The top or outer part of an object of thing.
Example: The surface of the earth is where we live.

Suspend: To hang an object or thing.
Example: A suspension bridge suspends the road from huge cables that extend from one end of the bridge to the other.

Theory: A provable explanation of how things work by scientific method.
Example: Sir Isaac Newton came up with a theory of how gravity works.

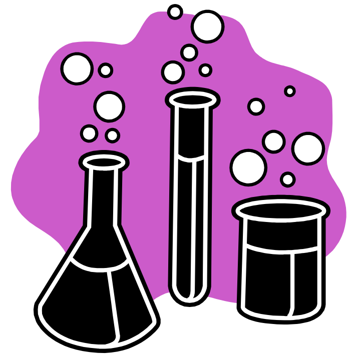
Trial: A test of performance, suitability, or qualities of a person or thing.
Example: When a person is suspected of committing a crime, they go to trial and a jury determines if they are innocent or guilty.

Van De Graff Generator: A machine that can create static electricity.

Weight: The measure of the force by which the earth attracts an object or thing.
Example: The scale in your bathroom measures the force of the earth's gravity on your body. The force of gravity that pulls you to the earth is proportionate to your weight. The smaller the force of gravity, the less something weighs. There is no place in the universe that is not affected by gravity, even if you are in outer space millions of miles from any planet.

Wings: The part of an object used for flying.
Example: Insects flap their wings to fly. Mosquitoes beat their wings 450 to 600 times per second to stay in the air. In aircraft, air is forced over and under wings by propellers and jet engines to give the aircraft lift.

IN-CLASS SCIENCE DEMOS



#1 - BOILING WATER IN A PAPER CUP (25 minutes)
Description: Observe heat absorption when boiling water in a paper cup.
Materials: paper muffin cup or a non-waxed cup, ring stand with wire screen, water, candle or Bunsen burner, matches
Procedure:
1. Assemble ring stand and burner. Ring should be 5 cm (2 in.) above the flame.
2. Place wire screen on ring.
3. Place paper cup on screen.
4. Add water to cup, about 1 cm (1/3 in) deep. Have extra water ready if too much boils away.
5. Heat paper cup until water boils. Remove heat. The water (H2O) absorbs the heat and keeps the paper cup from burning.

#2 - DOES AIR HAVE MASS? (30 minutes)
Description: Discover the properties of air using balloons and a yardstick!
Materials: 1 yardstick, 2 balloons, tape, string
Procedure:
1. Inflate the balloons to equal size. Tie and knot securely.
2. Tape the balloons by the knot, to each end of the yardstick.
3. Locate the point on the yardstick where the two balloons balance. Wrap string two or three times around this point and tape.
4. Have a student balance the yardstick by suspending it out in front of them.
5. Have students predict what will happen if the compressed air in one balloon is released.
Discussion:
1. Before puncturing the balloon ask the class the following questions:
2. Is there something inside the balloon? (Yes) What? (Air)
3. Does air take up space? (Yes)
4. Is there the same amount of matter in both balloons? (Yes)
Procedure (Continued):
1. Have a student stick a pin into one balloon at its base so the air escapes slowly.
2. Have students describe their observations.
Discussion (continued):
After puncturing the balloon ask the class the following questions:
1. Why is one end of the yardstick lower? (One balloon has less air in it.)
2. Does air have weight?
3. Does air have mass?

GENERAL DISCUSSION QUESTIONS; LIQUIDS, SOLIDS,& GASES

1. How did dry ice get its name?
2. What do the molecules do in matter when you add energy?
3. How could you turn a rock into a liquid?
4. Why do smaller things burn easier than big things?
5. What 3 things do you need to have a fire?
6. What is the scientific reason that a helium balloon floats?
7. What state(s) of matter are you?
8. How are molecules acting when in each of the different states - solid, liquid and gas?

#3 - THE PHYSICS OF OBJECTS WE PLAY WITH (30 minutes)

Description: How do toys/sports work? What makes them move? They are more complicated then you might think.

