Grade 5 Science Activities

Chemical Change Activities

Activity 1: Heat Activated

Students will be introduced to the concept of chemical change when they observe the chemical change that occurs between vinegar and lemon juice and heat.

Materials:
Vinegar or lemon juice
Toothpicks or paintbrushes
Pieces of paper
A heat source (light bulb or hot place)

Background Information:
The cancer fighting drugs used in conjunction with the LEDs are light activated. In this activity, we will talk about a chemical reaction that is heat activated. We will write with invisible ink that becomes visible after heat is applied.

1. Read the article (if possible) “Healing Light.” (Found in NASAexplores Article(s).)
2. Have students dip their toothpick or paintbrush into the invisible ink (vinegar or lemon juice) and write a secret message on a piece of paper. Do not press too hard.
3. Let dry.
4. Have each student give you their piece of paper and pass the paper back and forth over the heat source for them. Be careful not to let the paper get too close or too hot; it can catch on fire.

Discussion/Wrap-up:
What happened?
Gradually the writing should appear, because heat causes a chemical change in vinegar or lemon juice. The “invisible ink” chars at a lower temperature than the paper, so the writing appears faint and brown.

Density Experiments

Activity 1: The Floating Golf Ball

This activity is an introduction to a discussion on density.

Materials:
Clear plastic container
Kosher (pickling salt), salt
Golf ball
Food coloring
Water

Procedure:
1. Fill container ½ full of tap water.
2. Add salt until no more salt dissolves.
3. Add golf ball to the salt solution (it should float!).
4. Gently add fresh water on top of the salt water solution.

This activity may be used as a "teaser" to your discussion on density. Have it already set up when students arrive in class. Without any explanation, give the students all the materials and have them try and make their own golf balls float halfway in a container of water. Eventually, all student groups are successful. After they are, discuss density and why the golf balls are floating at that particular location. Many students mistakenly believe that they are diluting the solution of salt water to the "perfect" concentration when adding the fresh water. Add a few drops of food coloring and gently stir to show them that the fresh water is less dense and is actually sitting on top of the more dense salt water. The golf ball is actually floating on the salt water and sinking through the fresh water.

Activity 2: Sinking Soda Surprise

1. Ask the students what they believe density is? Volume? "Density" is a term used to compare the mass of two different objects with the same volume.

2. Have as props two objects of similar shape, but different volume (i.e. basketball and racquetball.) Ask which one has the most volume and why? Is one more dense than the other?

3. Using two containers with different shapes and different size, ask which has more volume? (i.e. Tupperware and plastic bottles.) Demonstrate that they have the same volume! (Use two containers which have the same volume, one filled and one empty, ask the question, then pour the water into the other to demonstrate that they have the same volume.)

4. Demonstrate density using two similarly shaped objects, but with different densities (i.e. rock and Styrofoam ball.) Emphasize the difference between **weight and density** (sometimes a tough topic.)
5. Briefly define volume. Explain by filling up same-sized containers. **Which container has a greater volume?** (This can be a particularly difficult concept for 5th grade children to grasp. Review volume from a number of perspectives; full, half-full. You can use two containers; one filled with water and one empty, and ask which has a greater volume? This poses a problem with question interpretation. The correct question is which bottle holds the greater volume of water?)

6. When defining mass, keep this part simple! The force placed on an object is related to its mass.

7. Demonstrate by dropping a basketball and a quarter.

8. Redefine density. "Density" is a term used to compare the mass of two different objects with the same volume.

9. Discuss how we all know certain things float in water while other things sink, but why? Do all heavy things sink? Why does a penny sink and an aircraft carrier floats?

10. Present your materials for the "Sinking Soda Surprise": 2 diet canned sodas, 2 regular canned sodas of two different brands, and a large, deep container of water like a 5 gallon bucket or an aquarium.

11. Ask your students the following question: "Will this can of regular soda float or sink in the bucket of water"? After giving everyone enough time to answer, place the can of regular soda in the water and notice that it sinks to the bottom. Note: If the can of regular soda floats, you might have an air bubble trapped under the bottom of the can. Make sure that you select a can of regular soda that sinks.

12. Pick up a can of diet soda and pose the same question. Be sure to point out the fact that the cans are exactly the same size and shape and contain the same amount of liquid (compare the number of milliliters). Place the can of diet soda in the water and notice that it floats! Show your students that there are no bubbles trapped under the bottom. It still floats. Why?

13. Let your group experiment with another brand of soft drink (1 diet and 1 regular). Have them try to determine why diet sodas float and regular sodas do not.

- **After students have formed their hypotheses explain how it works. Objects less dense than water float, and those denser than water sink. Empty cans float, rocks sink. This is only because of differences in density. If both cans could be placed on a double pan balance, it would be clear that the regular soda is heavier than the diet soda. This demonstrates the difference between mass and volume. Mass refers to how much stuff exist within an object. If something is heavier than another object, it contains more mass. Mass is measured in grams.**
- **Volume, on the other hand, refers to how much space an object occupies. For fluids, volume is usually measured in liters (L) or milliliters (ml). There are 1000 ml in one liter. Since both cans have the same volume, the heavier can must have a greater mass. Students can conclude that the heavier can is denser than the lighter can.**
- **Diet sodas usually contain aspartame, an artificial sweetener, while regular sodas use sugar. Have students take a look at the nutritional information on the side of the cans. Notice how much sugar is**

in a regular soda (look under carbohydrates). Most regular sodas have about 41 grams of sugar. How much is 41 grams? Try 18 packets of sugar like the ones you might find at a restaurant! Diet soda is flavored with a relatively small amount of an artificial sweetener (like aspartame) which is 200 times sweeter than an equal amount of sugar. Therefore, only a tiny amount of aspartame is needed. Both sugar and aspartame are denser than water, which can easily be demonstrated by adding small amounts of each to a container of water. So it is actually a matter of how much of each is used. The 41 grams or so of sugar added to a can of regular soda makes it sink. The relatively tiny amount of aspartame used in diet sodas will have a negligible effect on the mass, enabling the can to still float.

