TEACHERS ACROSS BORDERS

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

Southern Africa
www.tab-sa.org

SCIENCE
SENIOR PHASE
PORT ELIZABETH
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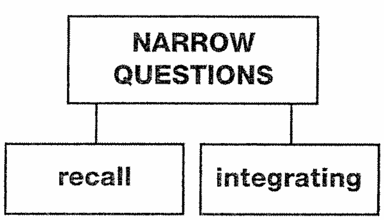
ENCOURAGING DISCOURSE

Discourse is an important component of science learning. Students need to describe their observations and reasoning and to interpret how other students are thinking. Good questions posed by the teacher can enhance this discourse by contributing to the development of concepts and vocabulary and by helping students connect ideas among the sciences. Thoughtfully presented questions promote thinking and draw students into sharing observations, communicating ideas, and uncovering relationships.

Questions fall into two general categories. **Narrow questions** call for specific answers. They focus student thinking on specific knowledge. **Broad questions** invite individual thought. They diverge from a central idea, encouraging unique and creative thinking. Both kinds of questions have application in FOSS.

Narrow Questions. There are two kinds of narrow questions, recall and integrating. Discussions often start with **recall** questions that ask students to remember terminology and procedures.

As the discussion continues, more complex **integrating** questions encourage students to put pieces of information together to generate ideas with which they have had no direct experience. These questions have "right" answers, but there may be more than one way to express an answer.

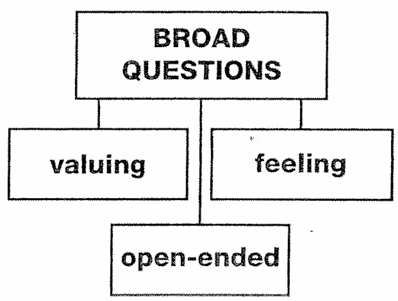


Broad Questions. Broad questions do not require specific answers that everyone agrees upon. Three kinds of broad questions invite students to share their personal ideas, feelings, and values about the subject matter under investigation. These questions have no right answers, so all student responses should be accepted, and many students should be invited to contribute to the discussion.

Open-ended questions encourage creative, speculative thinking.

Valuing questions allow students to reflect on the subject, based on their own value structure.

Feeling questions invite students to share their personal feelings about aspects of the topics being investigated.



Research shows that it is important to wait several seconds before calling on a student to respond to a question. Waiting improves the quality of student responses and increases the number of students who try to respond to the question.

Full Option Science System
Developed at the Lawrence Hall of Science
University of California, Berkeley, California USA

Activity #1: Water Droplets and the Particle Kinetic Theory

Adapted from: http://www.middleschoolchemistry.com/lessonplans/chapter1/lesson1
In this activity the students investigate the characteristics of water and begin to create a molecular-level model that explains why water acts as it does.

- Water in a small cup
- Popsicle sticks
- Index cards covered with wax paper

METHOD

- ❑ Place a drop of water, the size of a small coin, on the wax paper.
- ❑ Gently tilt the wax paper in different directions so that the drop moves
- ❑ Use a stick to slowly move your drop around the wax paper.
- ❑ Use your stick to separate your drop into two drops.
- ❑ Use the stick to bring the drops close to each other, and then move them together so they just touch.

OBSERVATION/DISCUSSION QUESTIONS:

1. When you were pulling the drop around, did it seem to hold together or come apart easily?
2. When you tried to split the drop, did the drop separate easily?
3. Was it easy or difficult to make the drops come together?
4. Imagine a drop of water hanging from your finger. How is this similar to the water staying together on the wax paper?
5. What is it about water molecules that helps explain why the water drops were difficult to split apart but easy to join together?

DEMONSTRATION:

In a large clear container filled with water, squirt food coloring and let the solution sit.

➢ What does this tell you about water molecules?

CREATE A MODEL:

Take out a clean piece of paper. Using circles to represent molecules and lines to represent motion, draw a model of water on the molecular level. Use the entire paper. Be sure to show that the water molecules are randomly arranged, close together, moving.

TAKING IT FURTHER: If possible, show a slow-motion video of a water balloon being popped.
http://www.youtube.com/watch?v=TdMIsCF_7p0

➢ Why do you think the water keeps its shape the moment the balloon is popped?

Activity #2: Creating Crystals

In this activity students will create copper sulfate crystals from a concentrated solution, with help from the sun or other heat source

- White or black construction paper,
- Very warm water
- Copper sulfate or Epsom salts
- Paint brush or straw
- Scissors and Aluminum foil (optional)

METHOD

- ❑ In a small cup, add 1 large spoonful of either copper sulfate or Epsom salts to a small amount of very warm water. Stir to dissolve. Continue to add solid until it will not all dissolve and some of the solid remains sitting in the bottom of the cup.
- ❑ Using the paint brush or using the straw as a eye-dropper, “paint” a picture on the paper. If using Epsom salts, use the black paper, if using copper sulfate, use the white paper.
- ❑ Hold the paper close to a heat source (in front of a hair drier? on a radiator?) or place in the sun.

OBSRVATION/DISCUSSION QUESTIONS

1. Look closely at the crystals and observe their shape. What does this tell you about the arrangement of particles in a solid crystal?
2. How is the arrangement of particles in a solid different from in a liquid?
3. What happens, at a molecular level, when ice melts? When water freezes?

Create a Model:
Take out a clean piece of paper. Using circles to represent molecules and lines to represent motion, draw a model of copper sulfate (or Epsom salt) particles on the molecular level. Use the entire paper. Be sure to show that the particles are arranged in an orderly fashion and close together.

➢ Do you think the particles are moving at all?

TAKING IT FURTHER: If possible, show a time-lapse video of a water crystals (snowflakes) forming.
http://petapixel.com/2014/02/23/mesmerizing-time-lapse-captures-formation-snowflake/

➢ Why do you think the crystals grow outward from a central point?
➢ Why do you think there are always six "points" to these water crystals?

Activity #3: Gases Hot and Cold

Adapted from: http://www.middleschoolchemistry.com/lessonplans/chapter1/lesson5
In this investigation you will observe how heating and cooling affects a gas.

- Two clear plastic cups
- A small water bottle
- Detergent solution in a small cup
- Hot water
- Cold water

METHOD

❑ Pour hot water into one of the cups until it is about ½ full.
❑ Pour cold water into the other cup until it is ½ full.
❑ Turn the water bottle over and dip the opening into the soap solution to get a soap film at the rim.
❑ While holding the bottle, slowly push the bottom of the bottle down into the hot water.
❑ While there is still a bubble on the bottle, slowly push the bottom of the bottle into the cold water.

NOTE: If the bubble has popped, make another by dipping into the soap solution and pushing down into the hot water again. Then proceed.

➢ Write down your observations

OBSERVATION/DISCUSSION QUESTIONS:
Before answering, there are two important facts to consider. The first is that, when gases warm up, their molecules move faster. The other is that the air on the outside of the soap film is also made up of gas molecules. Keeping these facts in mind, consider the following:

1. What caused the bubble to form when you placed the bottle into hot water?
2. What caused the bubble to "implode" when you placed the bottle in the cold water?

CREATE A MODEL:
Take out a clean piece of paper. Using circles to represent molecules and lines to represent motion, draw a model of air on the molecular level. Use the entire paper. Be sure to show that the particles are randomly arranged and very far apart.

➢ Do you think the particles attract each other at all?

TAKING IT FURTHER: If possible, show a video of liquid nitrogen (at -196°c) being poured out on a table.
http://www.youtube.com/watch?v=gvuOhpsI9yQ

➢ Why does the liquid nitrogen disappear?
➢ Why does the gaseous nitrogen take up so much more space than the liquid nitrogen?
➢ Would you want to put your hand in liquid nitrogen?

Activity #4: Attractions and Repulsions

Adapted from: http://www.middleschoolchemistry.com/lessonplans/chapter4/lesson1m
In this investigation students observe objects that attract and repel, and equate these observations with the expected action of electrons and protons in an atom.

METHOD

- *Create a charge strip*: Cut a strip from a grocery bag, about 2–4 cm wide and about 20 cm long.
- *Charge the strip*: Hold the plastic strip firmly at one end. Then grasp the plastic strip between the thumb and fingers of your other hand. Quickly pull your top hand up so that the plastic strip runs through your fingers. Do this three or four times. Your strip is now considered "charged."
- *Investigate*:
  - ❑ Once your strip is charged, bring your hand near it.
  - ❑ Bring your charged strip close to the charged strip of your partner.
  - ❑ Charge your strip again and bring it toward your desk or chair.

OBSERVATION/DISCUSSION QUESTIONS:
Objects that are not charged have an equal number of protons and electrons. When you rub the strips through your hand, electrons are lost from the atoms on your skin and are gained by the plastic.

1. What can you say about how electrons react when they are brought close to each other? Defend your answer by referring to your observations above.
2. What can you say about how electrons react when they are brought close to protons? Again, defend your answer by referring to your observations above.
3. This is trickier: Why do you think the strip responded the way it did when it was brought towards a neutral object, like your desk or chair? Use the words "electrons" and "protons" in your answer.

Activity #5: Molecules and Atoms – What is the Difference?

Adapted from Micron Foundation Lesson Plan: Atoms.
http://download.micron.com/pdf/education/k12_pdf_lessons/atoms.pdf

Gummy candies and toothpicks are used to create three-dimensional models of simple molecules.

1. Determine the number and type of elements in each molecule and write it down on the Data Table.
2. Draw the molecule model.
3. Working with a small lab group, make the molecule models using appropriately colored clay or candies and toothpicks.
4. Compare their structures with the true structures. Speculate on why the shapes might be different than expected.

Molecule	Elements	Draw it!
Water H_2O		
Carbon Dioxide CO_2		
Methane CH_4		
Propane C_3H_8		
Ammonia NH_3		

Activity #6: Exploring a Chemical Reaction

Adapted from: http://www.middleschoolchemistry.com/lessonplans/chapter6/lesson1

In this activity, students will explore where the atoms come from in a chemical reaction.

The reaction to be explored is the combustion of methane: $CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$

- Atom model cut-outs (carbon, oxygen, and hydrogen)
- Sheet of white paper or construction paper
- Colored pencils or markers
- Scissors
- Glue or tape

METHOD

Prepare the Atoms

- ❑ Working in groups, draw circles on paper to represent atoms: two larger circles with the letter C (for carbon)… 8 circles of the same size with the letter O (oxygen)… and 8 smaller circles with the letter H (hydrogen). Use scissors to carefully cut out the atoms.
- ❑ Color the carbon atoms black, the oxygen atoms red, and leave the hydrogen atoms white.

Build the Reactants

- ❑ On a sheet of paper, place the atoms together to make the molecules on the left side of the chemical equation. These are the REACTANTS.
- ❑ Write the chemical formula under each molecule and draw a + sign between them.

Build the products

- ❑ Draw an arrow after the second oxygen molecule to show that a reaction is taking place.
- ❑ Using the same atoms, rearrange them to make the molecules on the right side of the arrow. These are the PRODUCTS.
- ❑ Write the chemical formula under each molecule and draw a + sign between them.

Represent the chemical equation

- ❑ Use your remaining cut-out atoms to make the reactants again to represent the chemical reaction as a complete chemical equation.
- ❑ OPTIONAL: Glue or tape the atoms to the paper to make a more permanent chemical equation of the combustion of methane.

DISCUSSION QUESTIONS

1. How many atoms are created or destroyed in a chemical reaction? How do you know?
2. In a physical change, like changing state from a solid to a liquid, the substance itself does not change. How is a chemical change different from a physical change?

TAKING IT FURTHER

In addition to methane, some other common hydrocarbons are propane (the fuel in outdoor gas grills), and butane (the fuel in disposable lighters). Write balanced equations for these reactions on the board and have students count the number of carbon, hydrogen, and oxygen atoms in the reactants and products of each equation to see if the equation is balanced.

- ➢ Lighting a propane stove — Combustion of propane
  $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_20$
- ➢ Using a disposable lighter — Combustion of butane
  $2\ C_4H_{10} + 13\ O_2 \rightarrow 8\ CO_2 + 10\ H_2O$

If possible, show an animation of the reaction of methane with oxygen:
http://www.middleschoolchemistry.com/multimedia/chapter6/lesson1#chemical_reaction_methane

Activity #7: Turning Compounds into Elements – Splitting Water

Adapted from: http://highschoolenergy.acs.org/content/hsef/en/how-do-we-use-energy/electrolysis-of-water.html

In this demonstration, students observe the splitting of water molecules to produce two elements: hydrogen and oxygen gases. They also investigate the idea that energy from a battery can be used to drive a chemical reaction that does not happen spontaneously.

- 9-volt battery
- Two metal thumbtacks
- Water
- Epsom salt ($MgSO_4 \bullet 7\ H_2O$)
- Scissors
- Black permanent marker
- Glass or plastic cup
- Paper towels
- Clean, empty, clear and colorless plastic water bottle with cap with the label removed

PREPARATION

- ❑ Remove the cap from the water bottle. Turn the lid over so that the top of the lid touches the two contacts of a 9-volt battery. Center the lid over the two contacts. Using a black marker, make two dots on the inside of the lid, one over the center of each contact.
- ❑ Place the lid on a hard surface with the top of the lid facing up. Push a metal thumbtacks into the top of the lid directly over each of the dots. The two thumbtacks should not touch.
- ❑ Using scissors, cut off the top half of the bottle, so that it looks like a funnel.
- ❑ Screw the lid back onto the bottle.

DEMONSTRATION

- ❑ Fill the bottom half of the cut water bottle approximately half full of water. Add about a teaspoon of Epsom salt. Swirl to stir until most of the salt dissolves.
- ❑ Pour the Epsom salt solution into the top half of the bottle (hold so the lid faces down).
  Is there any evidence of a reaction occurring?
- ❑ Place the two thumbtacks so that each touches one of the contacts on the 9-volt battery.
  Is there any evidence of a reaction occurring?
- ❑ Place the battery into the bottom of a glass or clear plastic cup, held upright with paper towels or modeling clay. The top of the bottle can then be rested on top of the battery.

OBSRVATION/DISCUSSION QUESTIONS

1. What evidence is there that a reaction occurs when the battery touches the thumbtacks?
2. Is there any difference in the amount of gas produced at each battery contact?
3. Could the difference described in question 2 be due to a difference in the tacks? What could one do with the apparatus to potentially provide support for the idea that the battery contact is responsible?

More challenging questions:

4. What is the balanced equation for the breaking apart of water molecules?
5. If the reaction we are observing is the breaking apart of water molecules, which battery contact might be producing which gas and why?
6. What is the purpose of the battery?
7. Why is Epsom salt added to the water?
8. What could be done to gather further evidence that there are two gases produced and that they are H_2 and O_2?

Activity #8: Turning Elements into Compounds – Burning Steel Wool

Adapted from: http://www.adamequipment.com/education/Documents/experiment_3_R2.pdf

In this activity, students make quantitative measurements both before and after burning a piece of steel wool.

- Steel wool pads
- Acetone (nail polish remover)
- Aluminum foil
- New nine-volt battery
- Electronic balance

METHOD

In preparation for the activity, clean a few steel wool pads by placing them in acetone for about 5 minutes, removing and allowing to dry.

- ❑ Remove a small section of steel wool that has been cleaned with acetone.
- ❑ Create a "cup" out of a piece of aluminum foil. Weigh the cup and record the mass.
- ❑ Add the steel wool to the aluminum foil cup and record the mass of the cup and steel wool.
- ❑ Using a new nine-volt battery, touch the two battery terminals to strands of the steel wool. (Be careful the sparks do not hit you, your clothing or other flammable materials.) Make observations.
- ❑ Use the battery to burn the entire piece of steel wool.
- ❑ Record the new mass of the burned steel wool. Make observations.

OBSRVATION/DISCUSSION QUESTIONS

1. Describe the starting and ending substances for this first experiment. Were they different?
2. What observations indicate that a chemical reaction occurred?
3. What evidence might lead someone to think "matter was created" in this experiment?
4. Explain the differences in mass of the steel wool after heating.
5. Iron reacts with oxygen gas (O_2) to create iron(III) oxide: Fe_2O_3. Write a chemical equation to explain this change.

Real World Application

6. Why is the corrosion of iron a problem?
7. How can the corrosion or rusting of iron be prevented?

Activity #9: Identifying Acids and Bases with Red Cabbage Juice

In this activity students will investigate whether common substances form acids or bases when dissolved in water.

- Red cabbage
- Blender
- Strainer
- Clear drinking glasses
- White paper
- Drinking straw Water
- Test chemicals: Vinegar, baking soda, lemon juice, washing soda, laundry detergent, soda pop, and Alka-Seltzer

METHOD

- ❑ Set out three glasses, side by side, against a white piece of paper as the background. Fill each glass one-half full with cabbage juice.
- ❑ Add a little vinegar to the first glass of cabbage juice. Stir with a spoon and observe the color.
- ❑ In the second glass, add a teaspoon of washing soda. Again, stir and observe the color.

Keep these two glasses of red and green liquid for future reference, along with the third glass of purple cabbage juice to show the color of a neutral solution.

- ❑ Fill additional glasses with purple cabbage juice. Try adding each of the other "test chemicals" to juice and note the color change to determine if the chemical is an acid or a base.
- ❑ One last trick. Take a fresh cup filled ¼ of the way with indicator. Blow bubbles through a straw into the indicator solution. Keep blowing until you see a color change. What do you observe?

OBSRVATION/DISCUSSION QUESTIONS

Remind yourself about the colors of cabbage juice in acid and in basic solution.

1. How many acids and how many bases did you identify? Were any of the substances neutral?
2. What do you think causes the color change when you add vinegar to wash soda solution?
3. What substance do you think is in your breath to cause the final color change?

TAKING IT FURTHER: If possible, show an animation of proton transfer in water. http://www.middleschoolchemistry.com/multimedia/chapter6/lesson8#proton_transfer_illustration.

Activity #10: Acid/Base Neutralization

In this activity, students will use citric acid and sodium carbonate solutions to see that adding a base to an acidic solution makes the solution less acidic. Students will then use a base to help them identify which of two acidic solutions is more concentrated.

- Clear cups
- Measuring cup
- Cabbage juice indicator
- Water
- Wash soda (solid sodium carbonate)
- Lemon juice or "sour salt" (solid citric acid)
- Flat toothpicks
- Drinking straws to use as droppers
- Wax paper

METHOD #1: Preparing the solutions for the activity (or this can be done in advance and the solutions made available to the students for the next part of the activity).