Materials: toys from home

Procedure:

1. Have students bring in toys, non-electronic, representing each of Newton's 3 Laws.
   Newton's Laws:
   I. Every object in a state of uniform motion tends to remain in that state of motion unless an external force is applied to it.
   II. Force is equal to the change in momentum (mV) per change in time. For a constant mass, force equals mass times acceleration. F=ma.
   III. For every action, there is an equal and opposite reaction.
2. Divide students into groups and have them experiment with their toys and determine how Newton's Laws relate to the motions and forces of the toys.

Discussion:

Discuss the different forces and motions for several toys and how they relate to the laws.

#4 - FLOATING PING-PONG BALL: (20 minutes)

Description: Watch a ping-pong ball float in mid air using just your breath or a blow dryer.

Materials: ping-pong ball, straw that bends, blow dryer, empty toilet paper roll

Procedure:

1. Bend the straw at a right angle with the short part pointing toward the ceiling.
2. Blow a steady stream of air through the straw.
4. Position the ping-pong ball in the stream of air created by blowing through the straw.
5. See if you can suspend the ping-pong ball in the air by blowing in the straw.
6. What happens to the ping-pong ball if you move the straw?

Using the blow dryer:

1. Plug the blow dryer into the wall and turn it on high.
2. Point the blow dryer towards the ceiling.

3. See if you can suspend the ping-pong ball in the air above the blow dryer.
4. Once you have the ping-pong ball floating, hold the empty toilet paper roll above the ball. Watch it shoot through the tube and fall to the floor.

Discussion:

The floating ball is an example of what is called the Coanda effect. The Coanda effect is when a fluid or gas, flowing over a curved surface, follows the surface and "sticks" to it. When we blow through the straw the ping-pong ball is in the center of the air stream with the air flowing symmetrically around the ball. The air sticks to both sides of the ball causing it to float. But if we shift the air stream, and the ball moves out of the center of the stream, there will be more air sticking to one side of the ball and it will fall to the floor.

This is also a good example of Newton's third law of motion: "for every action there is an equal and opposite reaction." When the air pushes on one side of the ping-pong ball, air also pushes from the other side causing it to suspend in the air. When the straw or blow dryer is tilted, the ping-pong ball will stay suspended as long as it remains in the center of the air stream with both sides of the air stream equal on each side. Once the ball is no longer in the center of the stream, one side will push it away and out of the air stream allowing gravity to take over and the ball to fall to the floor.

#5 - AERO-DESIGN (60 minutes)

Description: Make and fly a paper airplane and investigate what factors affect the aerodynamics of flight.

Materials: paper, paper clips, tape

Procedure:

1. Each student designs his/her own paper airplane using only the provided supplies.
2. Students should analyze airplanes (preflight) to observe design variations.
3. Test planes for each of these criteria:

*height of flight *length of flight *stunt maneuvers

Discussion:

Discuss how forces affect airplanes.

Here are some websites that show you how to make super cool paper airplanes.

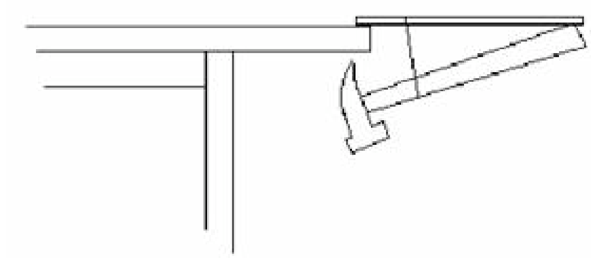
http://www.paperairplanes.co.uk/planes.php
http://www.bestpaperairplanes.com/
http://www.amazingpaperairplanes.com/

 # 6 - DEFY GRAVITY (30 minutes)

Description: A hammer, ruler, and string are all you need to challenge the law of gravity.