- **So why then do cans of diet soda float? It is all due to the fact that there is a little bit of space, called headspace, above the fluid in each can of soda. This space is filled with gas, which is much less dense than the soda, itself. It is this space above the soda that lowers the density of diet drinks just enough to make them float. Sugared drinks still have this headspace, but the excessive amounts of sugar added makes the can denser than water.**

Activity 3: Floating Lemons and Sinking Limes

Scientists seem to be infatuated with objects that float and sink. Even non-scientists find great joy in dropping stuff in water to see if it floats or sinks. Fans of David Letterman are quick to point out one of Dave's favorite segments called "Will It Float?" Here's the latest float or sink challenge: Why do lemons float in water but limes sink. Think you know the answer? Not so quick…

Materials:
Lemons and limes (roughly the same size and weight)
A deep container like a large bowl

Procedure:
1. Fill a bowl with water and drop in the lemons. Float or sink? (They should float.)

2. Toss the limes into the water. Float or sink? You might get a few that float but just barely. (The limes in our test sank to the bottom.)

3. Now it's time to figure out why. Your first guess might be the rinds of both fruits. Peel the rind off of the lemon and you'll find that it is thick and porous – similar to the rind of an orange (that also floats in water). The lime rind is much thinner than the lemon and does not contain the same porous material.

4. It's time to test the peeled lemon and lime. Drop both in the water… and you might be surprised. The lemon floats and the lime sinks! So, it's not the rind.

5. That's as far as we're going to take you. Keep experimenting and exploring before reading any further.

How Does It Work?
According to the USDA website, a lime is 88.26 % water by weight and a lemon is 87.4 %. This could mean that lemons have higher air content, but no one knows for sure.
If you weigh a lemon and a lime that are similar in size you can determine the volume of each. For example, let's say both fruits weigh 101 grams. Using displacement of water, it can be determined that the lemon has a

volume of 99 ml and the lime has a volume of 90 ml. (Fill a container to the very top with water and then submerge the lemon or lime. Collect and measure whatever water spills out over the edge of the container and you have the volume.

Using the density formula (D = M/V) it was easy to determine the density of each fruit.

The lemon – Density = 101g/99ml = 1.02 g/ml

The lime – Density = 101g/90ml = 1.12 g/ml

Since the density of water is approximately 1g/ml, it makes sense that the lemon in our experiment floated and the lime sank.

Some people have suggested that lime flesh is much denser than lemon flesh, and as a result, it holds its juice better. People who "juice" fruits know about this phenomenon. If you want to get more juice from a lime, warm it up in the microwave briefly and then firmly roll it along the worktop before slicing it lengthways and juicing it. It makes a huge difference.

Since the density of the lemon and lime are very close to water, even very small changes in composition could mean the difference between sinking and floating.

Activity 4: Gummy Bear Density

The student will determine what happens to a gummy bear when it is put in water overnight. The student will use density data to compare before and after results.

Materials:
Gummy bears (1 per lab group + extra to feed students)
Ruler
Balance
Beaker
Water
Data table chart (available at http://sciencespot.net/Pages/classmetric.html

To student:
Part A: Choose one gummy bear from the container on your table. Use the equipment available to measure your gummy bear and record the data in the chart for Day 1.

Measurements:

- The length of your gummy bear should be measured from the top of its head to the bottom of its feet to the nearest tenth of a centimeter.
- Measure the width at the widest point across the back of the bear to the nearest tenth of a centimeter.
- Measure the thickness from the front to the back at the thickest point to the nearest tenth of a centimeter.
- Calculate the volume by multiplying the length, width, and thickness. Round to the nearest hundredth.
- Measure the mass using a triple-beam balance or other scale to the nearest tenth of a gram.
- Calculate the density by dividing the mass by the volume. Round answer to the nearest hundredth.

Part B: Put the bear in a cup labeled with your name and class period. Add 50 ml of water to the cup and allow it to sit overnight. On Day 2, remove the gummy bear from the cup of water and use a towel to dry it off to prevent it from dripping all over the place. Repeat the measurements from Part A and record your data in the correct portion of the chart. Determine the amount of change for each measurement and record in the chart.

This activity can be extended to include a lesson on graphing the results from the chart.

Activity 5: Salt and Marble Mystery

Finding the toy surprise in your favorite breakfast cereal is never easy. Most of the time you dig through the cereal or dump the cereal out just to find the toy. Believe it or not, there's a science to finding the toy surprise. A classic science puzzle will teach you how to make the toy surprise rise to the top of the cereal…without ever opening the box!

Materials:
Plastic test tube with an end cap
Salt
Marble

It's easy to make the toy surprise rise to the top of the cereal if you understand the physics of friction.

Experiment:

1. Fill the test tube ¾ full with salt.
2. Place the marble on top of the salt.
3. Seal the end of the test tube with a cap (or a cork).

The trick is to get the ball from one end of the tube to the other, through the salt. One might think that since the marble is much denser than the salt, it will sink to the bottom when the sand is agitated. The opposite is actually true.

How does it work?

Hold the tube vertically with the marble at or near the bottom. As you shake the tube up and down, the marble will actually rise through the column of salt. Each time the tube is jerked upwards, both the marble and the salt move up at the same speed. Because the salt particles are lighter and smaller, they experience greater relative friction than the marble when rubbing against each other. This causes the salt particles to slow down faster. After each shake, more salt particles are packed underneath the marble, until it magically emerges from beneath the salt. .