- ❑ Use masking tape and a pen to label one cup citric acid and another cup sodium carbonate.
- ❑ Use a small piece of masking tape and a pen to label one straw citric acid solution and the other straw sodium carbonate solution.

Make a citric acid solution

- ❑ Add water to a depth of about 1 cm to the cup labeled citric acid.
- ❑ Use a flat toothpick to pick up as much citric acid as you can on the end of it.
- ❑ Add this citric acid to the water in the citric acid cup. Gently swirl until the citric acid dissolves.

Make a sodium carbonate solution

- ❑ Add water to a depth of about 1 cm to the cup labeled sodium carbonate.
- ❑ Use a flat toothpick to pick up as much sodium carbonate as you can on the end.
- ❑ Add this sodium carbonate to the water in the sodium carbonate cup. Gently swirl until the sodium carbonate dissolves.

METHOD #2: How many drops of sodium carbonate solution will it take to neutralize your citric acid solution?

- ❑ Place a piece of white paper behind a piece of wax paper.
- ❑ Use a drinking-straw dropper to create three small puddles of indicator solution. Do not add anything to the first puddle. This will be your "control".

1. TRIAL #1
    - o Counting drops as you go, add at least three drops of acetic acid solution to the indicator in the second puddle until you see a color change. Record the number of drops added.
    - o Add single drops of sodium carbonate to the same puddle in which you added the acid. Be sure to count the drops you use.
2. Trial #2: Repeat the experiment by performing the last two steps again in the third puddle.

OBSRVATION/DISCUSSION QUESTIONS

1. How many drops of sodium carbonate did it take to bring the color back to the color of the control?
2. Does the solution become more acidic or less acidic as each drop of sodium carbonate is added to the indicator?
3. How do you use the color of the control to help you neutralize an acid?
4. How did the number of drops of sodium carbonate solution needed in the second trial compare to the number you added in the first trial?
5. Why do you learn by performing the experiment twice?

TAKING IT FURTHER: If possible, show an animation of how adding a base to an acidic solution involves the reaction of H_3O^+ ions with OH^- ions.
http://www.middleschoolchemistry.com/multimedia/chapter6/lesson9%20-%20neutralizing_an_acidic_solution

METHOD #3: How many more drops of sodium carbonate solution will it take to neutralize a more concentrated citric acid solution?

- ❑ Use a flat toothpick to add two scoops of citric acid to your citric acid solution to make it even more acidic. Gently swirl until the citric acid dissolves.
- ❑ Create a new puddle of cabbage juice indicator.
- ❑ Add 3 drops of the more concentrated citric acid solution to the indicator.
- ❑ Add single drops of sodium carbonate solution to the same well in which you added the acid. Be sure to count the drops you use.

TAKING IT FURTHER: If there is time, prepare two “unknown” solutions, one with a high concentration of base and one with a low concentration. Have the students develop their own experiment to determine which is which.

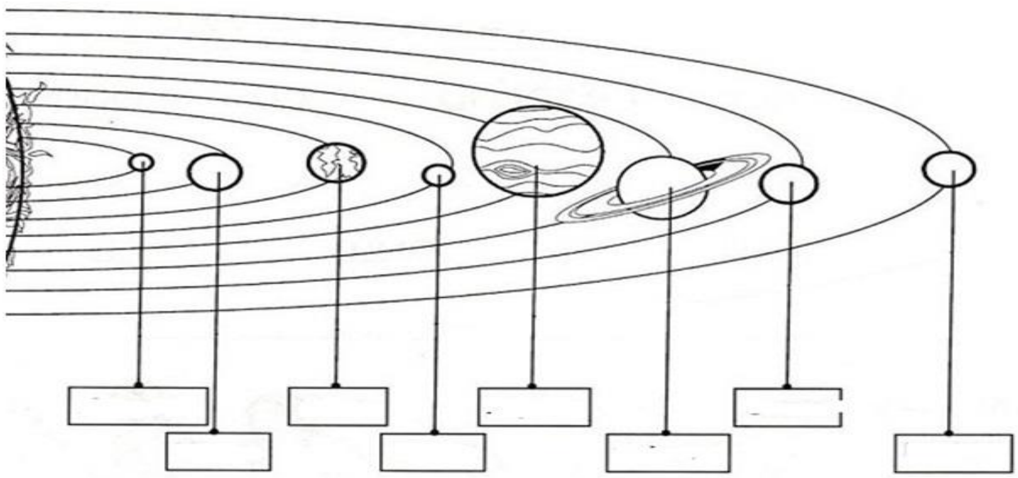
Periodic Table of the Elements

1 IA 1A	2 IIA 2A	3 IIIB 3B	4 IVB 4B	5 VB 5B	6 VIB 6B	7 VIIB 7B	8	9 VIII 8	10	11 IB 1B	12 IIB 2B	13 IIIA 3A	14 IVA 4A	15 VA 5A	16 VIA 6A	17 VIIA 7A	18 VIIIA 8A
1 **H** Hydrogen 1.008																	2 **He** Helium 4.003
3 **Li** Lithium 6.941	4 **Be** Beryllium 9.012											5 **B** Boron 10.811	6 **C** Carbon 12.011	7 **N** Nitrogen 14.007	8 **O** Oxygen 15.999	9 **F** Fluorine 18.998	10 **Ne** Neon 20.180
11 **Na** Sodium 22.990	12 **Mg** Magnesium 24.305											13 **Al** Aluminum 26.982	14 **Si** Silicon 28.086	15 **P** Phosphorus 30.974	16 **S** Sulfur 32.066	17 **Cl** Chlorine 35.453	18 **Ar** Argon 39.948
19 **K** Potassium 39.098	20 **Ca** Calcium 40.078	21 **Sc** Scandium 44.956	22 **Ti** Titanium 47.867	23 **V** Vanadium 50.942	24 **Cr** Chromium 51.996	25 **Mn** Manganese 54.938	26 **Fe** Iron 55.845	27 **Co** Cobalt 58.933	28 **Ni** Nickel 58.693	29 **Cu** Copper 63.546	30 **Zn** Zinc 65.38	31 **Ga** Gallium 69.723	32 **Ge** Germanium 72.631	33 **As** Arsenic 74.922	34 **Se** Selenium 78.971	35 **Br** Bromine 79.904	36 **Kr** Krypton 84.798
37 **Rb** Rubidium 84.468	38 **Sr** Strontium 87.62	39 **Y** Yttrium 88.906	40 **Zr** Zirconium 91.224	41 **Nb** Niobium 92.906	42 **Mo** Molybdenum 95.95	43 **Tc** Technetium 98.907	44 **Ru** Ruthenium 101.07	45 **Rh** Rhodium 102.906	46 **Pd** Palladium 106.42	47 **Ag** Silver 107.868	48 **Cd** Cadmium 112.414	49 **In** Indium 114.818	50 **Sn** Tin 118.711	51 **Sb** Antimony 121.760	52 **Te** Tellurium 127.6	53 **I** Iodine 126.904	54 **Xe** Xenon 131.294
55 **Cs** Cesium 132.905	56 **Ba** Barium 137.328	57-71	72 **Hf** Hafnium 178.49	73 **Ta** Tantalum 180.948	74 **W** Tungsten 183.84	75 **Re** Rhenium 186.207	76 **Os** Osmium 190.23	77 **Ir** Iridium 192.217	78 **Pt** Platinum 195.085	79 **Au** Gold 196.967	80 **Hg** Mercury 200.592	81 **Tl** Thallium 204.383	82 **Pb** Lead 207.2	83 **Bi** Bismuth 208.980	84 **Po** Polonium [208.982]	85 **At** Astatine 209.987	86 **Rn** Radon 222.018
87 **Fr** Francium 223.020	88 **Ra** Radium 226.025	89-103	104 **Rf** Rutherfordium [261]	105 **Db** Dubnium [262]	106 **Sg** Seaborgium [266]	107 **Bh** Bohrium [264]	108 **Hs** Hassium [269]	109 **Mt** Meitnerium [268]	110 **Ds** Darmstadtium [269]	111 **Rg** Roentgenium [272]	112 **Cn** Copernicium [277]	113 **Uut** Ununtrium unknown	114 **Fl** Flerovium [289]	115 **Uup** Ununpentium unknown	116 **Lv** Livermorium [298]	117 **Uus** Ununseptium unknown	118 **Uuo** Ununoctium unknown

Lanthanide Series	57 **La** Lanthanum 138.905	58 **Ce** Cerium 140.116	59 **Pr** Praseodymium 140.908	60 **Nd** Neodymium 144.243	61 **Pm** Promethium 144.913	62 **Sm** Samarium 150.36	63 **Eu** Europium 151.964	64 **Gd** Gadolinium 157.25	65 **Tb** Terbium 158.925	66 **Dy** Dysprosium 162.500	67 **Ho** Holmium 164.930	68 **Er** Erbium 167.259	69 **Tm** Thulium 168.934	70 **Yb** Ytterbium 173.055	71 **Lu** Lutetium 174.967
Actinide Series	89 **Ac** Actinium 227.028	90 **Th** Thorium 232.038	91 **Pa** Protactinium 231.036	92 **U** Uranium 238.029	93 **Np** Neptunium 237.048	94 **Pu** Plutonium 244.064	95 **Am** Americium 243.061	96 **Cm** Curium 247.070	97 **Bk** Berkelium 247.070	98 **Cf** Californium 251.080	99 **Es** Einsteinium [254]	100 **Fm** Fermium 257.095	101 **Md** Mendelevium 258.1	102 **No** Nobelium 259.101	103 **Lr** Lawrencium [262]

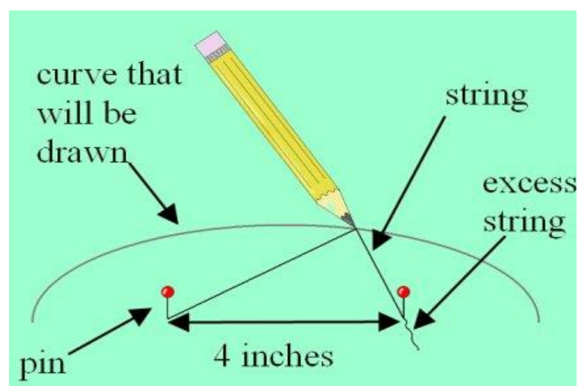
THE SOLAR SYSTEM

Can you correctly identify and label the planets below?			
URANUS	MARS	MERCURY	JUPITER
VENUS	NEPTUNE	EARTH	SATURN



ACTIVITY #1: MAPPING THE PATHS OF THE PLANETS

Planets travel around the sun in ellipses, not circles. The Solar System looks like a flat disc or plate. The Sun spins (rotates) at the centre and the planets and all other objects orbit around it in the same direction. A variety of objects orbit the Sun - eight planets and their moons, rocky asteroids, outer dwarf planets and many distant icy and dusty objects in the Kuiper Belt and Oort Cloud.



Supplies:

- ♦ A pencil
- ♦ A sheet of paper (8 ½" by 11")
- ♦ Six thumbtacks
- ♦ A piece of string 8 inches long
- ♦ A sheet of cardboard

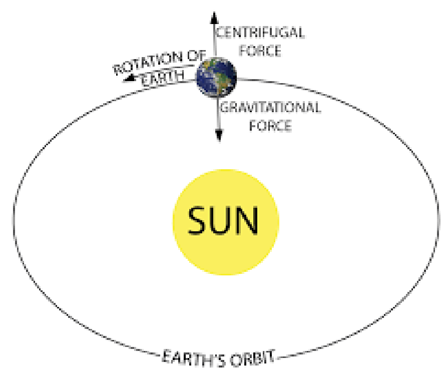
Procedure:

1. Lay the sheet of paper on top of the cardboard and pin it at each corner.
2. Take the remaining two pins and pin your string horizontally 5 inches apart and across from each other as shown in the picture above. There should be excess string dangling.
3. Take a pencil, keeping the string tight, and move from one pin to another, first above and then below
4. The result will be two curves that reflect each other. It is an oval, which mathematicians call an ellipse.
5. Pull the right pin off the paper and re-pin it through the very end of the string and back into the exact location as before. The pins will be in the same place, but with more string in-between and no excess.
6. Once again, use the pencil and string to draw two curves: one below the pins and one above them.

ACTIVITY #2: GRAVITATIONAL FORCE & CIRCULAR MOTION

The Sun is like all other stars – it produces large amounts of heat and light continuously. The energy in our Sun comes from powerful nuclear reactions during which hydrogen gas changes into helium gas. The immense mass of the sun keeps all the planets in their stable, predictable orbits due to the force of gravity. How does this happen? Circular motion requires a special kind of force. In this experiment we'll explore that force

Supplies:



- A mechanical pen
- A black marker
- Thin string or thread (preferably white)
- Five metal washers, all the same size
- Stopwatch
- Scissors

Procedure:

1. Set up your experimental device by following the picture.

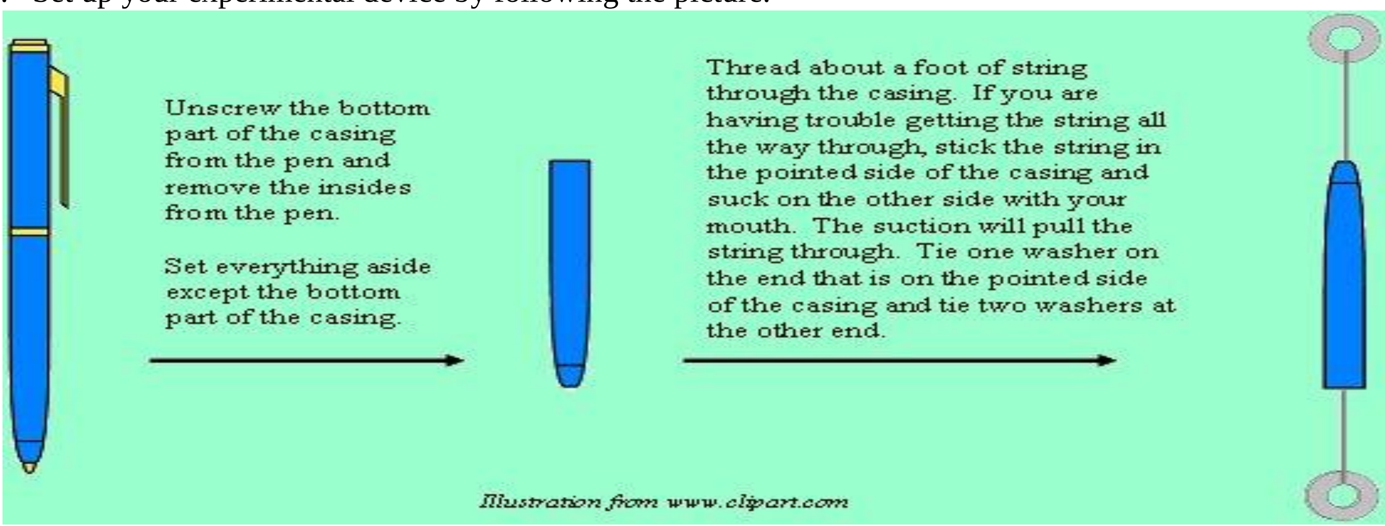


Illustration from www.clipart.com

2. Lay your device on the table and pull the string so that about 6 inches of string comes out the pointed side of the casing. Make a strong black mark on the string, right where it comes out of the casing.

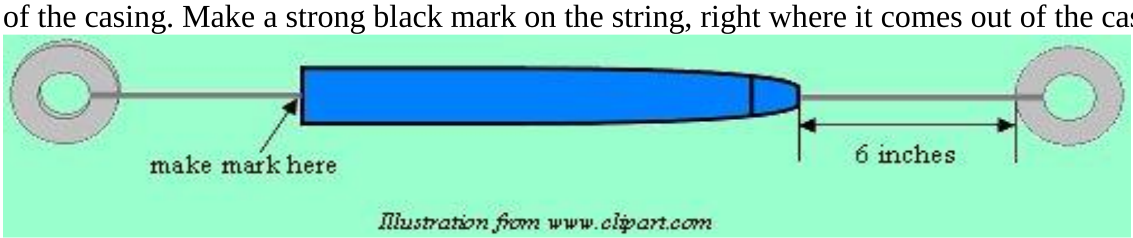


Illustration from www.clipart.com

3. Hold the device by grasping the pen with the pointed end up and begin twirling the single washer.
4. The faster you twirl the washer the sweep to become larger. The slower you twirl, the smaller the circle
5. Adjust the rate you are twirling until the black mark is visible right at the bottom of the pen casing.
6. Time how long it takes for the washer to make 20 full circles with the black mark visible at the bottom.
7. Add two more washers to the two washers already on the string. There are now four washers on one end
8. Repeat step 6 and determine how long it takes the single washer to make 20 circles against more mass.
9. Try to twirl the single washer so that the time it takes to make 20 full circles is *equal* to what you got in step 6. In other words, try twirling the heavier at the same rate as the lighter one. Watch the black mark
10. Finally, while the washer is still twirling around, cut the four washers off the string with the scissors. **Make sure no one else is near when you do this.** What happens?

Name: Period: Date:

Why Do They Call it "Space"?

Our solar system, with the sun at the center, is like our own little cosmic neighborhood. We have our close neighbors, the **terrestrial, inner planets**, and those a bit farther, the **gaseous, outer planets**. Our neighbor closest to the sun, **Mercury**, is the smallest planet with the biggest daily swings in temperature; from 801°F during the day to -279°F at night. Between us and the sun is **Venus**, a planet with a thick atmosphere that creates a surface pressure 90 times greater than that of Earth. Our own planet, **Earth**, is unique within our solar system in its ability to support life. Moving farther out, **Mars**, known as the "red planet," has some qualities similar to Earth like crustal movement, volcano activity, and polar ice caps that change with the season and may have supported life at one time in its history. Passing the **asteroid belt** we come to our first gas giant, **Jupiter**. Named for the Roman king of the gods, Jupiter is the largest planet in our solar system known for its large red spot that is a spinning storm that has been raging for over 300 years. Next in line **Saturn** is perhaps the most easily identified planet with its beautiful rings and, with 52 known moons, is almost a cosmic neighborhood on its own! Saturn's neighbor, **Uranus**, has an upper atmosphere comprised mostly of methane, absorbs red wavelengths of light causing it to be a beautiful blue-green color in the small amount of sunlight that is able to reach this far out in space. We knew about our final planetary neighbor, **Neptune**, through mathematical calculations by Galileo before we ever spotted it with a telescope.