Materials: ruler, hammer, string (10-12" long)

Procedure:



1. Tie string to form a loop about 4 or 5 inches across. Slip loop 2/3 way down the ruler, and about halfway down the handle of the hammer.
2. Place the tip of the ruler on the edge of the table. Place the hammer-head slightly under the table, and the end of the handle about 1/3 of the way down the ruler. (Adjust it a little to make the ruler and the hammer balance. The very tip of the ruler should rest on the edge of the table because the center of gravity is directly below the edge of the table.)

Discussion:

1. Think of the equipment on the school playground. What laws apply to each piece of equipment?
2. Describe how a top works on earth. What laws are at work? How might a top function in space, where gravity is minimal?
3. What are the 3 laws of motion?
4. Name and define the physical forces at work on earth.
5. What force is most powerful in space? on earth?
6. As an astronaut, which toy would you most like to test in space?

#7 - SOLAR AIR BAG (40 minutes)

Description: As the temperature of air changes, watch as its properties change.

Materials: solar air bag (or lightweight large black trash bags), kite string

The Solar Air Bag can be can be purchased for $17.95 at:

http://www.google.com/products?hl=en&resnum=0&q=Solar+Air+Bag&um=1&ie=UTF-8

Procedure:

1. Unfold the bag and have students run with the opening of the bag facing forward so that the bag fills with air.
2. Once filled with air, tie the end of the bag so the air does not escape.
3. Tie kite string to the end of the bag and put it in the warm sun.
4. Watch the bag slowly rise and float in the air like a balloon.

Discussion:

The black color of the bag absorbs the energy from the sun and heats the air inside the bag. As the air in the bag heats, it expands and becomes less dense then the cooler air outside the bag. Once the air trapped inside the bag heats up, it acts as a hot air balloon and floats!

#8 - MENTOS® AND DIET COKE® (30 minutes)

Description: Discover how potential (stored) energy in Diet Coke is transformed into kinetic energy using Mentos mints.

Materials: 2-liter bottle of diet coke, pack of Mentos mints (soft or hard can be used), two pieces of paper

Procedure:

1. Take one piece of paper and make a roll. The roll should be small enough to fit in the mouth of the Diet Coke bottle, but big enough for the Mentos to pass through.
2. Fold the other piece of paper into fourths.
3. Place the bottle of Diet Coke in an open area outside.
4. Carefully open the bottle of Diet Coke.
5. Place the piece of paper folded in fourths over the open mouth of the Diet Coke bottle.
6. Position the roll on top of the folded paper.
7. Drop the whole roll of Mentos into the roll.
8. Slide the folded piece of paper allowing the Mentos to be dropped into the Diet Coke, all at the same time and then STAND BACK quickly!

Discussion:

Is this reaction physical or chemical? It could be a combination of both, but most scientists are saying that the reaction is physical due to something called nucleation sites. A nucleation site is simply a place where a gas is able form a bubble. Diet Coke is pumped full of CO_2 gas to make it fizzy. When the CO_2 is mixed with the water or the liquid in Diet Coke it becomes stable because there are no nucleation sites on the liquid. When you drop the Mentos into the Diet Coke you are providing the CO_2 with thousands of nucleation sites to form bubbles that rise and cause the explosion. Why? Because the surface of a Mentos is made up of lots of pits and microscopic nooks and crannies, all of which act as nucleation sites for the CO_2 to form bubbles. The more Mentos you use, the more nucleation sites are available for the CO_2 to form bubbles and the bigger the eruption. See http://www.youtube.com/watch?v=kMXPOqovSBs

You can also look at it this way; When the CO_2 is in the bottle with the coke, it is has the characteristics of potential (or stored energy). Dropping the Mentos in the Diet Coke causes the energy state of the CO_2 to change from potential energy to kinetic (active) energy resulting in the eruption.

#9 - BALANCING A BOOK ON A PIECE OF PAPER (40 minutes)

Description: Discover the relationship between surface area and strength of a piece of construction paper.