What does this have to do with finding the toy surprise in my cereal?

Use the same technique you used with the marble puzzle to make the toy surprise rise to the top of the cereal. Hold the box vertically and shake it up and down. Each time the box is jerked upwards, the toy surprise moves up through the cereal to eventually emerge from beneath the flakes. To everyone's amazement, you'll be able to open the box cereal and have the toy surprise just waiting for you at the top of the box. That's physics in action!

ACIDS AND BASES

Ask: *What do you know about acids?* You might ask students to name some acids. Responses may include references to battery acid, acid indigestion, stomach acid, acid rain, citrus acid, and chemicals in a lab.

EXPLAIN ACIDS USING SOME OF THE FOLLOWING INFORMATION:
Note: Select the information that is appropriate for the class you are teaching. Try to keep the information on a level that the students can understand. Feel free to add other appropriate information. Keep this discussion brief. Explain any new vocabulary to the students.

ACIDS
Weak acids (like the natural acids in food) give foods a sour, sharp flavor.
Strong acids can burn your skin.
Many acids are corrosive. They eat away metals and other substances.
Some acids can be helpful. The acid in your stomach aids in digestion.
Two acids (sulfuric acid and nitric acid) cause damage in acid rain.
An acid releases hydrogen ions (H^+) in water.
Acids can neutralize bases.

Ask: *What do you know about bases?* You might ask students to name some bases. Most students know less about bases than acids. The most common response here is a reference to bases in softball or baseball. Accept that response if it is given and tell students, "Yes, that is one kind of base, but not the one we are going to focus on today."

EXPLAIN BASES USING SOME OF THE FOLLOWING INFORMATION:
Note: Select the information that is appropriate for the class you are teaching. Try to keep the information on a level that the students can understand. Feel free to add other appropriate information. Keep this discussion brief. Explain any vocabulary students may be unfamiliar with.

BASES
Bases taste bitter and feel slippery.
Weak bases are used to settle upset stomachs.
Detergents and many cleaning solutions are bases.
Strong bases can burn the skin.
A base releases hydroxide ion (OH^-) in water.
Bases can neutralize acids.
Many common substances are either acids or bases. Some acids, like stomach acid are necessary for our health, while others, like sulfuric acid are dangerous and can cause burns and other injuries. Baking soda is a common, weak base used in our homes, while sodium hydroxide, a strong base, is hazardous to skin and eyes.

The easiest way to determine if a substance is an acid or a base is to use an indicator. Indicators are organic molecules that change color in an acid or a base. When an indicator is placed on paper, it provides a fast way to determine if a substance has acidic or basic properties.

Activity 1: Are You Acidic or Basic?

Objectives: The students will – use litmus paper to test for an acid, base or neutral substance, and compile and evaluate the data in a class data table.

Materials: two pieces of litmus paper (one pink and one blue). You may go into pH if you wish to.

Procedure:

1. Take two pieces of litmus paper (1 pink, 1 blue) and place about one inch of each paper in your mouth.
2. Wait 5 seconds, then take out the papers and see if either changed color. You will determine whether your saliva is acidic or basic. **Red to blue means basic; blue to red means acidic, no change means neutral.**

Are you acidic or basic? __________ Class totals: Acidic _________ Basic __________

You will test either acidic, basic or neutral. The red litmus paper will turn slightly blue for a base. The blue litmus paper will turn slightly pink for an acid. If nothing happens, it is neutral. If you discuss pH with the students, you can determine how acidic or basic you are. You need to use pH paper, which changes color to indicate the pH. pH paper is treated with a broad range indicator that changes color with varying pH. (This pH value is an approximate value based on color comparison. More exact pH values are found using pH meters or by titration using acids and bases.)

How acid or basic are you?

1. Tear off a piece of pH paper about 1 in. long.
2. Place part of it in your mouth and wait about five seconds.
3. Remove the paper and compare the color with the pH color chart at your table. (Do not let the paper dry because the colors change as the paper dries.)

How acidic or basic are you? What was the pH? ______________

Use the data table below to compile the information for the class.

Litmus Paper			pH paper			
Acid	Neutral	Base	Below 6	Between 6 & 7	Between 7 & 8	Above 8

Questions

1. How many people tested acidic, basic or neutral with litmus paper? Which group was larger?
2. Was their a pattern in the results for the whole class? If so, what was it?
3. What substances could affect the outcome of the litmus test? (food, drinks, etc..)
4. What were the results with the pH paper? How many people were in each pH range?
5. Was there any pattern in the pH values for whole class? If so, what was it?

Interesting Fact: males tend to be more acidic than females!

Activity 2: Lose the Indicator Blues!

A surprising thing happens when you place pieces of a red cabbage leaf in water. When you squish the leaves and water together, the water turns blue! If you add small amounts of different liquids, the cabbage-water will turn a variety of beautiful colors – pink, purple, teal, or green. Red cabbage-water is a special substance called an indicator. This means that the color the cabbage-water turns says something about the liquid placed in it. You can make your own red cabbage indicator solution and explore its color changes.

In this activity, students will discover one way to tell that a chemical reaction has taken place.

Materials:
Red cabbage leaf (torn into pieces)
Warm water
Measuring spoons/measuring cups
Plastic zip-closing bag
2 eye droppers
5 small cups (plastic or paper)
Vinegar (about 1 teaspoon)
Laundry detergent powder (about 1 teaspoon)
1 flat toothpick (to use as a tiny scoop)
Masking tape/Ball point pen

First, prepare indicator solution:
Place the red cabbage leaf pieces into the zip-closing bag. Add ¾ cup of warm water and close the bag tightly. Squeeze the bag of cabbage and water until the water turns dark blue (about 3 minutes). This dark blue liquid is your indicator solution.