Though knowing your neighbors is a great way to get to know your community, nothing gives you a sense of place better than a map. Today in lab we're going to do just that. You and your partners will be making a scale map of our solar system to get a clearer idea of our place in our cosmic neighborhood.

Question: Why do they call space "space"?

Materials:

- ✓ Cash Register Tape
- ✓ 2 meter sticks
- ✓ Tape
- ✓ Rulers
- ✓ Markers

Pre-lab Questions:

Use the paragraph above to complete the matching below.

_______ Venus

_______ Mercury

_______ Earth

_______ Mars

_______ Jupiter

_______ Saturn

_______ Uranus

_______ Neptune

A. Its atmosphere absorbs red wavelengths of light

B. The only planet in our solar system to support life

C. Has a 300+ year old storm in its atmosphere

D. Has extreme temperature swings in a single day

E. Its polar ice caps change with the seasons

F. Galileo discovered it with math

G. Would have mega tides with its 52 moons

H. Has a surface pressure 90 times that of Earth

1. Complete the tables below. Use the scale **1 mm = 1,000km** for the Planetary Diameter table. Use the scale **1 mm = 100,000 km** for the Distance from the Sun table.
2. Once you have completed your tables, use your rolls of toilet paper to make your scale model of our solar system. Label your planets and make sure your distances AND diameters are to scale!!

Planetary Diameter Scale: 1 mm = 1,000 km

	Diameter			
Planetary Body	**Kilometers (km)**	**Millimeters (mm)**	**Centimeters (cm)**	**Meters (m)**
Sun	1,391,900			
Mercury	4,866			
Venus	12,106			
Earth	12,742			
Mars	6,760			
Jupiter	142,984			
Saturn	116,438			
Uranus	46,940			
Neptune	45,432			

Distance from the Sun Scale: 1 mm = 100,000 km

	Distance From Sun			
Planetary Body	**Kilometers (km)**	**Millimeters (mm)**	**Centimeters (cm)**	**Meters (m)**
Sun	0			
Mercury	57,909,227			
Venus	108,209,475			
Earth	149,598,262			
Mars	227,943,824			
Jupiter	778,340,821			
Saturn	1,426,666,422			
Uranus	2,870,658,186			
Neptune	4,498,396,441			

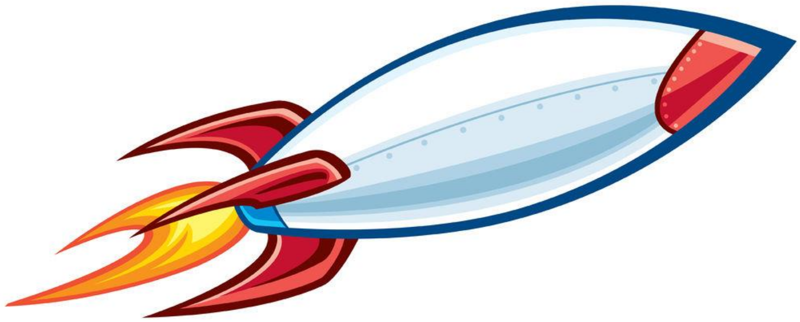
Name ____________________________ Date ____________________ Class ____________

EXPLORING SPACE: Design and Build a Water Rocket

In this lab, you will learn how to design and build a water rocket.

Problem
Can you design and build a rocket propelled by water and compressed air?

Design Skills
observing, evaluating the design,
redesigning



Materials
large round balloon
scissors
tap water
graduated cylinder
50 paper clips in a plastic bag
empty 2-liter soda bottle
poster board
modeling clay
hot glue gun or tape
bucket, 5 gallon
stopwatch
tire pump (one per class)
water rocket launcher (one per class)

Procedure
PART 1 Research and Investigate
1. Copy the data table on a separate sheet of paper.
2. In an outdoor area approved by your teacher, blow up a large round balloon. Hold the balloon so that the opening is pointing down. Release the balloon, and observe what happens. **CAUTION:** *If you are allergic to latex, do not handle the balloon.*
3. Now place 50 mL of water in the balloon. Blow it up to the same size as the balloon in Step 2. Hold the opening down, and release the balloon. Observe what happens.
4. Repeat Step 3 two more times, varying the amount of water each time. Write down your observations.

PART 2 Design and Build
5. You and a partner will design and build a water rocket using the materials provided. Your rocket must
- Be made from an empty 2-liter soda bottle
- Have fins and a removable nose cone
- Carry a load of 50 paper clips
- Use only air or a mixture of air and water as a propulsion system
- Remain in the air for at least 5 seconds
- Be able to be launched on the class rocket launcher

PART 3 Evaluate and Redesign
6. Begin by thinking about how your rocket will work and how you would like it to look. Sketch your design and make a list of materials that you will need.

7. Rockets often have a set of fins to stabilize them in flight. Consider the best shape for such fins, and decide how many fins your rocket needs. Use poster board to make your fins.
8. Decide how to safely and securely carry a load of 50 paper clips in your rocket.
9. Based on what you learned in Part 1, decide how much, if any, water to pour into your rocket.
10. After you obtain your teacher's approval, build your rocket.
11. Test your rocket by launching it on the rocket launcher provided by your teacher.

CAUTION:
Make sure that the rocket is launched vertically in a safe, open area that is at least 30 m across. All observers should wear goggles and stand at least 8–10 m away from the rocket launcher. The rocket should be pumped to a pressure of no more than 50 pounds per square inch.

12. Use a stopwatch to determine your rocket's flight time (how long it stays in the air).
13. Record in a data table the results of your own launch and your classmates' launches.
14. Compare your design and results with those of your classmates.

Analyze and Conclude
Write your answers on a separate sheet of paper.
1. Observing What did you observe about the motion of the balloon as more and more water was added?
2. Drawing Conclusions What purpose did adding the water to the balloon serve?
3. Designing a Solution How did your results in Part 1 affect your decision about how much water, if any, to add to your rocket?
4. Evaluating the Design Did your rocket meet all of the criteria listed in Step 5? Explain.
5. Evaluating the Design How did your rocket design compare to the rockets built by your classmates? Which rockets had the greatest flight time? What design features resulted in the most successful launches?
6. Redesigning Based on your launch results and your response to Question 5, explain how you could improve your rocket. How do you think these changes would help your rocket's performance?
7. Evaluating the Impact on Society Explain how an understanding of rocket propulsion has made space travel possible.

Communicate - On a separate sheet of paper, write a paragraph that describes how you designed and built your rocket. Include a labeled sketch of your design.

ACTIVITY #3: An Expanding Universe

The Universe is so vast, people have to measure distances beyond the Solar System in light years – or how far light travels in a year. Our closest neighboring star is *Alpha Centuri* at 4,2 light years away and our sun is one of billions of stars in the larger Milky Way Galaxy. Beyond the Milky Way lie BILLIONS of additional galaxies in the Universe and yet Astronomers believe the Universe continues to expand. There are many possible ways the universe could be expanding. This experiment demonstrates one of them.

Supplies:

- Balloon
- A marker (You need to be able to write on the balloon with the marker.)

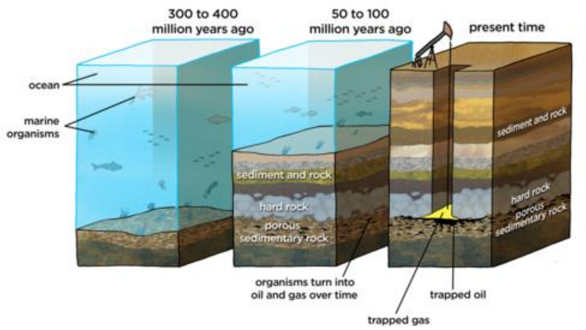
Procedure:

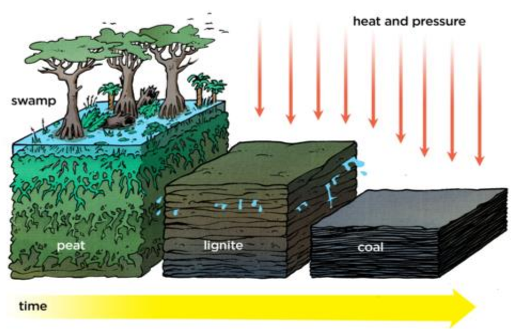
1. Lay the balloon flat on a table and use the marker to put many dots on both sides of the balloon.
2. Bring the balloon to your mouth and hold the balloon so that you can see the dots.
3. Blow up the balloon. What do the dots do? How do they move in relation to one another?

FOSSIL FUELS: Formation of coal, crude oil and natural gas

Long ago plants captured the Sun's energy and manufactured carbohydrates through the process of photosynthesis, just like plants do today. Through changes in the conditions on Earth, the land was increasingly covered by water, forming swamps. Over time the plants died, forming a thick layer of dead **vegetation** on swamp bottoms. Subjected to pressure and heat, this material eventually became coal.

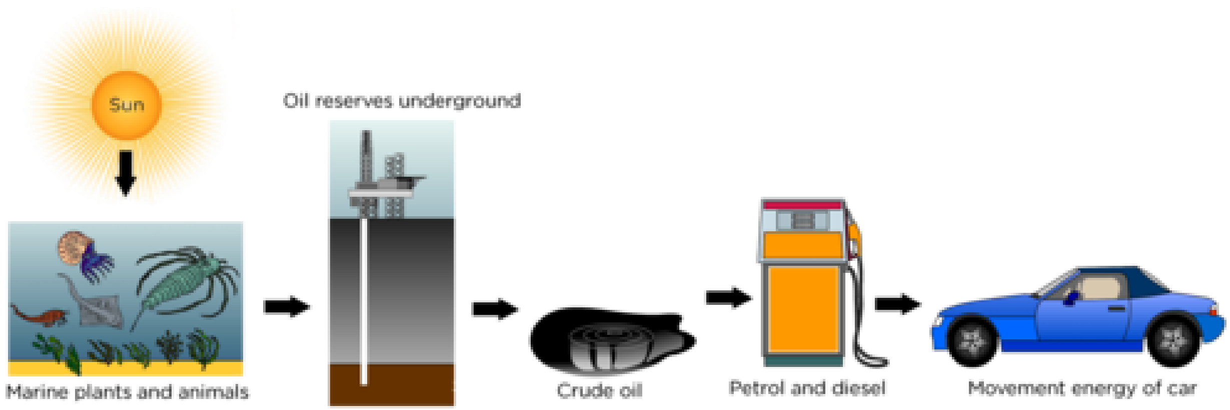
Oil, also known as crude oil, and natural gas were also formed by processes similar to those leading to the formation of coal. Sea animals and plants died in the oceans and were deposited on the ocean floor. Through the actions of temperature and pressure, the deposits were changed into crude oil and natural gas. Today, oil and gas are trapped under layers of rocks and sediment and have to be drilled and pumped out of the Earth. South Africa has some gas fields off the coast of Mossel Bay, but we do not have any oil reserves.





INSTRUCTIONS:

Petrol is made from crude oil, a fossil fuel. Use the diagram below to answer the questions about how the Sun's energy is captured in petrol and how this helps life on Earth.



QUESTIONS:

Using the diagram, explain how the Sun's energy is captured in petrol and used in cars.

Adapted from: http://www.mstworkbooks.co.za/natural-sciences/gr7/gr7-eb-01.html#toc-id-0

METAL EXTRACTION

How do you extract minerals out of rocks and put them in a form that we can use? This is what the mining industry is all about. The methods mentioned below are all **physical separation methods** which are often sufficient to separate minerals for use, like coal or iron ore. But more often the element that we are looking for is found as a chemical compound, and separation requires further chemical reactions.

Crushing and Milling

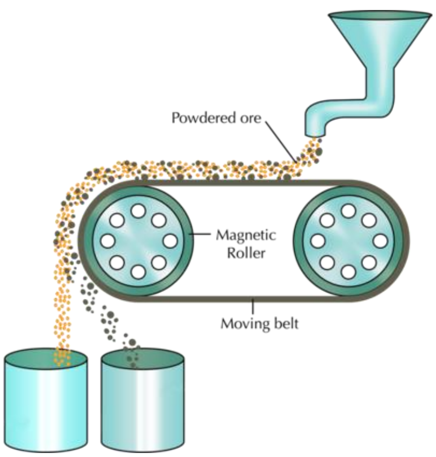
Mineral crystals are spread throughout rocks, just like chocolate chips are spread throughout a choc chip biscuit. The only way to find out how many choc chips there are is to crush the biscuit – this is similar to ore where minerals are spread through the rocks. The only way to find out is to break the rock into smaller and smaller pieces, separate out the chocolate pieces and throw away (or eat!) the unwanted crumbs called waste rock.

1.) Before Crumbling up your cookie, estimate how many chocolate chips will be inside

2.) After crumbling up your cookie, how many chocolate chips were there? Were there more or less than you expected?

Magnetic Separation

Iron is a metal with magnetic properties and as such can be separated with conveyor belts that carry the ore past strong **electromagnets** which remove the magnetic pieces (containing the iron) from the non-magnetic waste. How do you think this works? Study the following diagram



Which container, the left or the right, will contain the magnetic iron ore and which one will contain the non-magnetic waste? Label this on the diagram and provide a reason for your answer below.

Density Separation or Panning

One of the first methods for mining gold was that of **panning**, a technique where ore is mixed with water and forms a suspension. When it is shaken, the dense particles of gold sink to the bottom and could be removed. When gold was discovered in Pilgrim's Rest, Mpumalanga in the 1840s they mostly used panning to separate the gold nuggets ore from sand and stones in rivers. In this activity you are going to separate beads as an analogy for separating minerals in the mining industry.

MATERIALS

- collection of beads, different shapes, sizes, densities and magnetic properties
- paint tray
- piece of carpet
- plastic cup and mesh
- magnet
- water

INSTRUCTIONS:

1. Work in groups of three.
2. Your teacher will indicate to you which bead is the valuable mineral. You need to design a process to separate the valuable mineral from the waste rock.
3. Draw a flow diagram for the process you have designed. Consider using a number of steps in different orders. You may use the same technique more than once.
4. Also remember that repeating a technique improves the efficiency of it. Think about changing the order in which you separate the beads to see if you can find a more efficient process.
5. Hand sorting may NOT be used.

Although hand sorting is an effective method, it is very time consuming which makes it an expensive process, so it is almost never used in the mining industry, except for diamond sorting.

Use the following space to draw a final flow diagram of the process your group designed.

QUESTIONS:

How did you sort the beads based on size? Shape? Density?

Flotation - Density Separation

Flotation makes use of density separation, but in a special way. Chemicals are added to change the surface properties of the valuable minerals so that air bubbles can attach to them. The minerals are mixed with water to make a **slurry**, almost like a watery mud. Air bubbles are blown through the slurry and the minerals attach to the bubbles. The air bubbles are much less dense than the solution and rise to the top where the minerals scrape off easily.

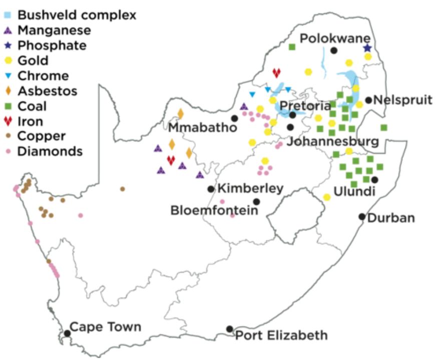
You will be working in pairs for this activity. You need to observe carefully and explain your observations.
MATERIALS:

- peanuts
- raisins
- soda water
- tap water
- two tall glasses or beakers

INSTRUCTIONS:

1. Pour tap water into the first glass until it is about ¾ full.
2. Add a handful of the peanuts and raisin mixture to the water and note what happens.
3. Pour soda water into the second glass until it is about ¾ full.
4. Add a handful of the peanuts and raisin mixture to the soda water and note what happens.
5. Write down your observations.
6. Explain your observations.

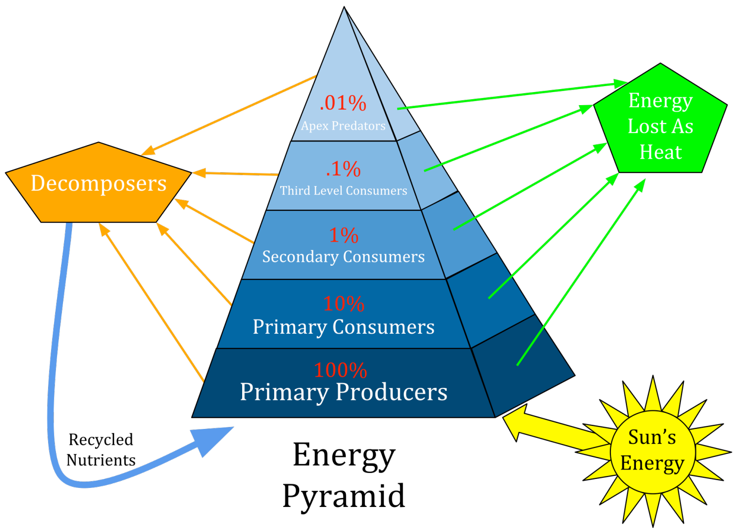
Use the following space to record and explain your observations.

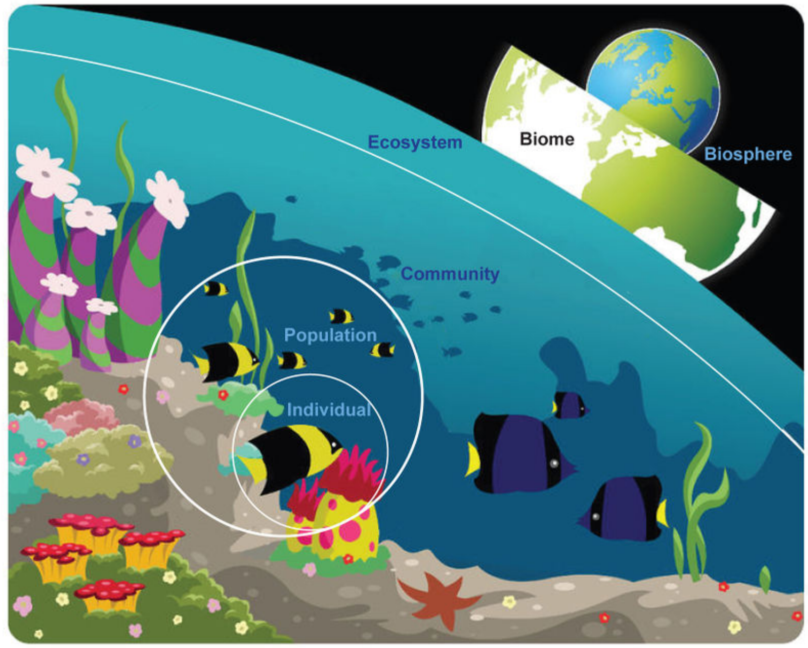


The Bushveld Igneous Complex has the world's largest primary source of platinum group metals, indicated on the map in light blue. It is one of the most important mining areas in South Africa due to its abundance of minerals. (Adapted from: http://www.mstworkbooks.co.za/natural-sciences/gr9/)

Ecology and Biodiversity

Energy Flow





Activity: Food Web Interactive

Estimated time: 10 minutes (can last as long as you want depending on how much you develop the activity).