Materials: several sheets of construction paper, small book, masking tape

Procedure:

1. Take a sheet of construction paper and place the long edge on the desktop so it is perpendicular to the surface. Now place the book on top of the paper. Does the paper hold the book?
2. Now fold the construction paper in a "v" shape. Place the paper on the desktop so that the "v" is horizontal to the flat surface. Place the book on top of the paper. Does the paper hold the book?
3. Make a cylinder out of the construction paper using a piece of tape to hold it together. Place the cylinder on a flat surface so the opening of the cylinder is pointing towards the ceiling. Now place the book on top of the piece of paper. Does the paper hold the book?
4. Can you make other shapes out of the paper that can support the book?

Discussion:

A piece of paper is not very strong by itself, but when rolled into a cylinder or other shape it becomes stronger and can support more weight. It can do this because the weight of the book is distributed over a greater surface area. When the book is placed on the tiny edge of the paper there is not enough surface area to support the book so it collapses. The cylinder provides a greater surface area to support the book. How did your shape work to support the book?

#10 - MAKING A PAIR OF GLASSES (20 Minutes)

Description: Make a pair of glasses that work using just a piece of paper or aluminum foil.

Materials: pair of glasses or someone who wears prescription glasses, piece of construction paper, or aluminum foil, and a needle, pin, or small nail

Procedure:

1. If you do not wear glasses, put the glasses on and look around the room. Things should appear blurry to you.
2. If you wear glasses, take off your glasses and look around the room. Things should appear blurry to you.
3. Using the needle (pin or nail), make a small hole in the piece of paper (or aluminum foil).
4. If you do not wear glasses, put the glasses back on and look through the hole in the piece of paper. How do things appear now?
5. If you wear glasses take off your glasses and look through the hole in the piece of paper. How do things appear now?
6. Now make another small hole very close to the first hole you made in the paper. Repeat steps 5 and 6. How do things appear?
7. Add five more pinholes. Repeat steps 5 and 6. How do things appear?

Discussion:

The piece of paper (or aluminum) acts as a simple lens. When you look through the hole with or without glasses (depending upon your need to wear them). The image becomes focused and appears clear. When you add a second pinhole you should see two images of everything in the room. As you add more pinholes the images start to overlap and the more holes you add the more blurred the images become.

In a true emergency, you don't even need paper to make glasses. Put the first finger and thumb of your right hand together, as if you were pinching something. Do the same with your left hand and then bring your hands together to form a small opening between your fingers and thumbs. When you look through the tiny hole in between your fingers, it should work the same way the pinhole in the paper worked.

#11 - REACTION TIME (20 minutes)

Description: How good is your reaction time?

Materials: yard stick, piece of paper, pen, groups of 5-7 students

Procedure:

1. One person holds the yard stick upright from the end with the highest numbers.
2. The second person places their hand below the yardstick, with their forefinger on one side and thumb on the other, not touching the yardstick.
3. At an unexpected moment, the person holding the yardstick drops it. Try not to anticipate when the yardstick will fall.
4. On a piece of paper note the measurement where the yardstick was caught (reaction time).
5. Repeat steps 2-4 ten more times, giving each person in the group a chance to catch the yardstick. Remember, the point of this experiment is to test your reaction time. So try not to anticipate when the yardstick will be dropped, this will skew the results.
6. Do this experiment three times; once - first thing in the morning, second - right after lunch, and third - right before students leave for the day.

Discussion:

1. This experiment tests your reaction time. The lower the number of on the yardstick where it is caught, the faster the reaction time. Reaction time is the time it takes for you to see, hear, or feel something and for you to respond physically to it. In this experiment, you see the yardstick fall then you grab it with your thumb and forefinger. The time it takes for you to catch the yardstick is your "reaction time".
2. Look at the reaction time measurements you recorded. Are all ten of your reaction times similar? Different? What do you think makes them the same or different? What do you think would cause someone's reaction time to be faster than someone else's?
3. Have each student get an average of his or her reaction time for each of the three time periods. Then have them compare the three times in their groups. Which time of day are their reaction times the fastest? Why? Have each group share their findings with the class.