1. Use your masking tape and pen to label the five cups: *Indicator + Vinegar; Indicator + Detergent; Indicator Control; Vinegar; Detergent Solution.*
2. Pour about 2 tablespoons of vinegar into the **Vinegar cup.**
3. Place 2 tablespoons of water in the **Detergent Solution cup.** Add 1 teaspoon of detergent and swirl to mix.
4. Place 2 tablespoons of indicator solution in the **three Indicator cups.**
5. Use your dropper to place 1 drop of vinegar in the **Indicator + Vinegar cup.** Gently swirl the cup to mix. *What did you observe? How does the color compare with the* ***Indicator control?***
6. Use the second dropper to add 1 drop of detergent solution to the **Indicator + Detergent cup.** Gently swirl to mix. *What did you observe? How does it compare with the* ***Indicator control?***

Think about this…
See if you can change the color in your **Indicator + Vinegar cup** back to blue!

Add a drop of detergent solution to the **Indicator + Vinegar cup.** Swirl to mix. Compare the color in the vinegar cup with the color in your **Indicator Control cup**. *How close did you get?* If the color does not match, see if you can add just the right amount of either detergent or vinegar to match the color of the control.

Now, try to change the color in your **Indicator + Detergent cup** back to blue!
How would you do it?

Activities Involving pH

At Home Sheet

Making Red Cabbage Juice

BLENDER:

Tear 3-4 red cabbage leaves and place them into a blender.
Add water until the blender is about ⅓ to ½ full.
Turn the blender on HIGH for 2 minutes.
Strain the shredded leaves as you pour the liquid into a jar.

OR

STOVE (with adult supervision)

Tear or chop up some cabbage (¼ head) and place in a saucepan.
Cover with water and bring to a boil.
Turn heat to low or medium and continue to cook until cabbage is done (pale).
Drain water into a jar and allow to cool. (Eat the cabbage if desired.)

Making pH strips

Cut sheets of white paper towel into strips about 1/2" x 2".
Soak the strips in red cabbage juice for about an hour.
Take the strips out of the liquid and allow them to dry completely.
When they are dry, cut them into small strips.

Magic Foam

Place a clear jar inside a plastic dish pan.
Fill it ⅓ to ½ full of red cabbage juice.
Add one spoonful of the following items (stir if necessary) and observe the color changes: baking soda, cream of tartar, laundry detergent, white vinegar.
Be careful! If you add more baking soda and white vinegar you will have a beautiful foaming volcano.
Watch for all the color changes – pink, red, purple, blue, and green!

Testing Household Products

Collect several household liquids that you would like to test (7-up, milk, window cleaner, rubbing alcohol, baking soda, water, lemon juice. DO NOT test bleach, ammonia, muriatic acid, or lye without parental supervision). If you try to test dark colas, the results are too hard to see. They will appear neutral, but colas actually have acid and should turn pink or red – the brown color of the cola masks the color change.
Put a small amount of the liquid in a cup (or use soft drink bottle caps for these tests).
Add some red cabbage juice to the liquid.
OR

Use one of the pH cabbage strips you made by soaking paper towel strips in red cabbage juice. ENJOY!

Energy Activities

Activity 1: Heat – Energy Extraordinaire!!

Explain to the students how heat is a form of energy that can do a lot. One of the ways we use heat energy is to heat water to make steam. The steam can then be used to run an engine or even a generator to make electrical energy (electricity). This is an example of one form of energy being changed to another. Heat can also be used to make water evaporate or to make the molecules in air move faster and farther apart or expand. This activity shows that heat can make molecules move!

Materials:
Hot water
2 plastic cups (wide enough for a plastic bottle to fit in)
½ liter plastic bottle (from bottled water)
Liquid dish detergent

1. In a cup, make a detergent solution by mixing ½ teaspoon of liquid dish detergent with 1 tablespoon of water.
2. Add hot water to another cup until it is about half full.
3. Lower the open mouth of the bottle into the cup with detergent. Carefully tilt and lift the bottle out so that a detergent film covers the opening of the bottle.
4. Slowly push the bottom of the bottle down into the hot water. What happens?

Think about this…

The air inside the bottle is made up of molecules. The heat energy from the water in the cup made these gas molecules move faster and further apart. Do you think heat energy has anything to do with evaporation?

What's happening?

Heat is a form of energy. The heat energy from the water makes the molecules in the gas inside the bottle move faster and spread further apart. This is heat energy being changed to the mechanical energy of moving molecules. In evaporation, heat energy makes water molecules move faster and further apart. Some of the molecules have enough energy to break away from the others and enter the air.

Activity 2: Mechanical Energy – A Moving Experience!!

Explain to the students how they need energy to do the things they do every day. When they eat food, their body can use the chemical energy in the food to make their muscles move so they can breath, walk, run, jump, lift things, and do all the other things they need to do to live. The chemical energy in the food gets changed into the mechanical energy of moving muscles.

Materials: Students

1. If the students are sitting, have them stand up. **Ask:** *Did standing up take a little energy? Try jumping up and down 5 times.* Explain that in order to stand up or jump, their body changes the chemical energy stored in food they have eaten into the mechanical energy of moving muscles.
2. Have the students jump up and down a lot (maybe 50-100 times). They should feel a little warm or even hot. **Ask:** *Where do you think that heat comes from?*
3. Have the students rub their hand together. This action is not only changing chemical energy into the mechanical energy of rubbing your hands together but is also changing the mechanical energy into heat energy and sound energy. They can change mechanical energy into sound energy better by clapping their hands together.
4. Have them imagine riding a bike that is hooked up to an electrical generator. **Ask:** *What are all the different energy changes taking place here?* Light energy to chemical energy; chemical energy to mechanical energy; mechanical energy to electrical energy; electrical energy to heat energy; heat energy to sound energy.