Materials: yarn, index cards, hole puncher, marker.

Objective: Students will understand the interrelatedness of food webs and see how populations affect other populations.

Content:

1. Write the names of various plants and animals (a variety of types) on index cards. You can use the list below, construct your own, or have participants select their own organism. Be sure to include the sun, plants, plant eaters, and flesh eaters in the array.

   sun, grasshopper, robin, grass, berry brush, hawk, quail, dandelion, mouse, worm, rabbit, cow, flea, meadowlark, owl, wheat, tick, fox, weeds, coyote, mushrooms, microscopic bacteria

2. Punch holes in each card and give each participant a card and a piece of string to hang the card around his/her neck.

3. Have individuals identify energy (or food) sources. As each one is identified, pass a ball of yarn between the two people. For example: One student is a cow, and one is the grass. The cow will take the ball of yarn, hold onto one end of the string and pass the rest of the ball to the grass. The grass will hold onto the yarn and pass the rest of the ball to "what it eats," in this case, the sun. Be sure that the sun is connected to all the plants. Once the string gets to the sun, cut it off, and start again in another place.

4. Continue building the web, making the relationships as complex as time and numbers of participants allow. Define terms such as herbivore, carnivore, insectivore, decomposer, etc and include them in your web.

[Note that insectivores are specialized carnivores.] Students can be in as many chains as you have time for; they do not have to be in all of the chains.

5. Discuss the nature and complexity of the food web that is formed. Note that it is not as complete or complex as most natural food webs, but that it illustrates how living things are dependent upon one another. Biologists feel that more complex food webs are more stable than simple ones.

6. After discussing the food web, the leader could ask what would happen if a species were removed from the web. Have a student pull on the strings they hold; anyone who feels a tug is directly affected by that organism. Those “organisms” affected directly could then pull on their strings and more organisms are affected. Have different students pull on their strings. When the “sun” pulls on its string, everyone should be affected. Have some organisms drop their string (become extinct) and see who is affected. Have students tell you if certain populations will grow or decline. The teacher can represent nature and cause any type of problem to occur; for example, a wildfire could occur, but some birds were able to fly away and some types of trees reseed well after a fire. The teacher defines what happens and who is affected; the students then reveal what would happen. New species could also move into the area at any time disrupting the web.

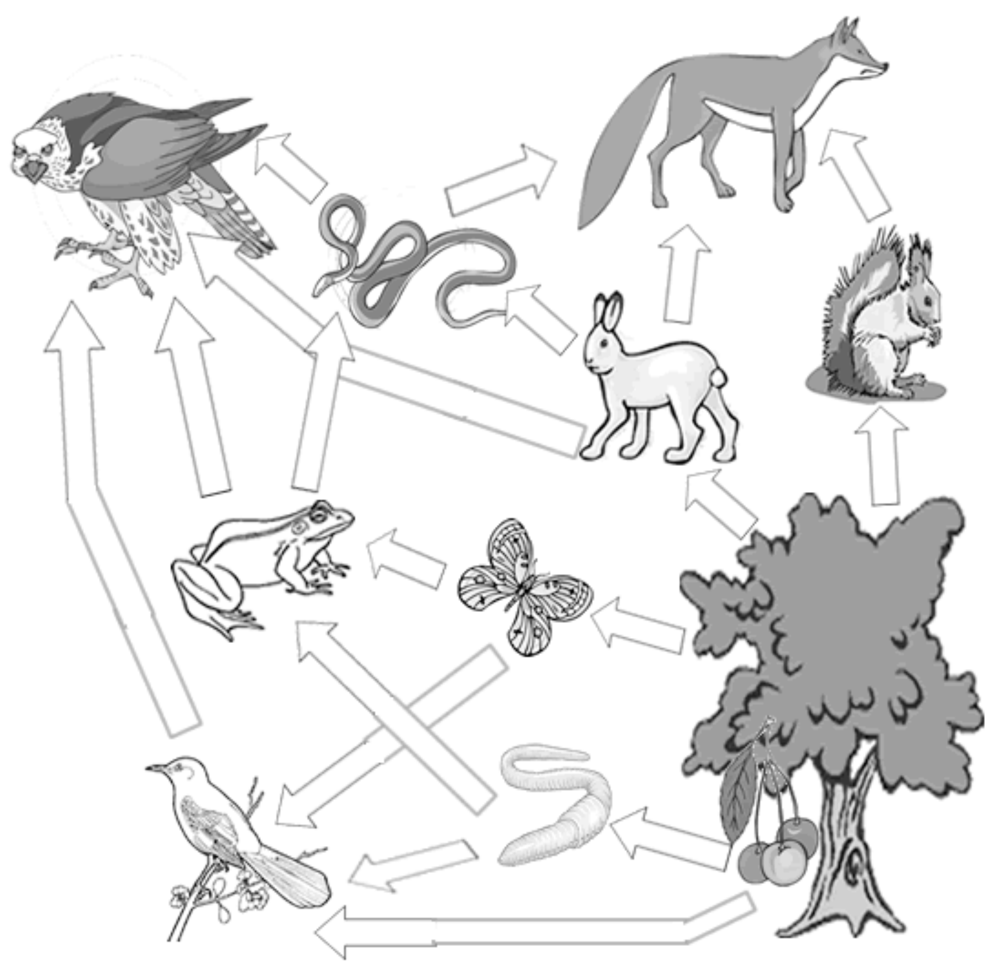
7. Discuss what would happen if all of the predators were removed. Some species might exhaust their food supply and starve, but others will continue to reproduce only until the food supply becomes limiting or their interactions limit population size.

8. If desired, discuss the simplified food webs that produce most foods used by people. Remind the participants that such food webs are inherently unstable and require large amounts of management (raising/slaughtering cows, chickens, etc) to avoid problems.

Closure: Review everything with students telling them that this is the way a food web works. They can throw away their yarn pieces.

Assessment: The activity could be assessed by participation, or students could complete a worksheet to demonstrate their mastery of the concepts, as seen below:

For the food web, label each organism (some may have more than 1 label): producer, primary consumer, secondary consumer, tertiary consumer, quartenary consumer. Then, label each organisms as either a herbivore, carnivore, or omnivore.



African Grassland Food Web Activity

In this African Grassland Food Web activity, students will be asked to connect all the individual food chains that make up this food web. Once complete, students will be asked to label which trophic level each organism belongs.

Directions: The following organisms are part of an African Grasslands food web. Using these notes, construct a food web of this ecosystem in the box by drawing arrows between the organisms, making sure to use different colors to represent each food chain in the food web. After, label what trophic level each organism belongs to: producer, primary consumer, secondary consumer, tertiary consumer, etc.

If this were to be a complete food chain/food web, what is one thing missing? Explain why it is important to include that missing part of the food chain/food web?

Organisms (photos):


Dung Beetles


Zebra


Vulture


Baboon


Termites

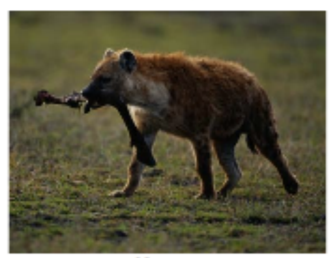

Fungi (including mushrooms)


Acacia


Grasses


Giraffe

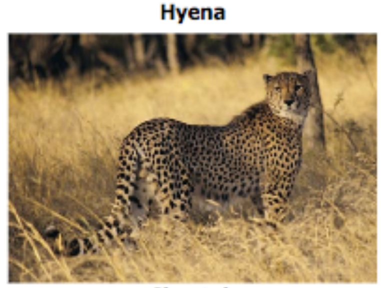

Lion


Hyena


Hunting Dog


Impala


Wildebeest


Cheetah


Leopard

Organisms (dietary habits):

- Baboon: eats grasses and other producers
- Vulture: scavenger that will feed on the remains of any dead animal
- Grasses: producer
- Acacia: producer
- Hunting Dog: eats zebra, impala, wildebeest, baboon, and hyena
- Hyena: eats impala and zebra
- Leopard: eats cheetah, impala, baboon, and hyena
- Cheetah: eats impala and zebra
- Zebra: eats grasses
- Dung Beetles: decomposers that feed on the solid waste of other animals
- Fungi (including mushrooms): decomposers of dead plants and animals
- Termites: feed on wood from the Acacia tree and will feed on grasses also
- Lion: will hunt and feed on cheetah, leopard, giraffe, impala, baboon, zebra, wildebeest, and hyena
- Giraffe: eats the leaves and new shoots of the Acacia
- Wildebeest: eats grasses
- Impala: eats grasses and the leaves of the Acacia

Food Web

The Fox and the Rabbit game

Jackie Sibenaller
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Based on an original activity from "Biology: A Community Context" predator-prey simulation.

Summary

This simulation illustrates how predator-prey interactions affect population sizes and how competitive interactions affect population sizes. The student simulates the interactions between a predator population of fox and a prey population of rabbits in a meadow. After collecting the data, the student graphs the data and then analyzes the graph to predict the populations for several more generations. Students can also examine the co-evolutionary interaction between predator and prey (how predators react to selective pressure by increasing their efficiency and how prey becomes more skillful at evading their predators).

Learning Goals

One goal of this activity is to have students understand how predator-prey interactions affect population size. Students will also analyze data to predict future population sizes. A third goal is for students to explore the major factors that influence the predator-prey relationship.

Key concepts the student should acquire from this activity include how carrying capacity of the environment for the prey population defines the maximum number of prey individuals that can be maintained. They should also see how the reproductive rates of both predator and prey play a crucial role in both population sizes. A third concept students should identify is that behavioral responses of the predators to changes in prey density (migration or change in prey) will affect the pressure on prey.

Before playing this game students should be able to define a food chain, population, immigration, carrying capacity, predator and prey.

Context for Use

I use this activity with a special education inclusion class in 10th grade biology. It can be used in the regular biology classroom, but I would increase the rigor of the game by adding additional predators and other biological factors that can affect populations. This activity is used during a study of populations and ecosystems. The game takes approximately 30 minutes to play. So with an introduction to the game and a closure after the game, I usually allow 45 minutes.

Materials:

-50 10x10 cm tagboard squares of one color (representing the fox)
-200 5x5 cm construction paper squares of another color (representing the rabbits)
-1 50x50 cm square section of table top (the meadow)
-Masking tape (to mark off the meadow)
-Data table
-Graph paper

Rules of the game:

You will start the first round with 3 rabbits and 1 fox. The surviving rabbits each produce one offspring for the start of the next round. The fox will survive if it captures (lands on) at least one rabbit, but will only reproduce if it lands on three or more rabbits during one drop in one round. If the fox does not land on any rabbits during a round, it dies, and a new fox will immigrate into the meadow so you will always have at least one fox to start each round. If all the rabbits are captured during a round, three new rabbits will immigrate into the meadow to start the next round. Each round represents one year or a generation.

Procedure:

Use masking tape to outline a 50x50 cm square on a flat surface to simulate a meadow in an ecosystem.

Randomly distribute 3 rabbit cards in the meadow.

Take the fox square and drop it from a height of 10 to 15 cm above the rabbits in an effort to catch a rabbit. (At this point in the activity there is no way that the fox can catch the 3 rabbits that it needs to survive and reproduce. The fox is not allowed to skid and the rabbits should be distributed throughout the field.)

Complete the data table for generation #1. The fox will starve if it did not land on a rabbit and there will be no surviving fox or new baby fox.

At the beginning of generation #2, double the rabbits left at the end of generation #1. A new fox immigrates into the meadow. Be sure to disperse the rabbits in the meadow.

Eventually the rabbit population increases to a level that allows the fox to catch 3 rabbits in a single toss. If the fox catches 3 rabbits it not only survives but it reproduces too! It has one baby fox for each 3 rabbits that it catches. Therefore, if it catches 6 rabbits it will have 2 babies. Fox are not allowed to cheat, but they should try to be efficient. Stupid foxes result in an overabundance of rabbits.

As the number of fox increases, throw the tagboard square once for each fox. Record the number of rabbits caught by each fox. The simulation is more realistic if the number of new baby fox is based on each foxes' catch rather than merely the total number of rabbits caught in a generation.

There are always at least 3 rabbits at the beginning of a generation. If and when the entire rabbit population is wiped out, then three new rabbits immigrate into the meadow.

Remember that the number of rabbits in the meadow needs to be correct at all times. Remove the rabbits caught and add new ones as indicated by your data table.

Model about sixteen generations and predict nine more or up to a total of 25 generations. Base the prediction on the pattern observed during the first sixteen generations.

Analysis:

Graph the data for 25 generations. Place both the rabbit and the fox data (the first two columns of the data table) on the same graph so that the interrelationship can be easily observed. Label the vertical axis "Number of Animals" and the horizontal axis "Generations." Use one color of line for rabbits and another color of line for fox.

Resources:

There are many versions of this simulation in use. Other versions include owl and mice, etc. If your students are unable to run the simulation at their own workstations then it may be played on an overhead projector. You may wish to introduce disturbances in the cycle such as killing off the fox or starving the rabbits. This activity serves as a good introduction to computer models.

Teaching Notes and Tips

Students play the game in groups of three to four.

You could introduce a new predator, such as a wolf, that would require more rabbits for survival, (by using a different color card) to the game as students are playing or after they are finished to see how this new "invader" can affect the population sizes of the existing predator and prey populations.

Assessment

Students will develop a graph from their data. They will need to analyze their graph to identify limiting factors and carrying capacity of the populations. Also, the graphs will be presented, group by group, to the entire class.

Generation	Rabbits	Fox	Rabbits Caught	Fox Starved	Fox Surviving	New Baby Fox	Rabbits Left
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

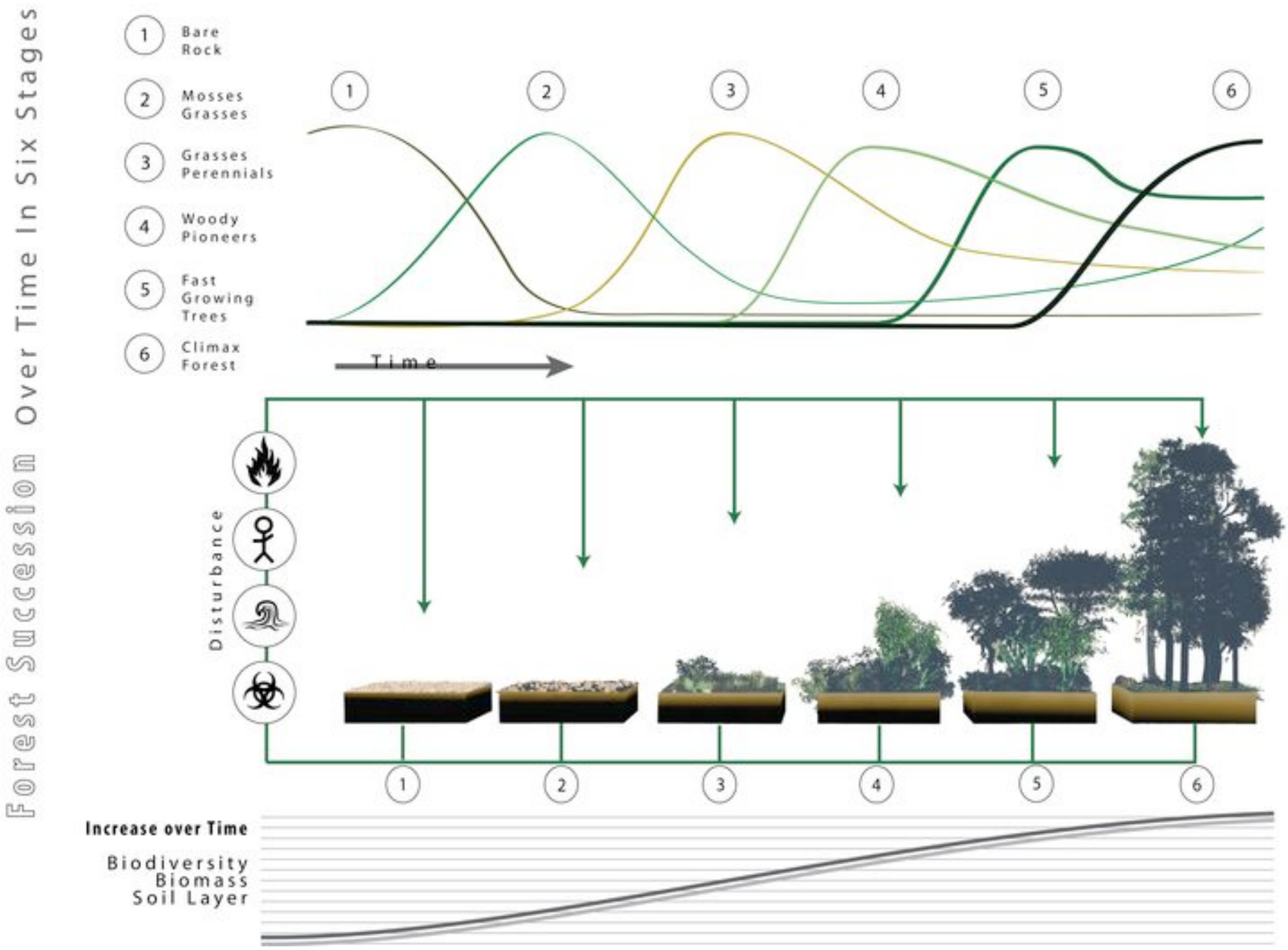
Symbiotic Relationships

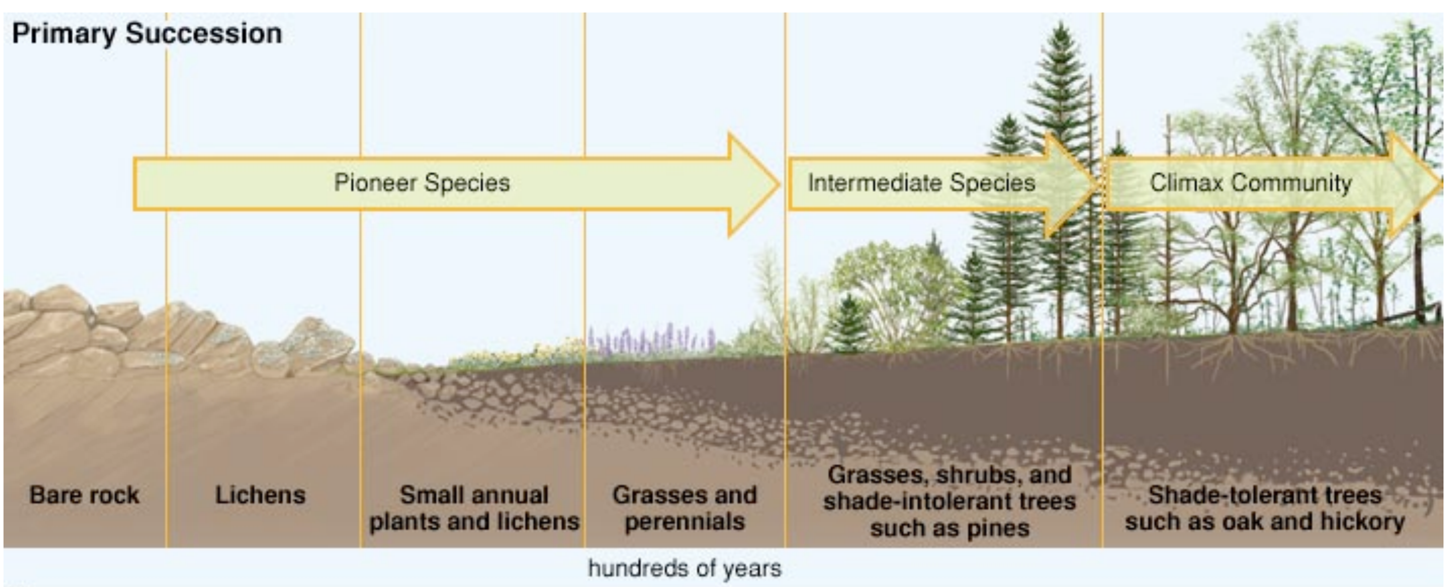
Students will be given several examples of symbiotic relationships and will need to decide if the relationship is an example of parasitism, mutualism or commensalism. Students will put each example in Pocket Foldable. Have students write the definition of each symbiotic relationship on the front of foldable.