#12 - SMOKE RINGS (20 minutes)
Description: Understand the science behind what makes a smoke ring.
Materials: two-liter bottle-empty, candle, matches or lighter
Procedure:
1. Light the candle.
2. Blow out the candle and place the opening of the two-liter bottle over the top of the candle to catch the smoke.
3. Replace the cap on the bottle so the smoke cannot escape.
4. Repeat steps 1-3 several times until the two-liter bottle is filled with smoke.
5. Gently squeeze the bottle and see if you can make smoke rings come out of the bottle. How does this work?

Discussion:
When you squeeze the bottle, you force a small ball of air out of the bottle. As the ball of air moves forward, the air on the outside of the smoke ball encounters friction with the still air around it. This causes the outside ring of the "smoke ball" to move a little slower than the center. As the center moves forward it pulls the slower outside surface of smoke in behind it creating a smoke ring.

#13 - BUILD A SIMPLE TELESCOPE (20 Minutes)
Description: Build a simple telescope and discover how telescopes work.
Materials:
convex lens (a lens that is thicker in the middle then on the ends.)
concave lens (a lens that is thinner in the middle then on the ends)
To purchase kit go to http://sciplus.com. p/n: 68093 PLASTIC LENS, 20 for $1.95,
or Edmund Scientific http://scientificsonline.com p/n: #3040414 DEMONSTRATION LENSES, 50 mm Dia. Set of 36, for $9.95)
Procedure:
1. Hold the convex lens up to your eye. This is the “eye piece lens” of your telescope.
2. Now hold the concave lens in front of the convex lens. This is called the “objective lens” of your telescope.
3. Focus on a well-lighted object in the distance. Move the objective lens slowly forward until the object comes into focus.

Discussion:
How do telescopes work? Why can't you see an object that is far away without a telescope? For example, why can't you read the writing on a dime when it is 150 feet (55 meters) away? The answer to this question is simple: the dime is too small and does not reflect enough light onto your eye's retina to make the image visible. The retina is the part of the eye that the lens focuses light onto. Once light is focused onto the retina, it processes the light into signals that our brain turns into the images that we see.

If you want to think about it in digital camera terms, at 150 feet the writing on the dime does not cover enough pixels on your retina for you to read the writing. If you had a "bigger eye," you could collect more light from the object and create a brighter image, and then you could magnify part of that image so it stretches out over more pixels on your retina. Two pieces in a telescope make this possible:

An eyepiece lens takes the bright light from the focus of the objective lens or primary mirror and "spreads it out" (magnifies it) to take up a large portion of the retina. This is the same principle that a magnifying glass (lens) uses; it takes a small image on the paper and spreads it out over the retina of your eye so that it looks big. The objective lens collects lots of light from a distant object and brings that light, or image, to a point or focus.

#14 - BUILD A SATELLITE (3-4 Hours)

Description: Build a model of your very own satellite and learn how satellites work.

Materials cardboard, construction paper, poster board, glue, tape, markers or crayons, string, index card

Procedure:

1. Split class up into groups of five students each.
2. Have the students search the Internet to determine what satellite they are going to build. Here is a link to the NASA list of active and inactive satellites to get you started.
   http://ilrs.gsfc.nasa.gov/satellite_missions/list_of_satellites/
3. Have the students build a model of a satellite.
4. Use the string to hang the satellite.
5. Use the index card for the information:
   Name?
   Nickname, if any?
   Date of launch?
   Country, manufacturer, or sponsor if known?
   Mass or weight of satellite?
   Why the satellite was built?
   What kind of data is the satellite collecting?
   What is unique about this satellite?
   Is it still in orbit?
   Location of orbit?
   If not in orbit, what happened to it? Where is it now?
6. Have each group present their satellite and information to the rest of the class.