Think about this…

In different parts of the country, windmills are used to make electrical energy. The mechanical energy of moving air causes the windmill blades to turn. The spinning blades turn a coil of wire inside a generator that is directly behind the blades. The generator changes the mechanical energy of the moving blades into electrical energy. How do you think moving water could also be used to generate electricity?

What's happening?

The energy in any food that we eat really came from the sun. Food is like fuel for living things. In fact, the energy in fuels like gasoline or oil also comes from the sun. The energy in sunlight is used by plants to make chemicals. These chemicals have some of this energy stored in them as chemical energy. When we or other animals eat the food, we change the chemical energy into mechanical energy of a living, growing, and moving body.

There are lots of plants that living things do not eat. These plants die and over a very long time become coal or oil. But the chemical energy is still in them. When we burn them, the energy is changed from chemical energy into heat and light.

Activity 3: Potential and Kinetic Energy

Materials:
Two desks or chairs
Masking tape
Yard or meter sticks
3 shooter marbles

One 8 feet strip of vinyl ceiling molding

What to do:

1. Tape the ends of the track (molding) on opposing chairs so that the center hangs down to the floor like the letter U. Use masking tape to secure the bottom of the track to the surface that the track is laying on.
2. Place a marble on one end of the track and let it roll down. How many times did the marble travel back and forth before it stopped in the middle? This activity illustrates potential and kinetic energy. In what position(s) was the marble when it was illustrating potential and kinetic energy?
3. **Other possible discovery experiments:**
    - What is the ratio between the spot where the marble goes down to the spot where the marble goes up? Keep a chart of each measurement.
    - What will happen when one marble is at rest on the track and another is dropped on the track?

So What?

Energy is the ability of matter to move other matter or to produce a chemical change in other matter. Scientists define energy as the ability to do work. Work is defined by scientists as only being done when a force, which is usually a push or a pull, is moved through a distance.

Mechanical energy is the form of energy that we see around us. All moving objects produce mechanical energy.

Kinetic energy is the energy of motion.

Potential energy is the energy that a substance or object has because of its condition or position. Potential is also called stored up energy. When potential energy is set free, it changes into kinetic energy.

Now what?

This activity illustrates potential and kinetic energy. To establish potential energy, you must first establish the conditions of the situation for energy. For example, the height or distance of the ends of the track from the floor is different than the height or distance of the ends of the track from the seat of the chairs. Therefore, you must establish the conditions of height or distance. The marble held at the end of the track with the established conditions of height or distance has the potential to MOVE the length of that established distance or height if a force, namely that of gravity, were to release the potential energy of the marble. Once the marble is let go, the force of gravity (a pulling force) releases the potential of the marble to drop and the marble drops the established distance or height. Work has been done. Work is the force times the distance.

The marble gains energy be traveling down the slanted track. The higher the marble's starting point, the greater the energy it has at the bottom. On top of each hill the amount of energy the marble has is called potential energy. When you place the marble in the valley, or at the bottom of the big U, it doesn't go anywhere. Its potential energy is ZERO. However, when it rolls into this valley from the top of the track, it keeps traveling. The marble at that point is said to have kinetic energy. The kinetic energy enables the moving marble to travel up the next hill.

Convex and Concave Lenses

Activity 1:

In this activity the students will see how both convex and concave lenses work, some of the different uses of both types of lenses and see how these lenses work. Also, they will be able to describe terms related to lenses. The student will be able to visually recognize the difference between concave and convex lenses. They will be able to explain that convex lenses cause rays of light to converge (come together) at a single point, and that concave lenses cause rays of light to diverge (spread apart). They will be able to explain how a lens is used to produce an image.

Materials:
10 plastic cups
10 pennies or spoons
Pieces of window
Glass
Small magnifying lens
White cardboard
Paper
Ruler

Motivational Activity:
Explain to the students about light rays. Have a small empty plastic cup with a penny placed in the bottom of it. Have the students back up until they cannot see the penny. Then go around and add water to the cups until they are able to see the penny in the bottom. Or, if more plausible, put a spoon in a cup of water. After doing this with the students, ask them if they know why they were able to see the penny with the water in the cup? Or, why the spoon appeared to be "broken?" After they answer, or after a few tries - explain why. It is because of refraction of the light.

Discussion:
1. **Refraction** – the bending of light as it moves from one substance to another. Ask students for more examples of where refraction takes place? Explain to students about how lenses are used to refract light. Also, explain that there are different types of lenses: convex and concave
2. Ask students if they know the difference between a convex and a concave lens.
    a. **Convex** – a lens that is thicker in the middle than on the ends.
    b. **Concave** – a lens that is thinner in the middle than on the ends.

* A concave lens looks like the opening to a cave, therefore you can remember that it curves inward.

Convex Lenses:
1. Refracts parallel light rays so they come together at a single point. Does anyone know what it is called when the light rays are made to come together? (convergence)

2. Point - is known as focal point.
3. Distance from center of lens to focal point = focal length.
4. The thicker the middle of the lens the shorter the focal length.
5. Example of a convex lens is a magnifier.
6. Image can be seen without actually looking through the lens. This type of image is known as a real image.
7. When held close to objects, inside of its focal length, it produces an image known as a virtual image. To see a virtual image you must look through the lens.

Concave Lenses:
1. Refracts rays so they come apart. Does anyone know what it is called when the light rays are made to come apart from each other? (divergence)
2. Always forms a virtual image.

Practical Uses of Lenses"
1. Who knows of some uses of lenses?
2. Cameras (normally convex), glasses (near – concave; far – convex); telescopes (at least 2 convex), microscopes (at least 2 convex).
3. Answer any questions students may have.