Directions: Read the following descriptions of symbiotic relationships and decide which example of symbiosis it belongs. Cut out the description and place in the corresponding pockets of the symbiosis pocket foldable: Mutualism, Commensalism or Parasitism. Pick three of the examples and either draw illustrations on your page or find pictures to paste in your notebook.

A barracuda takes a head up posture near a coral to let the cleaner fish, living in the coral, know that it's safe for them to come out and clean its gills.	The cuckoo bird lays it's eggs in a warblers nest. When the baby cuckoo hatches, it pushes the warbler's eggs out of the nest and the warbler feeds and raises the cuckoo's young.	Whales are seen having barnacles attached to them, creating a home site for the barnacle.	Orchids grow inside bromeliad plants, which don't harm the bromeliad, but allows the orchid to obtain water and nutrients.
The tree sloth has algae growing in its fur. The alga camouflages the sloth in the tree to hide it from predators.	Heartworms develop inside a dog's heart, living off the blood and causing severe health problems, and sometimes death.	Remoras attach themselves to a shark's body, feeding on scraps leftover from the shark's meal. The remoras neither hurt nor harm the shark.	In the rainforest, the acacia tree provides nectar and shelter for acacia ants and in return the ants kill herbaceous insects and any nearby plant competing for the space.
Honey guide birds alert and direct badgers towards bee hives. The badger exposes the hive to eat the honey, then the honey birds take a turn to eat the honey.	A spruce tree starts to die when mistletoe seeds grow into the spruces' roots, extracting water and nutrients from it.	The cattle egret follows herds of cattle eating the insects stirred up by the cattle.	The oxpecker rides on the back of rhinos eating off the ticks and alerting the rhinos to predators.
A wasp will lay its eggs on the back of a caterpillar called the catalpa worm. When the larvae hatch, they will feed on the caterpillar and kill it.	A solitary golden jackal will follow a tiger at a safe distance alerting the tiger to a kill, then eating the leftovers when the tiger is done.	The Egyptian plover lands inside a Nile crocodile's mouth, getting a good meal, and cleaning the crocodile's teeth at the same time.	Hermit crabs live in shells made by snails who have since abandoned them.

Ecological Succession: Primary and Secondary





Ecological Succession Flip Book

Students will create an Ecological Succession Flipbook to show examples of primary and secondary succession.

<u>Directions</u>:

1. Make a flip book foldable according to your teacher's instructions.

2. Label the foldable according to the following diagram and cut the top three tabs up the middle (see the dotted lines).

Primary Succession - After Volcano	Secondary Succession - After Wildfire
After 3-5 Years	After 3-5 Years
After 15-30 Years	After 15-30 Years
After 100 Years	After 100 Years

3. On the front tab, for each side, draw an illustration of how the area would look after the disaster.

4. Read the following descriptions of each type of succession, Using what you know about succession, write a description about what is happening for each time frame, then add plant and animal species to each tab that correlates with the number of years after each disaster.

Primary Succession

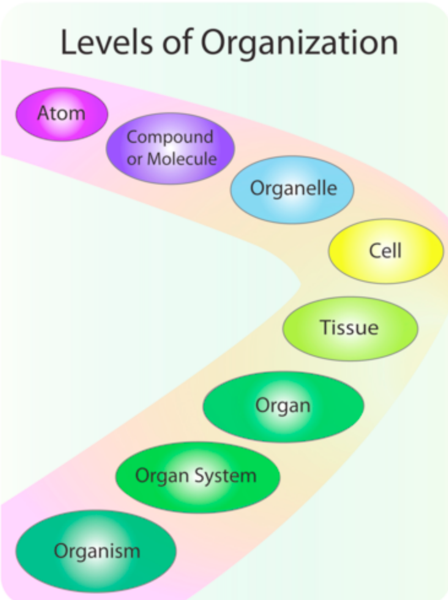
After a volcanic eruption, the land is mostly bare for three to five years until lichens, moss and small pioneer species of plants begin to grow in cracks of rocks. Eventually these pioneer plants die and begin to form soil. About 20 years later a soil layer has formed able to support herbs, grasses and small berry bushes and shrubs. Insects live in grassy areas eating herbs, while mice live in burrows eating berries and insects. After 100 years the soil is able to support larger shrubs, berry bushes and small trees where some birds can build their nests, rabbits can hide and foxes can live in burrows, coming out to hunt birds, mice, rabbits and insects.

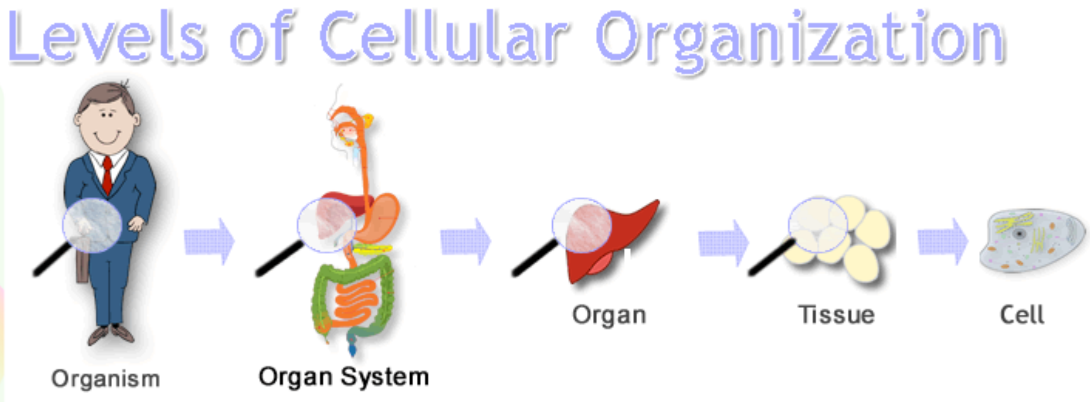
Secondary Succession

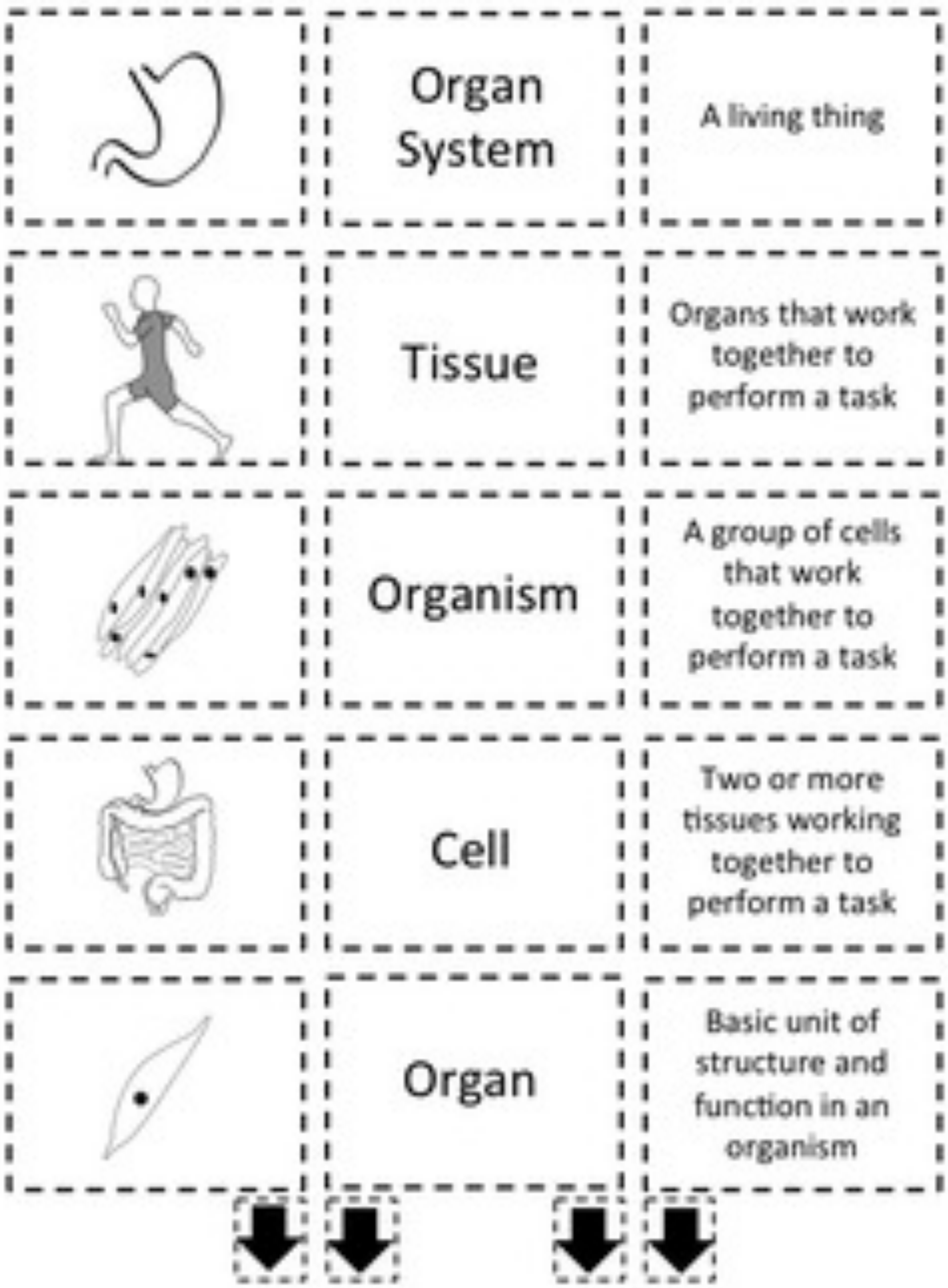
The wildfire that burned the forest has released many of the nutrients in stumps and branches, as well as opened up some seeds that need heat to start reproducing. In three to five years grasses, weeds and small plants have taken over. Saplings are starting to spring up, along with large berry bushes, such as blackberry. Small animals that eat insects and berries have taken resident in the larger bushes and ground covering. A noticeable change occurs about 20 years later when the area begins to start looking like a forest, with pines and cedars growing. Acorns and other nuts are being produces allowing squirrels to inhabit the trees, along with a variety of birds, including owls who feed on mice below. 100 years later, the forest has pines and oaks that are 70-100 feet tall, that tower over the smaller trees and berry bushes. The mature forest allows covering for many animals, including deer and bears. Birds are singing in trees and small rodents are rustling along the ground collecting food and making shelters.

Human Body and Healthy Living

<u>Levels of Organization</u>

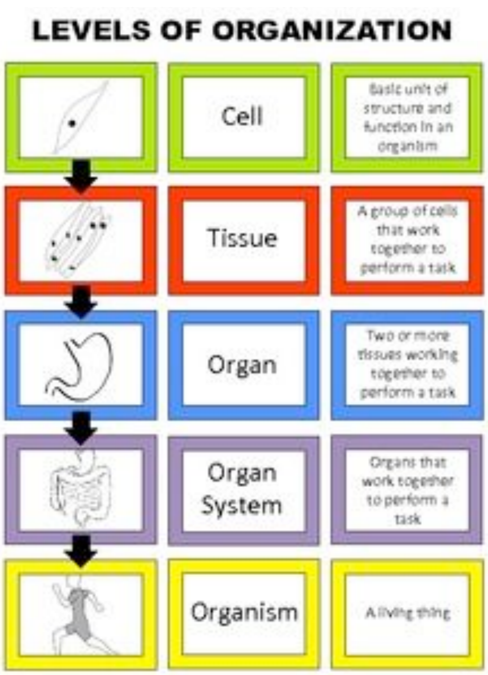






Task:
Using three columns (picture, term, and definition), cut out and arrange the 15 boxes into the levels of organization in order from the cell to the organism. Additionally, give an example at each level.

Answer Key:

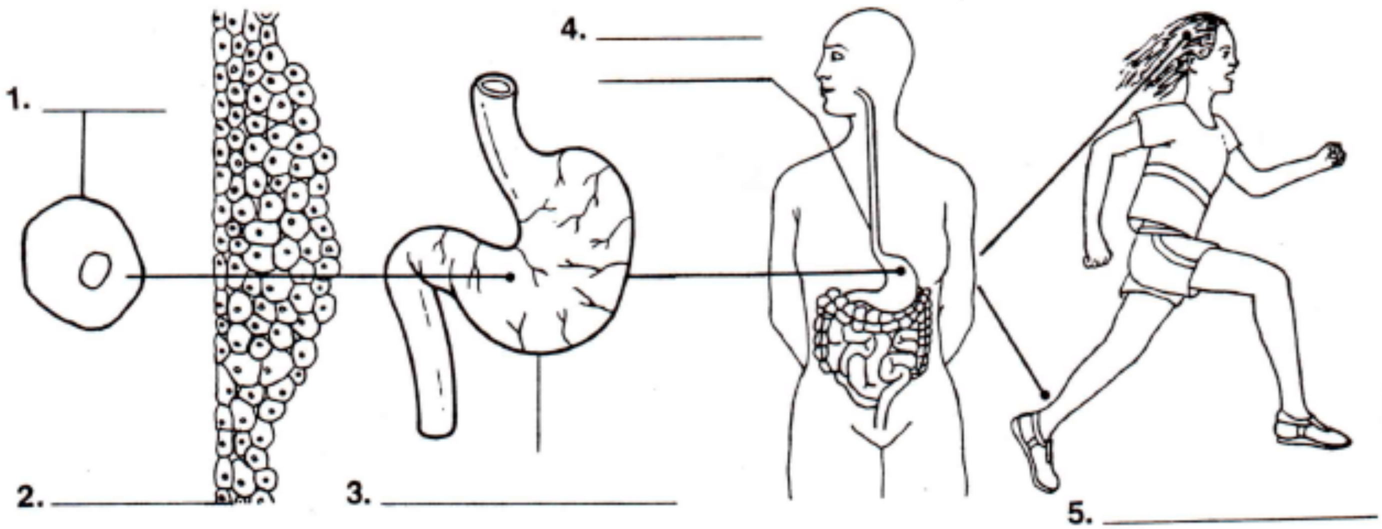


These drawings show how WE are made of CELLS.

Directions:

1. Match the correct word from the **WORD LIST** below to the drawings 1-5.
2. Color each drawing the CORRECT color noted under the word.
3. Use your colored drawings and the same words to fill in the blanks for questions 1-10.

Word List:	**organism**	**organ system**	**organ**	**tissue**	**cell**
color to use	(purple)	(blue)	(green)	(yellow)	(red)



1. A________________is the smallest unit of structure and function of a living thing.
2. An example of a **cell** is a________________cell.
3. A **tissue** is made of a group of similar________________working together.
4. An example of a **tissue** is____________________tissue.
5. An **organ** is made of different ________________working together to do a special job.
6. An example of an **organ** is the ________________.
7. An **organ system** is made of many ____________working together to do a special job.
8. An example of an **organ system** is the ____________________ system.
9. An ________________is a living thing that carries our its own life activities.
10. An example of an **organism** is____________________.

Digestive System

What Happens When You Eat?

Objectives: These activities will show students what organs aid in digestion and how digestion occurs in the human body.

Activity #1: How Long is the Digestive System?

- yarn

Have students cut a piece of yarn according to the following measurements. Allow students to use different color yarn to represent different organs. After the yarn has been cut tie the pieces together.

Esophagus: 25 cm, Stomach: 20 cm, Small Intestine: 700 cm, Large Intestine: 150 cm; TOTAL: 895 cm

Activity #2: Digestion

- sugar cubes
- granulated sugar
- 2 clear cups filled with water

Place a sugar cube in a cup of water. Place about a spoonful of granulated sugar in the other cup of water. Observe what happens.

Activity #3: Carbohydrate Digestion

- unsalted soda crackers (2 per student)

Have the students chew two unsalted soda crackers for two minutes without swallowing.