Writing Skills:
Students if possible, write a letter to the theater thanking them for providing the show, or write to Professor Smart and Dr. Knowitall! Ask them a question, and tell them what about your favorite part of the show. The performers will write back!

Jest In Time Educational Programs
115 Coronation Dr.
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Reading List

101 Physics Tricks
Cash, Terry 530.078

Fascinating Experiments in Physics
Cherrier, Francois 530

Physics Lab in the Home
Friedhoffer, Robert 621

Science Lab in a Supermarket
Friedhoffer, Robert 540.78

Famous Experiments You Can Do
Gardner, Robert 530

Measuring Weight and Time
King, Andrew 530.8

Science School
Manning, Mick 530.078

A Physics Lab of Your Own
Mark, Steven 530

Adventures With a Cardboard Tube
Milgram, Harry 500

Have a Ball
Stone, A Harris 530

The Heat's On
Stone, A. Harris 536

Science on a Shoestring
Strongin, Herb 372.35

Be a Kid Scientist
Wellnitz, William 530.078

Way Cool Web Sites

Unboxing Scientists of the World
www.unboxingscientists.com
Video biographies of 55 world changing scientists with Professor Smart

University of Maryland
http://www.physics.umd.edu/deptinfo/facilities/lecdem/services/demos/mainindex.htm
The BEST index of hundreds of science demonstrations with pictures and brief explanations.

Brain Pop
http://www.brainpop.com/
BrainPOP is an educational web site with Flash-based movies about mathematics, technology, health science, and social studies.

NASA Kids Club Page
http://www.nasa.gov/audience/forstudents/k-4/index.html
NASA-(National Aeronautics and Space Administration) website just for kids.

Science Monster.com
http://sciencemonster.com
Free online Science games and puzzles.

The Science Explorer
http:www.exploratorium.edu/science _explorer/
Many easy to do experiments, from creating volcanoes to tiny sparks.

Let's Go Science Show
http://www.letsgoscienceshow.com
Professor Smart's and Ms. Knowitall's home page.

Science Show Quiz for 4th-8th Grade

1) Name the elements that make up air:

2) In a vacuum do all objects fall: a) faster if they are heavier? b) slower if they have more surface area in relationship to their weight? c) at the same rate?

3) If we were on the moon dropping objects of varying size and mass would all objects fall a) faster if they are heavier? b) slower if they have more surface area in relationship to their weight? c) at the same rate?

4) What if we were dropping objects under water? How would the objects fall in relationship to each other?

5) Name 5 places where you would find objects with gyroscopic properties:

6) Are all things in textbooks true? why or why not? 6a) Can you think of one example?

7) Where would you find denser air, at sea level or at 20,000 ft. above sea level?

8) Centrifugal force is often used in laboratories. Describe how.

9) True or false: An optical illusion makes something appear different than it actually is.

10) Wings can give objects lift but what conditions need to be present?

11) You are going 10 miles per hour on a skateboard, you hit a bump, what do you hope hits the concrete before your head?

12) Why should you be aware of static electricity while pumping gas?

13) Why should you place portable gas cans on the ground before filling them with gas?

14) How can you easily create a static electric charge on your body?

15) Name 4 common uses of levers and fulcrums?

16) Where would you be heavier, in San Francisco? or Denver?

17) Ok you're smart, you study, you've got great grades, what else will you need to do to be happy in your life?

18) Who do you think is the smartest person that you know? What have you seen them say or do that has brought you to that conclusion?

19) How are you smart?

20) What skills are you developing this year that you may use in the future?

Answers for Written Science Show Quiz for 4th-8th Grade

1) Nitrogen, Oxygen, Argon, and Carbon Dioxide

2) At the same rate.

3) At the same rate.

4) Objects that have a greater weight in relation to their surface area would pass faster through water or any liquid.

5) Airplane navigation systems, spinning bicycles wheels, spinning motorcycles wheels, stabilization systems of large ships, revolving planets, a spinning ball, a thrown frisbees, a thrown football, and many many more.