Reinforce:
1. What does a lens do to light to form an image?
2. What is the difference between a convex and a concave lens?
3. What are some of the uses of lenses in everyday life?

Activity 2: Looking Into Lenses

Students will learn about the differences between concave and convex lenses, along with practical uses for lenses. They will be able to explain how convex lenses cause rays of light to converge (come together) at a single point and how concave lenses cause rays of light to diverge (spread apart). Students will be able to explain how a lens is used to produce an image. They will also be able to explain the following terms: **refraction, lens, convergence,** and **divergence**.

Materials:
Clear plastic wrap
Newspaper
Water
Cups for the water
Eyedroppers
Lenses (convex and concave)
Paper/pencils

Procedure:

Give students the following directions: "Each of you will be receiving a piece of newspaper, a piece of clear plastic wrap, an eyedropper, and a cup of water. You will lay the piece of newspaper on your desktop. Then you will lay a piece of clear plastic wrap on top of the newspaper. Using an eyedropper, you will place a drop of water on the plastic wrap. Before we begin, take out a piece of paper and write a prediction of what you think you are going to observe."

Pass out the materials needed for the activity. While the activity is being conducted, monitor the class to make sure everyone is on task. Ask the students what they are observing. What does the newspaper print look like? Encourage students to try different techniques such as adding more drops of water or folding the plastic wrap in half. Ask students to share what they think is occurring with the "water lens."

Lesson Focus:

Discuss the term, ***refraction*** (the bending of light as it moves from one substance to another). Explain how a lens is used to refract light (a lens is a piece of curved material which light is able to pass through, such as clear plastic or glass). Explain that there are two different types of lenses, **convex and concave**. **Ask:** "Does anyone know the difference between a convex and a concave lens?" **Describe convex lenses** –A convex lens is thicker in the middle than on the ends, which causes light rays to focus (converge). Show a demonstration with a convex lens. Explain how the lens refracts parallel light so that the rays come together at a single point. **Ask:** "When light rays come together at a point, what is that called?" (**Answer:** convergence) Explain that the point that light focuses on is known as the focal point, and the distance from the center of the lens to the focal point is called the focal length. Explain that if the lens is thicker in the middle, the focal length will be shorter.

Describe concave lenses – A concave lens is thinner is the middle than on the ends which causes light rays to spread apart (divergence). Explain how the lens refracts the rays so that they spread apart. Demonstrate with a concave lens. Share an easy way to remember what a concave lens looks like. Focus on the word cave; the opening of a cave looks similar to a concave lens. **Ask:** "When light rays spread apart, what is that called?" (**Answer**: divergence)

Ask students if they can name any practical uses of lenses. Examples might include the following: cameras (convex); magnifying glass (convex); glasses (near sighted – concave, far sighted – convex); telescopes (at least 2 convex lenses); and microscopes (at least 2 convex lenses).

Closure:

Remind students of the "water lens" that they made at the beginning of class and ask them, "Was that lens convex or concave? Why or why not?" (Answer: convex) Review the terms learned today: **refraction, lens, convex, and concave**.

Gravity

Activity 1: Weigh In

If you went to Mars, would you weigh more, less, or the same as you do here on Earth? What do you weigh on other planets?

Materials: Pencil and paper

What to do:

1. Use a pencil and paper to create a chart like the one below.
2. Record your mass in each space in the "mass" column. Your mass is equal to your weight on Earth.
3. Next, write down the gravity for each location in the proper column. Earth is 1, and outer space, where there is no gravity, is 0. Fill in the rest of the numbers.
4. Finally, multiply your mass times the gravity in each row to figure out your weight at each location.

My Weight Chart

Location	Mass	Gravity	Weight
Earth		1	
Outer Space		0	
Earth's Moon		0.17	
Venus		0.90	
Mars		0.38	
Mercury		0.28	
Jupiter		2.36	
Saturn		0.92	
Uranus		0.89	
Neptune		1.13	
Pluto		.07	

To calculate your weight: **mass x gravity = weight**

So, what do you think? If you went to Mars, would you weigh more, less, or the same as you do here on Earth?

Activity 2: Weightlessness Demonstration

This lesson demonstrates that free-fall eliminates the local effects of gravity.

Materials:
Styrofoam or paper coffee cup
Pencil or other pointed object
Water
Bucket or other catch basin

Procedure:

1. Punch a small hole in the side of the cup near its bottom.
2. Hold your thumb over the hole as you fill the cup with water. Ask students what will happen if you remove your thumb.
3. Remove your thumb and let the water stream out into the catch basin on the floor.
4. Again seal the hole with your thumb and refill the cup. Ask students if the water will stream out of the hole if you drop the cup.
5. Drop the filled cup into the catch basin. The demonstration is more effective when you hold the cup high before dropping it.
6. Lead students in discussion based on notes below.

Notes:
Earth-orbiting spacecrafts experience a condition described as weightlessness. The spacecraft is in a state of free-fall as it orbits. If the spacecraft has astronauts on board, the astronauts are able to move about with ease because they too are in a state of free-fall. In other words, everything in their immediate world is falling together. This creates the weightless condition.

Crew members and all the other contents of the spacecraft seemingly float through the air.

On Earth, momentary weightlessness can be achieved in a number of ways. Some amusement parks achieve a second or two of weightlessness in certain wild high-tech rides. NASA achieves about 30 seconds of weightlessness with a special airplane fondly termed the Vomit Comet. High above Earth, the plane begins a long arc-like dive downward at a speed equal to the acceleration of a falling object. After 30 seconds, the plane pulls out of the dive and climbs back to the high altitude to begin another weightless cycle.