Activity #4: How do Villi aid the Small Intestine in Absorption?

- paper towels (10 per group)
- 4 cups of an equal amount of water
- graduated cylinder

Compare how 1, 2, 3, and 4 folded paper towels absorb. Dip each paper towel into a cup of water (use the same amount of water in each cup). Record the volume of water left in the cup (using a graduated cylinder).

Activity #5: A Digestive System Simulation

- large thin plastic bag
- newspaper
- markers & paper
- sponges
- paper sacks (2 sizes)
- Zip-lock bags
- candy
- masking tape
- trash can
- labeled spray bottles of water

Procedure:

1. FOOD TUBE: Lay out two parallel lines of tape on the floor, 3' apart and long enough for half the class to stand shoulder to shoulder on one side of the parallel lines.
2. FOOD PARTICLE: The food particle consists of M&M's placed in small zip-lock bags.These are placed in wadded newspapers in small paper sacks. Place the small sacks in larger sacks with added newspaper. Place all sacks and add newspaper until the large plastic bag is full. This bag is then taped or tied closed to complete the food particle.

Action:

1. Peristaltic Movement: Put the food particle to be eaten at one end of the food tube and a large trash can at the other. Have students line up on both sides, facing each other, squeeze the food particle the length of the food tube.
2. Digestion: Label and/or instruct the players. As the food comes to a student they should narrate what they are doing and why.

    Teeth - tear food apart (break plastic bag)
    Saliva - use spray bottles to moisten food particle
    Stomach - tear small bags apart
    Pancreatic juices - spray food
    Small Intestine - absorbs food, find bags of candy and pass to blood (teacher plays role of the blood)
    Large Intestine - reabsorbs water, sponge up water on the floor
    Rectum/Anus - puts the waste papers in the trash can

Performance Assessment: At the completion of this simulation, answer the following questions:

1. What system in your body is the same length as the completed piece of yarn? What is it's length (in centimeters, in feet)?

2. From your observations in Activity #2, what can you conclude must be done to food before digestion begins?

3. What physical and chemical changes occurred to the soda cracker?

4. What caused the physical and chemical changes to the soda cracker?

5. Did you notice a taste change in the soda cracker?

6. How was mechanical or chemical digestion simulated in Activity #4.

7. Which paper towel had the largest surface area?

8. Which cup had the highest volume of water left?

9. How do the villi (of the small intestine) aid in absorption?

10. Follow the path of a food particle through the digestive system; include the organs and their functions.

Cardiovascular/Circulatory System

Note: For children ages 6-15, the normal resting heart rate is 70-100 beats per minute. Resting heart rates for children and adolescents are typically faster than adults' because they have smaller bodies.

The Heart: What a Muscle!

Directions: Part 1: Find your pulse and use it to calculate your heart rate. Next, you will complete a list of physical activities then count and record your heart rate after each activity. Use your data to create a bar graph (or use the grid below) and compare with others in your group. Part 2: Label and color the heart diagram.

Measuring Heart Rate

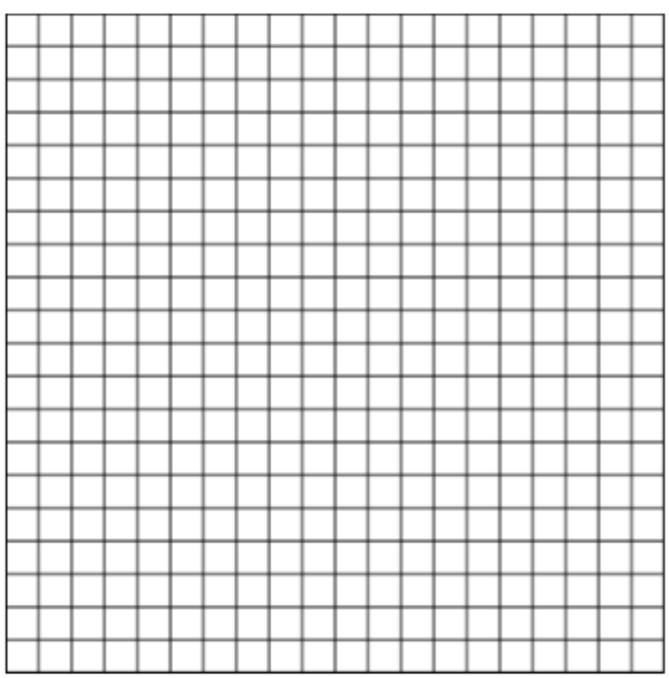
To measure your heart rate you will need to use your pulse. To find your pulse, gently place your index and middle finger on the artery shown in the diagram. Do not use your thumb because it has its own pulse they you may feel.

Count the pulses for 20 seconds, then multiply by 3 to get the number of heart beats per minute.

Data Table and Graph

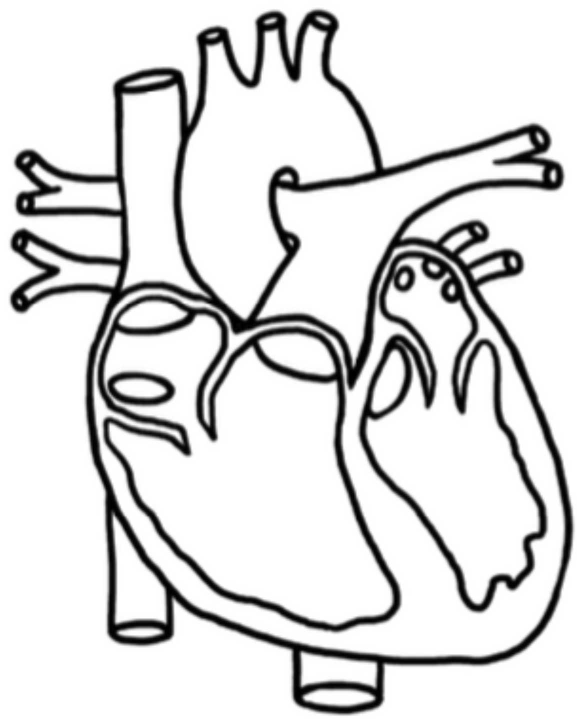
After each activity rest for at least two minutes in order to let your heart rate recover.

Physical Activity	Heart Rate
Sitting in a chair	
Standing	
Walk a leisurely pace for 2 minutes	
Speed walk for 2 minutes	
Jog in place for 2 minutes	
Do 30 jumping jacks	
Run fast in place for 1 minute	



Heart Diagram

Color and label the heart diagram below.



Discussion

In your notebook, give a description of what you observed between your physical activities and your heart rate. Why do you think this occurred?

<u>Respiratory System</u>

The Respiratory Flap Book is a great way for students to see how the parts of respiratory system work together. They will be able to see the individual structures and will need to identify each in order to write the function of each.

Respiratory System Flap Book

Directions: Cut out Diagrams A, C and D along the solid lines. Cut out Diagram B around the shape. Paste each diagram by stacking in order A - D. (Note that Diagram B will actually be glued to the top of the trachea.) For Diagram C and D, fold along the dotted lines to make tabs for gluing., then cut up the center to make "flaps". On the back of each diagram "door" write the function or importance of each part of the respiratory system. Finally, draw in the alveoli and explain their function.

Diagram A: The trachea and the bronchi

Diagram B: The pharynx

Diagram C: The lungs

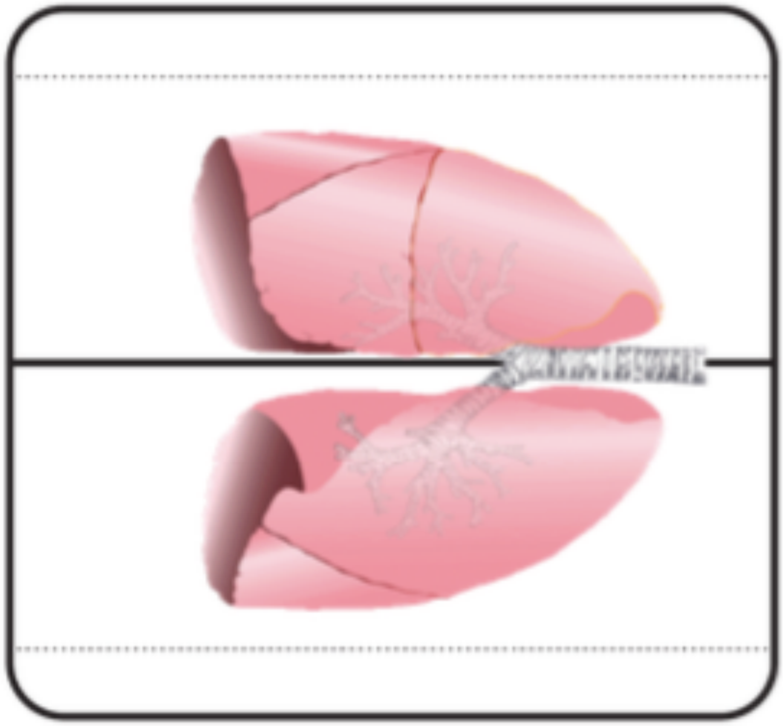
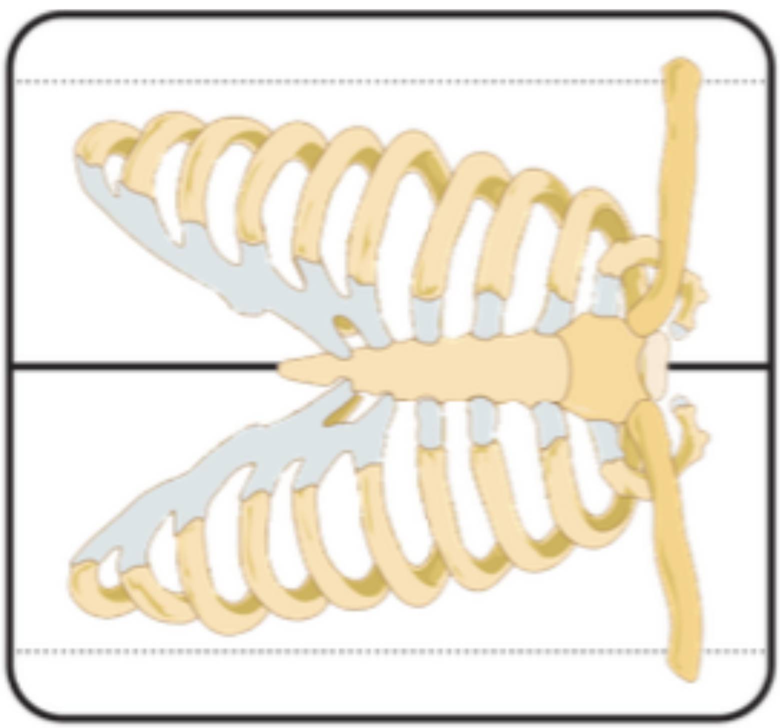


Diagram D: The ribcage



Excretory System

Students learn and understand how the excretory system removes waste from your body by sorting the stages for When You Gotta "Go"! The stages start with blood entering the kidneys and finish with the body going pee.

When You Gotta Go!

Directions: Cut out and unscramble the stages that describe how your body produces urine. Paste in proper order on the diagram.

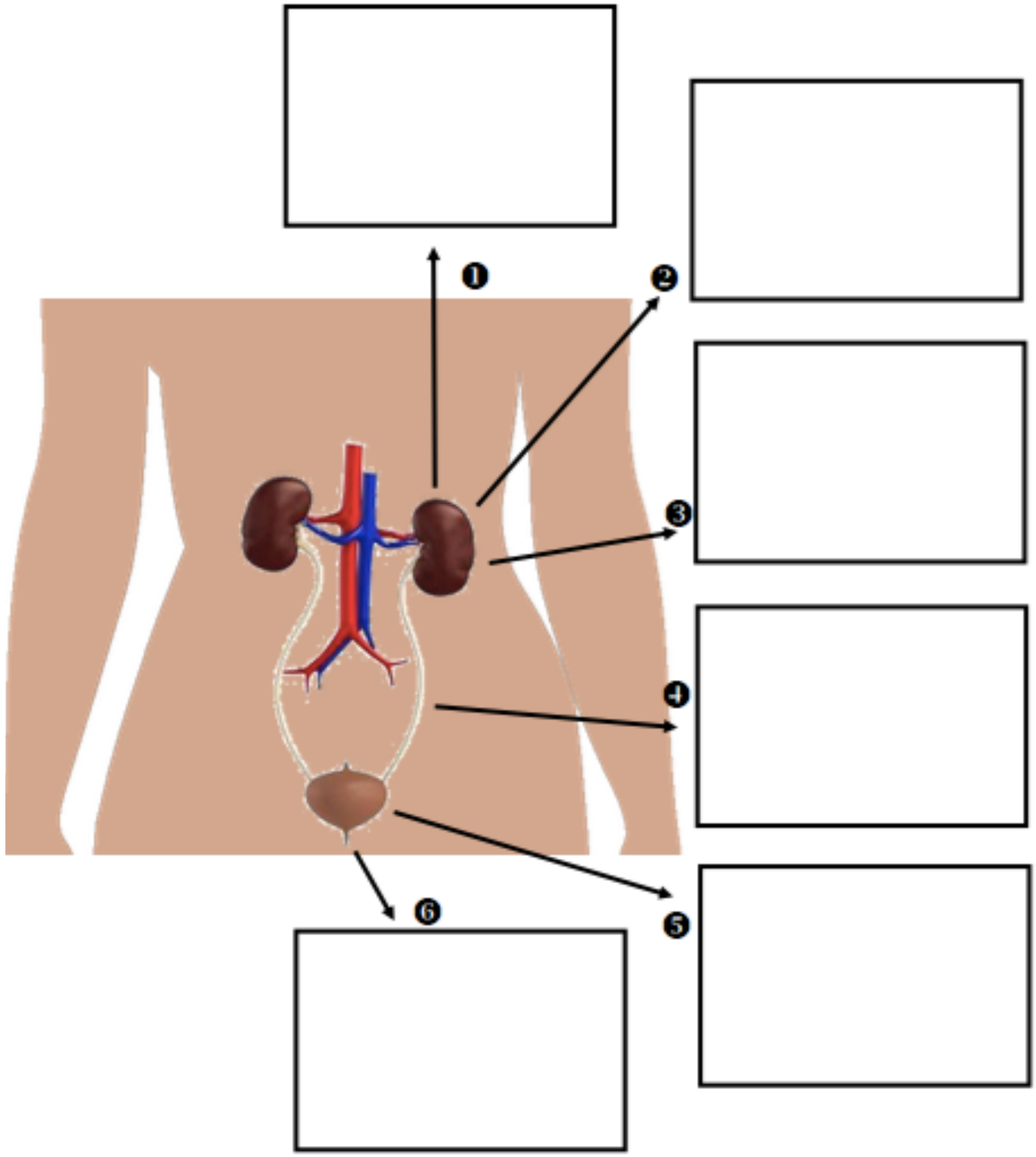
When you pee your bladder empties and urine leaves body through urethra

When bladder is halfway full, a signal is sent to brain telling your body you have to pee.

Capillaries in nephrons are surrounded by a capsule where urea, glucose and some water enter from the blood.

Urine slides down tubes called ureters into the bladder.

Blood enters kidneys and reaches cluster of capillaries in nephron



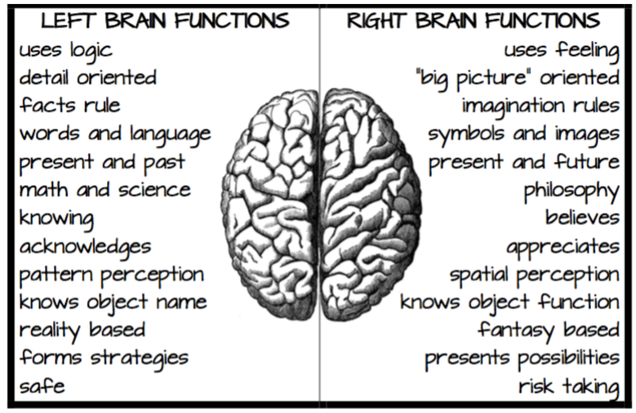
Some filtered materials, such as glucose and water are returned to blood, leaving urea and other waste products, called urine, in tube.

The Nervous System: Central Nervous System and Peripheral Nervous System

This is a great activity to get students thinking about the nervous system and their brain. They will love determining which side of their brain is more dominant which will lead to discussions among group members about other possible personality traits or actions that may be controlled by the right and left brain.

Right or Left Brain Dominant?

Introduction: Human brains are like a complex computer system that is composed of two hemispheres. Each hemisphere controls different skills or ways of thinking. The right hemisphere of the brain is referred to as the analog brain. It controls three-dimensional sense, creativity and artistic senses; processing information from the “big picture” first then looking at the details. The left brain is sometimes referred to as the digital brain since it controls logical thinking, reading and writing and processes information in an analytical and sequential way.

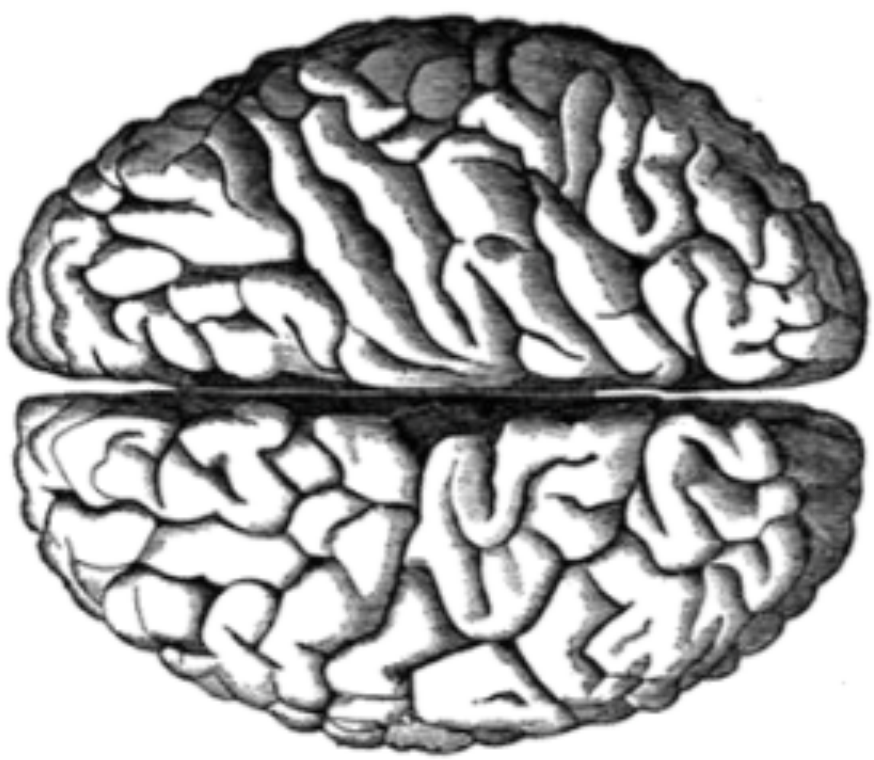


The funny thing about our brain, however, is that our right and left hemispheres control the opposite side of our bodies. For instance, the right hemisphere controls our left side movements and what our left eye sees, whereas our right hemisphere controls the right side of our body and processes what our right eye sees.