6) No, knowledge changes as scientists discover and challenge theories of scientist from the past. Often with newer technologies people can rewrite what has been held true for hundreds or thousands of years. 6a) Scientific journals said that the earth was flat not too long ago.

7) At sea level. The farther away you are from the core of the earth and its gravitational field the less dense air becomes. Imagine being 60,000 ft. above sea level or 100,000 miles above sea level.

8) Centrifuges separate liquids like blood into different substances by creating an artificial gravity many times earth's pull. The more dense liquids go to the bottom of a centrifuge when in motion.

9) True. Objects do not change, only their appearance changes.

10) Wings need the movement of air or other type of fluid around an object.

11) Your helmet should hit first, if not your feet.

12) Gas fumes are combustible. If you discharge enough electrical energy to catch the gas fumes next to the tank opening on fire, then BIG BOOM, with BIG FIRE as your gas tank catches on fire.

13) Often motor vehicles have a static electrical field around them because of friction between the tires and the road. It can cause a spark from the vehicle (stored electrical charge) to the gas pump (the ground) igniting the gas fumes as you fuel the can and then BIG BOOM as the gas can explodes.

14) Rubbing your shoes over a carpeted surface can create a static charge. You are scraping electrons off the carpet that build up throughout your body until you discharge them back to the floor by touching something that is grounded.

15) Levers include; seesaw, scissors, crow bar, can opener, bottle opener, car jack handle, hammer handle, and even a soda can has a little lever to pop open the top by pushing down on a small point of the opening.

16) San Francisco; You would be heavier there because you would be closer to the center of the earth than you would be in Denver, the mile-high city.

17) **Good health**: Eat smart and exercise and don't become a smart lump that sits around and knows everything. Turn off the tube, turn off the computer, get out the door, walk, run, dance, play ball, climb or bike. You don't have to be the fastest or the best to do anything. You can choose to participate or you can vegetate.

Good friends: Treat everybody with respect because someday they might be the people that you need to help you.

Good job: Most of your learning will NOT come from school, go out and seek people that you aspire to be like and ask them how they developed their business or their skills.

Good attitude: Nurture yourself as you would the most important person in the world. You are the most important person in the world to you.

Good adventures: Go where no one else is going. Think what no one else is thinking. Try something that you know you can't do well. It is OK to mess up. Try again, and again, and again. It's OK. Messing up is so much better than giving up or not trying at all! You learn from you mistakes.

Good times: Have fun, do stuff, explore, take a chance and do something that no one else is doing.

18) 19) and 20) You are going to have to answer these for yourself.

Let's Go Science Show Evaluation Sheet

Your chance to grade the Professor and Dr. Knowitall:

School name:_______________ Time of Show:_______ Grade:__________

1= Poor 5= Average 10 =Outstanding

1) Did you and your students enjoy the show?

1 2 3 4 5 6 7 8 9 10

2) Were there direct correlations between your school's science curriculum and the subjects covered in the show?

1 2 3 4 5 6 7 8 9 10

3) Could you and your students see and hear the show clearly?

1 2 3 4 5 6 7 8 9 10

4) Was the material presented in a clear and understandable manner?

1 2 3 4 5 6 7 8 9 10

5) Was the show age appropriate?

1 2 3 4 5 6 7 8 9 10

6) Were the study materials helpful?

1 2 3 4 5 6 7 8 9 10

7) Was the vocabulary used during the show grade level appropriate?

1 2 3 4 5 6 7 8 9 10

8) How many hours a week do you spend on science in your class?

0 1 2 3 4 5 6 7 8 9 10

9) Is there anything that you think the show could add?

____

____

10) Was there anything the show could have left out?

____

____

Additional Comments:____

____

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Please return to your school office secretary.

Please mail to:

Jest In Time Educational Programs
115 Coronation Dr.
Santa Rosa, CA 95401

For Information: (800) 829-9360 or todd@jestintime.com