The falling cup for a moment demonstrates weightlessness. When the cup is stationary, water freely pours out of the cup. If the cup falls, the water remains inside the cup for the entire fall. Even though the water remains inside, it is still attracted to Earth by gravity and ends up in the same place that the water from the first experiment did.

The demonstration works best when students are asked to predict what will happen when the cup is dropped. Will the water continue to pour out the holes as the cup falls? If your school has videotape equipment, you may wish to videotape the demonstration and then use the slow motion on the playback machine to replay the action.

Life Science

Activity 1: Healthy Heart

Instruct students to lay their hand (palm side up) on their desk and have students count how many times they can open and close their hand for one minute. Their hands should start getting tired after about 45 seconds. The students might start to wonder what they are doing…be sure they record how many times they opened and closed their hand. Don't stop! Let's see if we can keep going a little longer. Ask students what is their hand doing? (opening and closing). What part of the body might your hand represent? Which system of the body might use the heart?

Materials:

"The Beat Goes On" worksheet (see bottom)
Seconds timer (stopwatch)
Beef hearts cut in two
Diagram of the heart
Dish pan for each heart
Sharp knife to cut hearts in two

To find pulse rate:

Place index and middle fingers on your wrist or neck. (Do not use your thumb). Hold fingers in place until you feel the steady beating of your pulse. When the teacher says 'go' have students count the beats for six seconds. Multiply this count by 10 to find the number of beats per second.

First, the students should take their resting pulse rate. Then have them jog in place for one minute and take another pulse rate to compare the resting pulse rate and the active pulse rate.

Divide class into cooperative groups of four by numbering off 1-4. Now, assign all roles to a number.
1 – Starters, 2 – Getters, 3 – Readers, 4 – Recorders.

Get several animal hearts from a butcher and wash them before students handle them. Cut each heart in half lengthwise, exposing as many chambers as possible. Getters will come to supply table and get one heart for their group. The Starters will point to the part of the heart the teacher is identifying and make sure that everyone sees it. The Readers will point out on the diagram which part the teacher is identifying. They will be able to observe the heart chambers, the difference between the upper and lower chambers, the openings through which blood had flowed, the muscular composition of the heart and blood vessels on the exterior of the heart. The students will identify the chambers using the diagram and the functions of each chamber. The Recorder will record the observations made by the group. The teacher writes observation questions on the blackboard:

What did you see inside the heart? (Different chambers and muscles)

How did the heart feel when you touched it? (Smooth and rubbery)
How do the different regions of the heart compare? (More muscle around the lower chambers)

The students will compare their heart rates and use the beef heart to show the route the blood flows through the heart. They will average the heart rates among their group.

Introductory Directions/Procedures:
Introduce lesson with hand activity and focusing questions. Find the resting and active pulse rate. Divide the class into cooperative groups and assign roles. Go over safety rules. Safety Rules: No sharp items left out during exploration. Make sure all students wash their hands immediately after exploration. Check with students about feelings toward handling the heart. If someone does not want to touch it, they can just observe. Wash hearts prior to handling.

Students:
1. Listen to all instructions.
2. Walk to and from supply table.
3. The heart stays on the table at all times.
4. Wash hands immediately after experiment, and use soap and water.
5. Share with everyone in your group.
6. Getters will go to the supply table and get a heart for their group. The Starters will point to the part of the heart the teacher identifies. The Reader points to the part on the diagram.
7. The teacher writes observation questions on the black-board while the students are exploring the heart.
8. The Recorders record the observations of the group.
9. The Getters return the heart to the supply table.
10. Everyone washes their hands using soap and water. The group compares heart rate with other members of their group. They discuss the flow of the blood through the heart. The teacher then disposes of the hearts in a plastic bag and closes it. The Recorder makes sure every name is on the observation paper and turns it into the teacher. The teacher asks what they have discovered and leads into explanation. Graph the average resting and active heart rates on the board.

Explanation:
What did you find out?
How many hearts do we have?
Do you think the heart plays an important role in the circulatory system? Why?
Does everyone agree?
What are some things we can do to make sure we keep our hearts healthy? (Exercise and diet)
Graph the average heart rates of each group on the board.
Calculate the average for the class. Let students determine where they fall in comparison to the average. List similarities of the beef heart to the human heart.

Each student will record for one week what they eat and the exercises they do in their journal. At school, they will determine if they are doing what it takes to keep their heart healthy. They will write an agreement from themselves to their heart to be more aware of their habits and write down some changes or modifications they want to make.

Concepts/Terms:

Circulatory system – the group of organs that carries nutrients, oxygen, and other substances to all cells of the body.
Heart rate – the rate at which the heart pumps blood through the heart.
Upper right chamber – collects blood from the body.
Lower right chamber – pumps blood to the lungs.
Upper left chamber – receives blood from the lungs.
Lower right chambers – pushes blood to the rest of the body.

Teacher Content Background:
The heart – The two halves of the heart are separated by a membrane called the septum. This wall prevents the flow of blood between the two atria or the two ventricles.

The heart pumps blood in two phases. In the systolic phase, the ventricles contract, pumping blood into the arteries. In the diastolic phase, or second phase, the ventricles relax and blood flows into them from the atria. These two phases of the heartbeat are measured when the blood pressure is taken.

The valves within the heart are one-way valves. This means that blood can flow into the heart but not back into the arteries or ventricles.

The heart is a hollow muscle. It is about the size of your fist. It is located slightly to the left of the center of your chest. The hollow inside is divided into four sections. These sections are called chambers. Two chambers are on the left and right side. Each side has an upper and lower chamber. The right upper receives blood from the body. The right lower pumps blood to the lungs. The left upper receives blood from the lungs. The left lower pumps blood to the rest of the body.