Even though humans tend to have a more dominant side, both sides of the brain are used and thought processes shift between the two sides since they have overlapping skills and different ways of thinking. So, next time you’re working with your partner on a project, try to be aware that he or she may be using a different brain hemisphere and that they may process information differently. It’s also important to be self-aware of your most successful way of learning and understanding.

Directions: Identify which of your brain hemispheres may be more dominant by completing each task in the data table. Mark whether the task was right or left side dominant, or mark both if the task could be done easily with both your left and right sides. When you are finished with the tasks, cut out the table and fold it shutter style with opening in center. Paste brain diagram on the front of shutter foldable, cut up the center, and then color the hemisphere that was your dominant side.

Brain Diagram



Left Side ☑		Task	Right Side ☑
	Hand dominance	Write your name - which hand did you use?	
		Give someone a "high five" - which hand did you use?	
		Fold hands - which thumb is on top	
		Throw a paper ball in wastebasket with both right and left hand - which was easier?	
	Foot dominance	Start to run - which foot did you start with?	
		Kick a ball - which foot did you use?	
		Stand on one foot - which side has better balance?	
	Visual dominance	Look through a "telescope" made with your two hands. -which eye did you use to look through it?	
		Draw a horse (side view) - mark which direction the horse is facing.	
		Draw a circle with right hand then with left hand. If both circles were drawn clockwise mark right, counterclockwise mark left, if one in each direction mark both.	
		⬅ TOTALS ➡	

Which body side seems to be your dominant side? ______________________

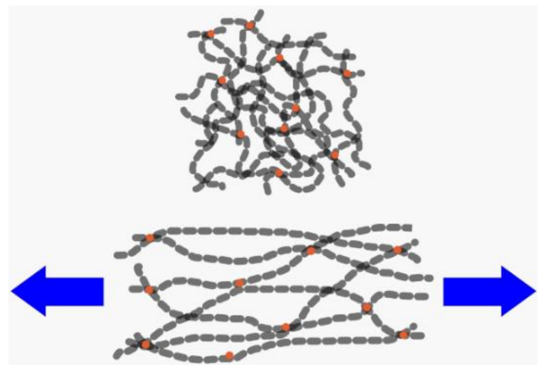
Which is your dominant brain side? ______________________

Potential Energy → Kinetic Energy

Rubber Band Energy

What to do:

1. Place your thumbs through a thick rubber band, one on each end. Without stretching the band, hold it to your forehead and note the temperature - does the band feel cool or warm or about the same as your skin? Repeat the test several times until you are sure of the result.
2. Move the rubber band slightly away from your face, so it is not touching your skin. Quickly stretch the band about as far as you can and, holding it in the stretched position, touch it again to your forehead. Does it feel warmer or cooler or about the same as it did when it was relaxed?
3. Move the stretched rubber band away from your face. Quickly let it relax to its original size and again hold it to your skin. Does it feel warm or cool?
4. Repeat the stretching and testing, and relaxing and testing several times until you are sure of the results.



Why does it happen?

An object feels cool or cold to you when heat flows from your skin to the object. Conversely, an object feels warm or hot when heat flows from the object into your skin. If the stretched rubber band feels cool, then it absorbs heat from your skin. If it feels warm, then it gives off heat to your skin. If the band feels neither warm nor cool, then there is no detectable heat flow.

Rubber contains millions of randomly coiled long molecules called polymers, which are each made of shorter molecules known as monomers. When you stretch a piece of rubber the coiled molecules are pulled straight; when you let go again they move around at random through thermal vibrations, which restore them to their more compact coiled configuration.

So why does an elastic band become hotter when you stretch it and colder when it shrinks?

When you stretch the rubber band you are adding energy to the rubber, which causes it to vibrate more strongly and this makes it hotter. Then, when you let go, the rubber molecules must do work to pull the polymer chains back into their compact configuration; since this process uses energy, the elastic band must have less energy after it has shrunk and therefore it becomes colder.

Potential to Kinetic Energy Transfer

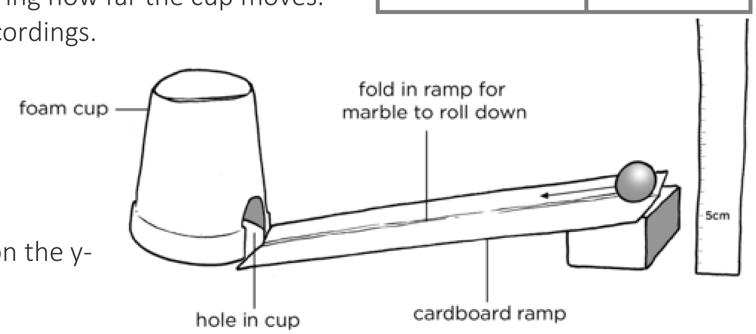
How can you give a marble more potential energy so that it can transfer more kinetic energy to the cup?

Height of marble up the ramp (cm)	Distance cup moves (cm)

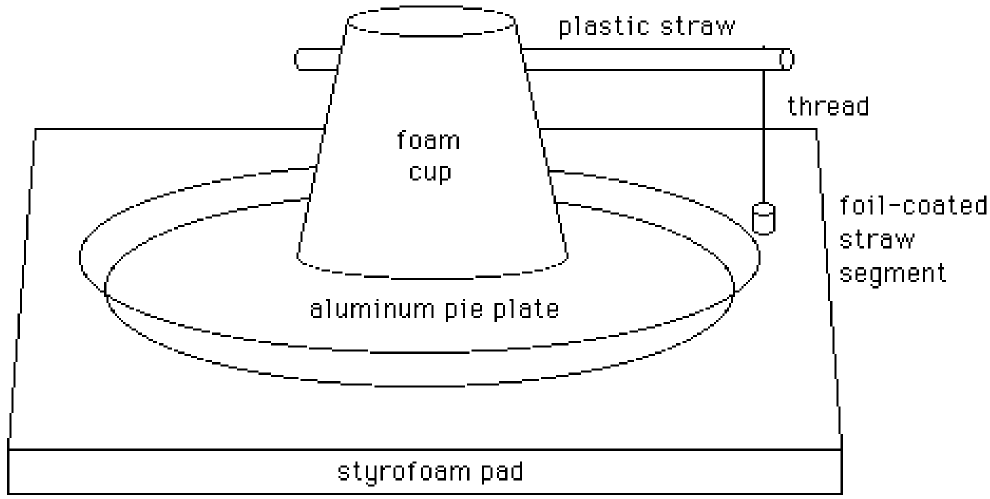
1. Build the setup. Set up the ramp so that the top of the ramp is at a height of 5 cm. Roll the marble from a height of 5 cm & then measure how far the styrofoam cup moves.
2. Adjust the height of the ramp by increasing by 5 cm each time. Each time place the marble at the top of the ramp and roll it down, measuring how far the cup moves.
3. Repeat the measurements until you have at least 6 recordings.
4. Graph: marble height vs. the distance the cup moved.

independent variable = the value you changed in the investigation & is written on the x-axis (horizontal axis).

dependent variable = variable you measured & is written on the y-axis (vertical axis).



Static Electricity



A. Build the electrophorus device. Tape a plastic straw horizontally to the top of the cup so that it extends over the edge of the pie plate. Cut slits in the end of the straw and suspend a pith ball so that it is just touching the rim of the plate as in the diagram. Use a few Styrofoam plates for the base if you don't have a Styrofoam pad.

B. Vigorously rub the Styrofoam pad with a piece of wool fabric for one minute. Now, lower the electrophorus plate onto the foam. What happens to the pith ball? Move the electrophorus plate up and down above the foam. What happens to the pith ball? What does this tell you about charges on the rim of the electrophorus plate and the pith ball as you move the electrophorus plate closer to the foam?

C. Discharge the electrophorus plate with your finger while it is in the air, lower the electrophorus plate onto the foam and bring a charged balloon near the pith ball. What happens?

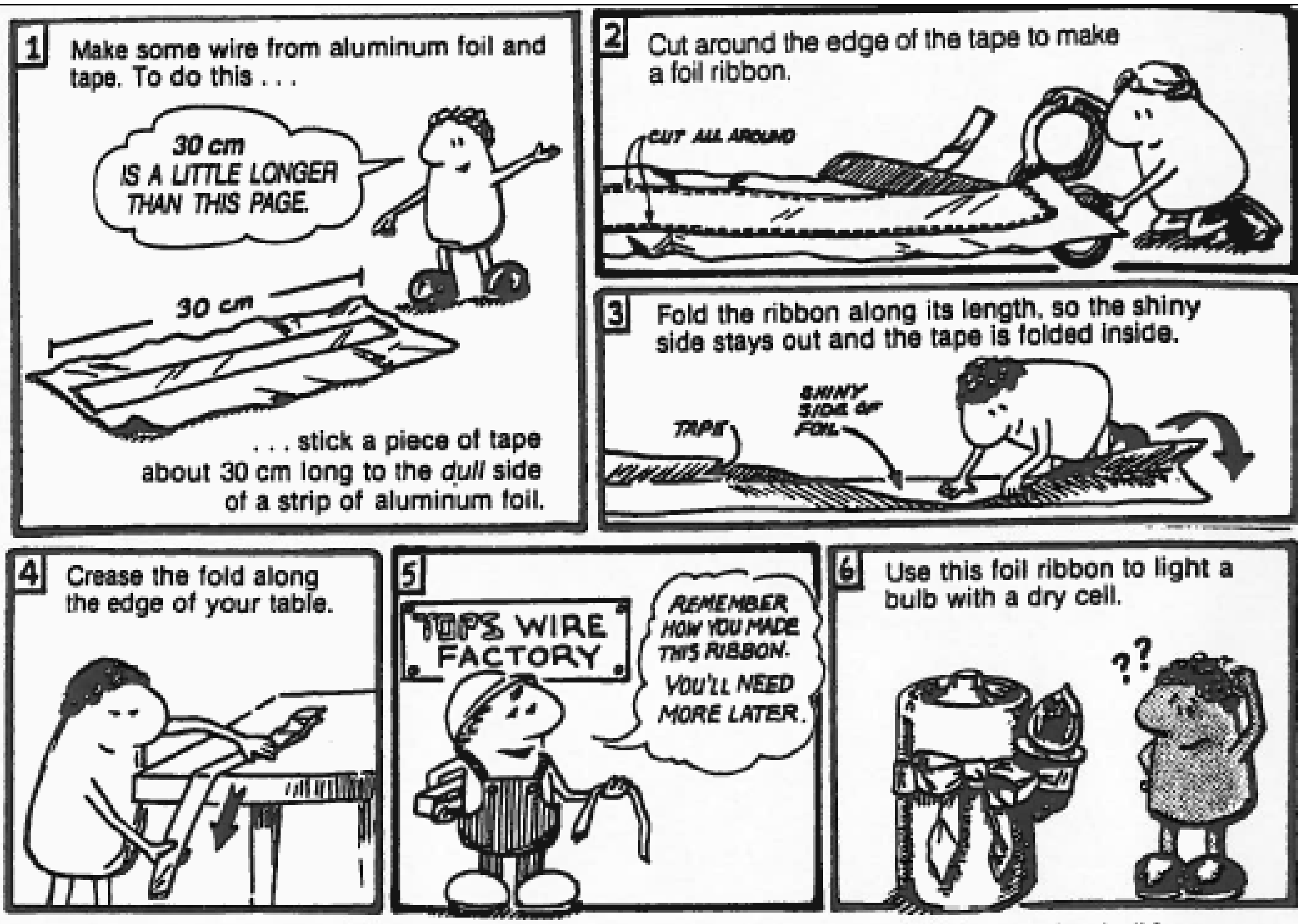
- What can you infer about the amount of charge on the rim of the electrophorus plate? Where must the charge on the rim come from? Is the charge on the electrophorus plate the same type as the charge on the pith ball?
- When electric charge flows from one place to another, we say that there is an electric current. Is there an electric current between the two plates? How do you know?
- Does the behavior of the pith ball tell you anything about how fast the charge is transferred? What does this tell you about the size of the current that is flowing? Explain using your model of charge.

Electricity Misconceptions

Learners' INCORRECT understandings of electricity include these non-scientific ideas:

1. The electricity companies supply electrons for your household current.
2. We pay electricity companies for power.
3. 'Static' and 'current' electricity are two types of electrical energy.
4. 'Electricity' is used up in electric circuits.
5. Charge is used up in electric circuits.
6. Energy is used up in electric circuits.
7. More devices in a series circuit mean more current because devices 'draw' current.
8. Electrical power is the same as electrical energy.
9. Electricity means the same thing as current, or voltage, or energy.
10. Batteries store, and supply, electrons or 'electricity' to the electric circuit.
11. A wire from a battery to a bulb is all that is needed for the bulb to light up.
12. The electrical energy in a circuit flows in a circle.
13. Electric current is a flow of energy.
14. The stuff that flows through wires is called 'electric current'.
15. Electrons travel at, or near, the speed of light in the wires of an electric circuit.
16. Voltage flows through a circuit.
17. Voltage is energy.
18. High voltage by itself is dangerous.
19. Electrons move by themselves.
20. Current is the same as voltage.
21. A conductor has no resistance.
22. The bigger the battery, the more voltage.
23. Batteries create energy out of nothing.
24. Alternating current (AC) charges move all the way around a circuit and all the way back.

Making Electrical Wires



2. Using one bulb, your wire, and one battery, find four different ways to make the bulb light up. Sketch all four successful attempts and 2 unsuccessful attempts. Show in detail where the bulb and wire are touching the battery. Use these shapes to represent the components:

Success!☺	Success!☺	Unsuccess☹
Success!☺	Success!☺	Unsuccess☹

3. Use two foil wires. The bulb may NOT touch the battery. Draw it:

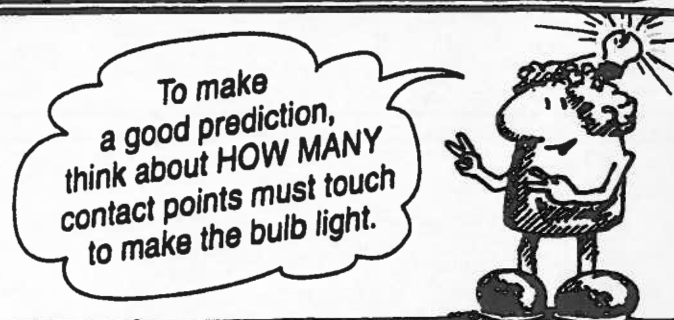
4. To light a bulb, _____ places on the battery must connect to _____ places on the bulb.

LIGHT BULB PREDICTIONS

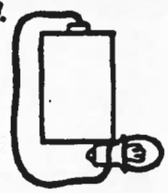
1

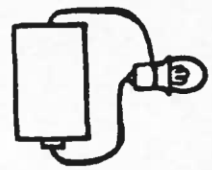
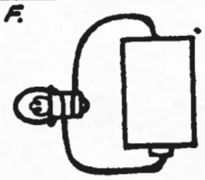
In the table below, guess if the dry cell lights the bulb. Write your *prediction* next to each hook-up.

After you predict, experiment to see if you are right. Write each result in the table.



2

HOOK-UP	PREDICTION *Will it light?*	RESULT *Did it light?*
A. 		
B. 		
C. 		

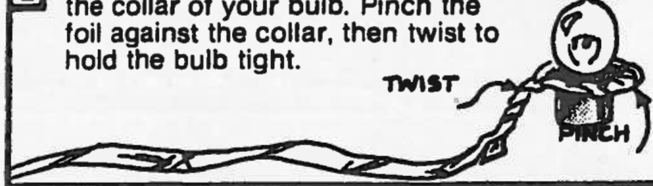
HOOK-UP	PREDICTION *Will it light?*	RESULT *Did it light?*
D. 		
E. 		
F. 		

3

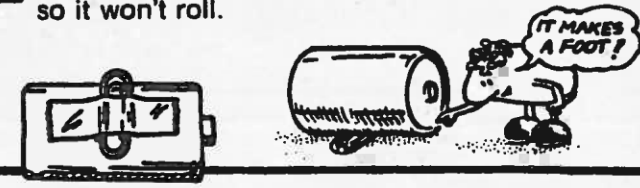
You are now an expert on how to light a bulb. Write directions for someone who doesn't know how:

SERIES MEANS IN A ROW

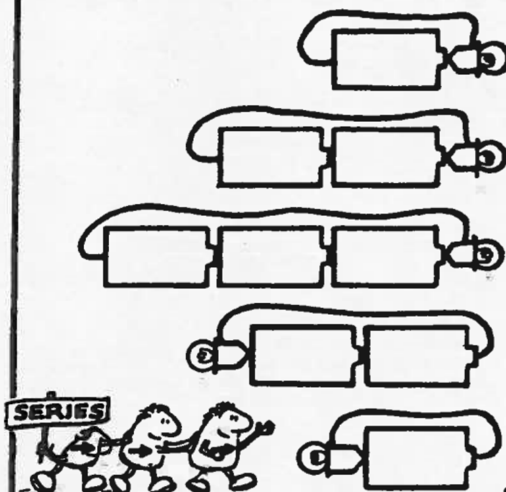
1 Wrap a 30 cm foil ribbon around the collar of your bulb. Pinch the foil against the collar, then twist to hold the bulb tight.



2 Tape a paper clip to the side of your dry cell so it won't roll.



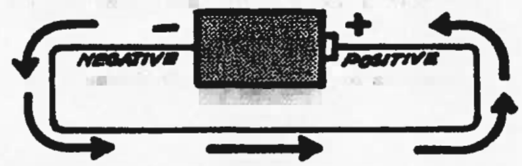
3 If the bulb shines "dim" with 1 cell, find out how it shines with more cells connected in a *series*. Tell if it shines bright, medium or dim.



dim
____
____
____
____

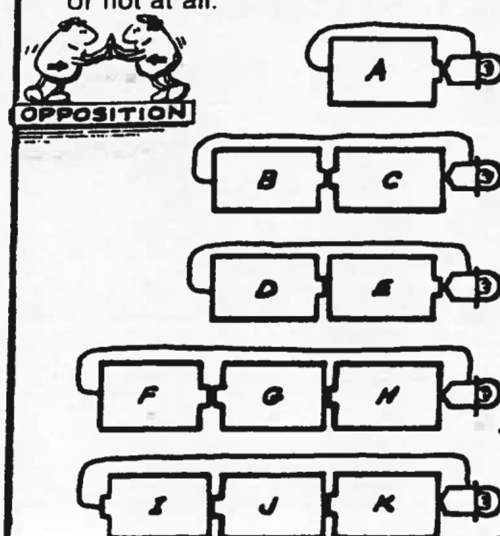
What happens as you add more cells in a series?

Electrons flow ***away from negative*** (the flat side), and ***toward positive*** (the bump side):



Use arrows to show how electrons flow through each circuit to the left.

4 If the bulb shines "dim" with 1 cell, tell how it shines with more cells connected in *opposition* and series: bright, medium, dim or not at all.



dim
____
____
____
____

Cells B-C are in ***opposition***. Other cells in opposition are .... Cells D-E are in ***series***. Other cells in series are .... and ....

Use arrows to show how electrons flow through each circuit. *(In one circuit, they don't flow at all.)*

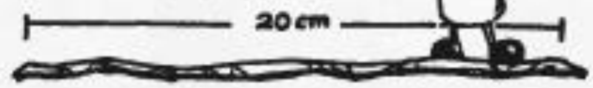
Why do cells B-C give no light?

Why do cells F-G-H give only about as much light as cell A?

PARALLEL MEANS SIDE BY SIDE

1 Start with about 30 cm of foil ribbon attached to your light bulb.


2 Make a second foil ribbon about 20 cm long (almost as wide as this paper.)

3 If the bulb shines medium with 2 cells in *series*, find out how it shines with cells connected in *parallel*: bright, medium or dim.

medium

....

....

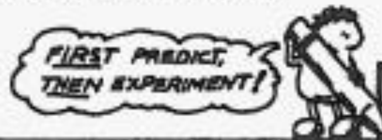
....

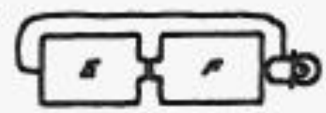
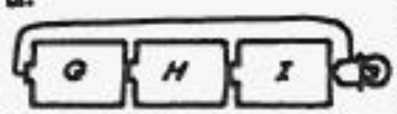
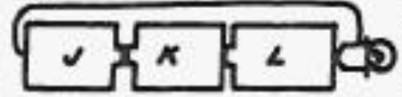
Finish each sentence:

When you add more cells *in parallel*, the bulb...

To make a bulb shine brightest, it is best to connect cells...

4 Predict how each bulb shines: bright, medium, dim or not at all. Then experiment to see if you are right.



	1. Prediction	2. Result
a. 		
b. 		
c. 		
d. 		
e. 		

Cells A-B are connected in ____________.

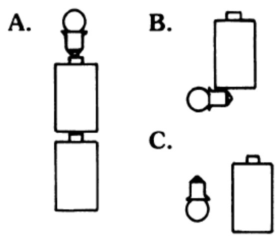
C-D are connected in ____________.

E-F are in ____________. G-H-I are in ____________. K-L are in ____________ while J is in ____________ to them both.

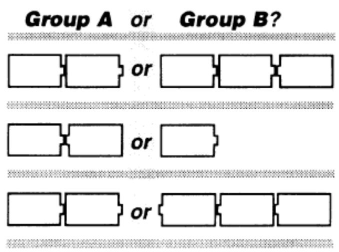
TOPS LEARNING SYSTEMS

Electricity Challenge Questions

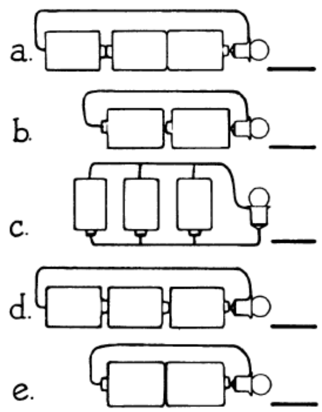
Connect bulbs and dry cells with lines to show how to light each bulb.



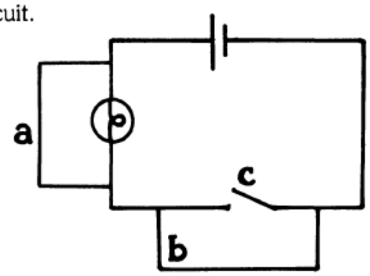
Circle one group (A or B) to show which cells make a bulb shine brighter. Do this in all three rows of problems.



Number these 5 groups of cells by how bright they make the bulb shine. Write *1* in the blank next to the brightest, *2* for the next brightest, and so on.

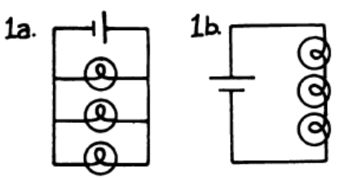


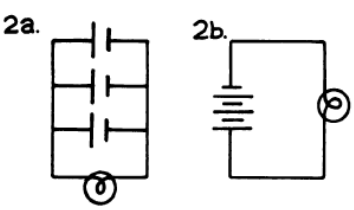
This circuit has a bypass at ***a***, another bypass at ***b***, and an open switch at ***c***. Circle all true sentences about this circuit.

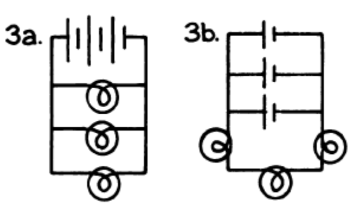


1. The bulb lights if you close ***c***.
2. The bulb lights if you remove ***a***.
3. The bulb lights if you remove ***b***.
4. The bulb lights if you remove ***a*** and ***b***, then close ***c***.

Compare each pair of circuits. Circle the one that produces more light.

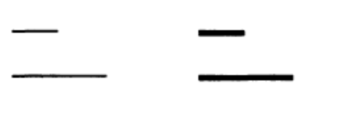


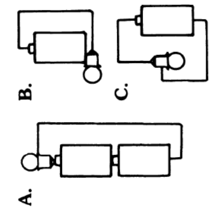




In which pair of circuits is the difference in the amount of light the greatest? Why?

Six copper wires, 3 thin and 3 thick, have different lengths as shown. *Circle* the wire with the greatest resistance. Draw a *box* around the wire with the least resistance.



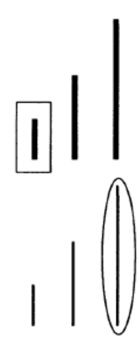


Circle Group A.
Circle Group B.
Circle Group B.

a. 4 b. 2 c. 3 d. 1 e. 5

Sentences **2** and **4** are true.

Most light: 1a, 2b, 3a. The third pair has the greatest difference in the amount of light produced. The cells are changed to parallel, producing less light and the bulbs are changed to series, also producing less light.



Electricity Costs

V=I*R P=I*V

V: Voltage measured in Volts
R: Resistance Measured in Ohms

I: Current measured in Amps
P: Power Measured in Watts

Energy = kW*hr or Joules
South African Voltage = 230 V

The average per unit price of electricity from Eskom is 71,65 c/kWh.

60 watt Light bulb

Current =_____________A
Voltage = ____________ V
Resistance = _________ ohms
Power = _____________ watts
= _____________kilowatts

Cost to light for 24 hrs. =
____

500 watt Toaster

Current =_____________A
Voltage = ____________ V
Resistance = _________ ohms
Power = _____________ watts
= _____________kilowatts

Cost to toast 5 slices of bread (2 min each) = __________

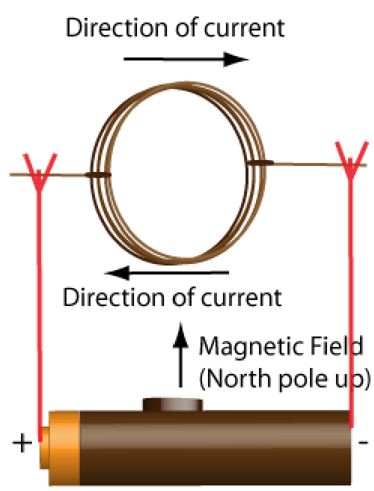
7000 watt Television

Current =_____________A
Voltage = ____________ V
Resistance = _________ ohms
Power = _____________ watts
= _____________kilowatts

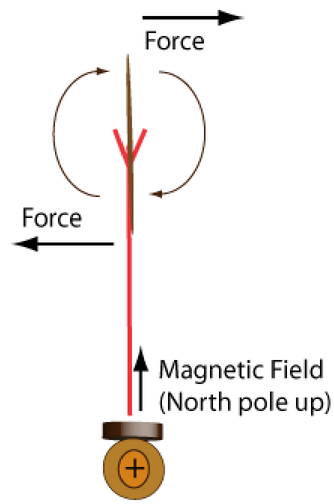
Cost to watch 3 hours of TV per night for a month = _________

Electromagnetic Induction

Simple Motor:



** the coil is wound clockwise



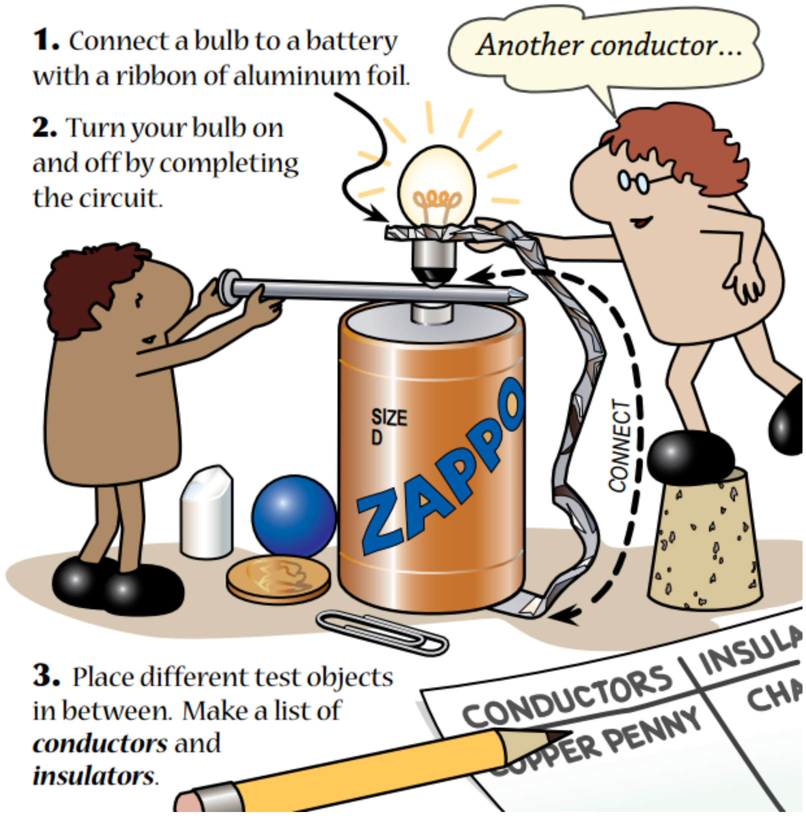
1. Starting in the center of the wire, wrap the wire tightly & neatly around the battery several times.
2. Slide the coil you made off the battery.
3. Wrap each loose end of the wire around the coil a few times to hold it together, then point the wires away from the loop. Use sandpaper to remove the top-half of the wire insulation on each free end of the coil. The exposed wire should be facing the same direction on both sides.
4. Thread each loose end of the wire coil through a bent open paper clip. Try to keep the coil as straight as possible without bending the wire ends.
5. Lay the battery sideways on a flat surface.
6. Tape the battery down so it does not roll away.
7. Place the paper clips upright next to the terminals of each battery so that the side of each needle touches one terminal of the battery & tape them in place.
8. Tape the small magnet to the side of the battery so that it is centered underneath the coil.
9. Give your coil a spin. *What happens? What happens when you spin the coil in the other direction? What would happen with a bigger magnet? A bigger battery? Thicker wire?*

<u>How does it work</u>? The metal, paper clips, & wire create a closed loop circuit that carries current. Current flows from the negative battery terminal, through the circuit, and to the positive battery terminal. Current also induces a magnetic field in the coil, which helps explain why the coil spins. Magnets have two poles, north and south. North-south interactions attract, and north-north and south-south interactions repel. The magnetic field created by the current in the wire is not perpendicular to the magnet taped to the battery, so at least some part of the wire's magnetic field will repel and cause the coil to continue to spin.

Electrical Conductors & Insulators

Objective:
Use a bulb and battery to find materials that conduct or resist electric current.

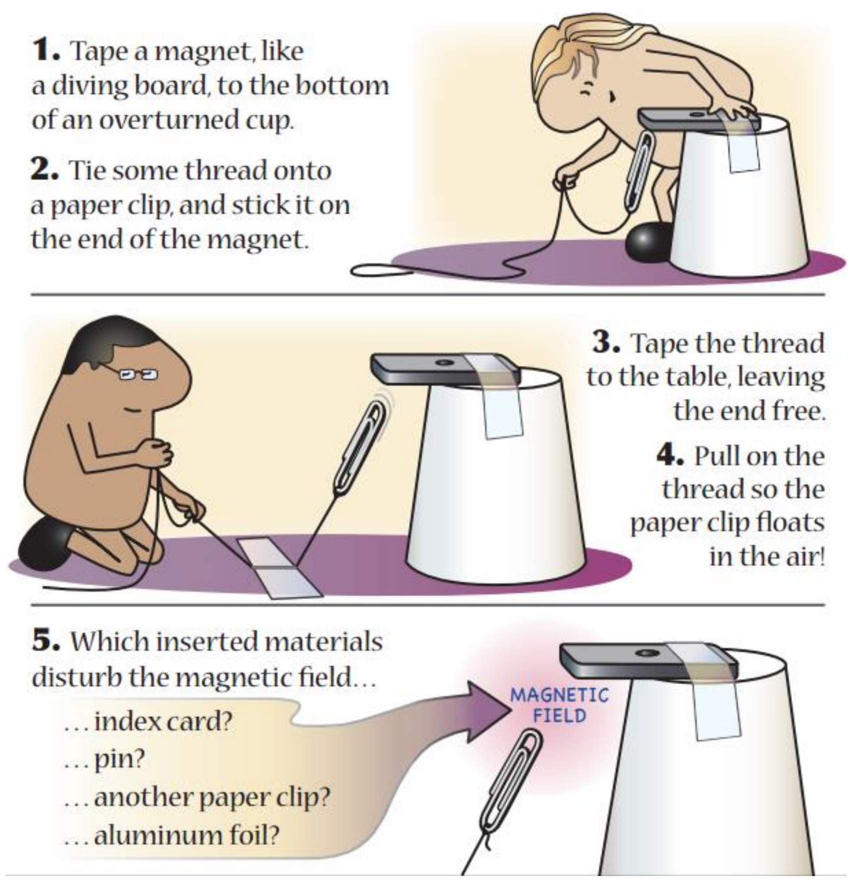
Materials:
Battery and bulb
Aluminum foil strip, 8” long, folded for strength.
Test objects: metal/rubber washer, button, glass, painted surfaces, string, leaf, copper, chalk, skin, candle, tin, eraser, aluminum, wood



Magnetic Force at a Distance

Objective:
To observe that a magnetic field passes through solid objects if they are not magnetic.

Magnetic Force acting at a Distance:
Magnetic lines of force pass undisturbed through nonmagnetic materials (paper, aluminum, plastic, glass), with no visible effect on the floating clip. The field is altered by magnetic materials like iron or steel. When passing through a magnetic field, steel pins and clips become temporary magnets and interact with the field, causing the floating clip to wobble or fall.



Motion & Forces

Which of these are true and which are misconceptions?

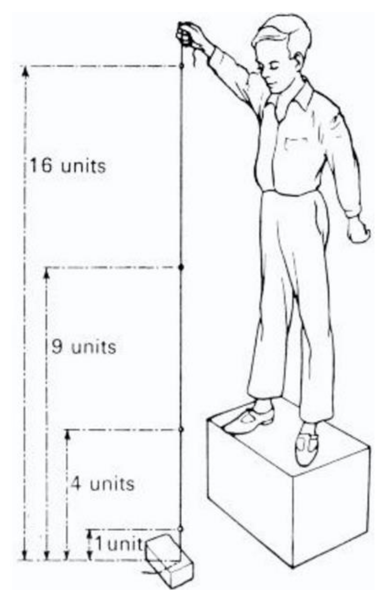
1. If an object is stationary there are no forces acting on it	2. If a force acts on an object it must move	3. The weight of an object is always equal to its mass	4. distance travelled = average speed x time
5. An object moving at a steady speed has equal and opposite forces acting on it	6. If the average speed is 20 m/s a car can have gone at lots of different speeds or even stopped	7. If an object is accelerating it must have a force acting on it	8. Forces can change the direction of an object while its speed stays the same
9. On a distance time graph an object travelling at a steady speed is shown as a straight horizontal line	10. An object falling at a steady speed will slow down if the resultant force on it is zero	11. All objects have the same acceleration due to gravity on Earth	12. As an object falls its speed remains the same
13. When an object runs out of force it stops moving	14 Work = force x distance moved in the direction of the force	15. The steady speed reached by a falling skydiver is called the terminal velocity	16. According to Hooke's Law doubling the force doubles the extension

Truths:

- Force can speed an object up or slow an object down.
- Forces can change the direction of a moving object.

String Drop Challenge

Objective: Tie metal objects to a piece of string so that when it is vertically dropped from a high spot, the sounds the metal makes in hitting the floor are evenly spaced "beats".



- To make the sounds occur at even intervals, should you tie the metal pieces at evenly spaced intervals along on the string? No!
- What sort of sound pattern will metal objects tied at evenly spaced intervals along the string produce?
- Consider acceleration due to gravity!

Graph:

- distance between objects vs. time (beat #) – what is the shape?
- distance between objects vs. time squared - what is the shape?

False: 1, 2, 3, 9, 10, 12, 13

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