Integration With Other Subject Areas:
Math – students will calculate how many times their heart beats per minute. Hour? Day? Year?
Health – students will keep a record of heart rate for a period of two weeks to find their average. They will also create a healthy diet plan.
History – students will research the first heart transplant.
Language Arts – students will write a letter to their heart and tell what they will do to keep it healthy.
Art – students will create a poster with a message relating to the heart.

THE BEAT GOES ON WORKSHEET

My Resting Heart Rate

(when I'm calm and relaxed)

_________ beats in 6 seconds x 10 - _________ beats per minute

My Active Heart Rate

(after I've jogged in place for 1 minute)

_________ beats in 6 seconds x 10 = _________ beats per minute

Activity 2: Bird Adaptations

Students will understand and apply the concept of adaptation and its role in survival. Students will create a bird of their own and explain the bird's adaptation. Students will gain an understanding of how living and nonliving things change over time and the factors that influence the changes.

Materials:
Overhead projector
Overhead transparency of bird adaptations (create your own)
Dry-erase or chalkboard with appropriate markers or chalk
Pictures of different types of birds
Handout of bird adaptations based on overhead transparency
Blank paper
Crayons, markers, or colored pencils

Procedure:
Ask students to come to the board and write one thing they have learned about animals. After all students have had the opportunity to write, ask students, "What are some common words we see?" Students should have written answers such as "animals have different traits", "animals live in different areas", and "animals have different colors." Point out to the students the word different. Then introduce them to the lesson.

Instruct/Investigate:

1. Review the agenda for the lesson. First we will talk about a few animal adaptations together, then you and a partner will work on listing inferences you can make about the bird pictures. Finally you will design your own birds.
2. Place the transparency on the overhead and review a couple of traits from each category (beaks, feet, legs, wings, and color). Call on students to help get the class started on their list. Say to the class, "You will have approximately five minutes to work on the list."
3. Once the five minutes is up, get the students attention.
4. Tell the students, "You will now pretend you are on a great expedition. You have just seen a very unusual bird, one you believe no one has ever seen before. Unfortunately you forgot your camera. But you did happen to bring paper and pencil. Your job as explorers/scientists is to draw this bird as documentation that you were the first to discover it. When you draw your bird, you will need to make sure to label all the parts of your bird and tell the purpose of the beak, feet, legs, wings, etc. You also need to describe the habitat where you discovered the bird and give it a name, because all discoverers are given the privilege of naming their discovery." (Children may not know that the person who discovers something is the one who gets to name it."
5. Before students begin to create their bird let them know they need to plan the adaptations they will use. Once they feel they have planned well they will then draw their bird on white paper. Tell students they

will have between 10-15 minutes to create their bird and they will have to present the bird to the rest of the class.

Have students share their birds with the rest of the class. As students present, prompt students about why they chose the particular adaptations they did. Wrap up by saying "If you have not finished your bird, you may take it home to finish it and present it tomorrow."

Earth and Space Science

Activity 1: Rock Cycle Fudge

Equip two lab stations with a microwave, a large microwave-safe bowl, a large spoon, a set of measuring cups and measuring spoons. A station should be set up with the ingredients accessible to students and labeled as the various "sediments." Each group should have a can with the roles on individual slips to be drawn. Read the scenario with the students and let them draw roles.

Let the Cycle Begin!

We begin our journey through the rock cycle with sediments that have been weathered into small pieces. These sediments will come together to form sedimentary, then metamorphic rock. They will melt into magma, and finally end up as igneous rock. YOU are to play the part of the forces involved in creating and destroying rocks in the endless rock cycle. (Draw your "role" from the can.)

Roles:

Erosion	Weathering	Crust
Uplifting	Heat	
Time	Pressure	
Ocean	Plate Tectonics	

Materials:
One bowl, one spoon, wax paper, measuring cups and spoons, and the following "sediments:"

- 1/3 cup silt (Erosion) – Evaporated Milk
- 1 cup quartz crystals (Uplifting) – Sugar
- 1 Tablespoon organic sediments (Time) – Margarine
- 1 cup limestone pieces (Ocean) – Mini-marshmallows
- ¼ cup sandstone pieces (Weathering) – Pecans or Walnuts
- ¾ cup basalt pieces (Heat) – Semi-sweet chocolate chips
- ½ teaspoon crude oil (Pressure) – Vanilla extract

1. "Erosion", "Uplifting," and "Time" will measure and add the silt, quartz crystals, and organic sediments to the bowl.
2. "Plate Tectonics" will mix them thoroughly with the spoon.
3. "Heat" will place bowl in the microwave for 45 seconds, then "Plate tectonics" will stir it. Do this 3 times! (Pick up materials for the next step while this is going on.)

4. While step 3 is being done, “Weathering” will break the sandstone pieces into smaller pieces. Nuts will be “broken down” simulating weathering.
5. “Ocean,” “Weathering,” “Heat,” and “Pressure” will measure and add the limestone, sandstone, basalt, and crude oil to the bowl.
6. “Time” and “Ocean” will take turns stirring the sediments as they undergo metamorphosis, finally melting the limestone and basalt into magma. Discuss the natural processes that are being simulated.
7. “Erosion” will hold the bowl as “Plate Tectonics” uses the spoon to scrape the magma back out onto the Earth’s surface (wax paper).
8. “Crust” will add another sheet of the Earth’s surface (wax paper) over the top of the cooling igneous rocks after labeling it with student names and class period.
9. “Crust” and “Plate Tectonics” will carry the sheet of igneous rocks to a cooling area (refrigerator in the science storeroom).

Review with the students that this was a simulation of the rock cycle and that the actual cycle takes millions of years, incredible temperatures, and very high pressure. Have each group clean their areas for the next class, and arrange a time when the students can return to eat their “igneous rocks,” perhaps having a “rock party” after the quiz over the rock cycle