Chemical and Physical Change

GRADE LEVELS: Grades 4th – 7th

CONCEPTS: This is an introduction to the concepts of chemical and physical change.

OBJECTIVES: See an explosive show that highlights chemical and physical changes in daily life, and then investigate if changes are chemical or physical.

ACADEMIC CONTENT STANDARDS:
- Science: Physical Sciences: 4.1, 4.2, 4.4, 6.2, 6.3, 6.4

VOCABULARY/KEY WORDS:
- Chemical Change: a process in which one or more substances are changed into one or more different substances.
- Physical Change: a process in which the physical properties of a substance changes but the chemical composition of the substance does not.
- Chromatography: a method of separating and analyzing mixtures of chemicals. 2: the separation, especially of closely related compounds, by allowing a solution or mixture to seep through an adsorbent (such as clay, gel, or paper) so each compound becomes adsorbed into a separate, often colored, layer.
- Steganography: the art and science of writing hidden messages in such a way that no one apart from the sender and intended recipient even realizes there is a hidden message.
- Exothermic Reaction: A chemical reaction in which heat energy is given off during the formation of chemical compounds.
- Endothermic Reaction: A chemical transformation in which energy (in the form of heat) is absorbed from the surroundings.
- Conversion: Changing from one substance to another.
- Phase Change: A change from one state of matter (solid or liquid or gas) to a different state of matter.

EXTENSIONS AT COSI:
- Holiday Lights Show-Gadgets Stage (seasonal)
Fireworks Show-Gadgets Stage (seasonal)
Gadgets Show-Gadgets Stage (seasonal)
Gadgets Cafe

ADDITIONAL RESOURCES:
Secret messages for kids. Here you will discover how to decode loads of secret messages and learn how to create them yourselves.
http://www.indigoimage.com/secretmsg/

Utah state Office of education 8th grade. Enrichment & Videos dealing with Matter, Energy, Forces, Machines, and Earth
http://www.usoe.k12.ut.us/curr/Science/sciber00/8th/matter/sciber/intro.htm

Chem4kids. Connect to info about chemical & physical changes, states of matter, solutions and mixtures.

Quia Chemical & Physical change quiz. Take a 20 Question quiz that asks if these are examples of chemical or physical change.
http://www.quia.com/quiz/303980.html

About.com Chemistry. Safe Exothermic and Endothermic reactions that you can do in class.
http://chemistry.about.com/cs/genera1chemistry/a/qa051903a.htm
SAMPLE TEST QUESTIONS:

Q. Which shows a chemical change?

A. Match

B. Paper

C. Balloon

D. Ice

Q. A tightly sealed glass box has a mass of 20,000 grams and contains a 5-gram cube of ice, making the total mass 20,005 grams. The box with the ice is placed in direct sunlight. After three hours, the box appears to be empty, with just small droplets along the sides of the box.

Which statement describes the mass of the sealed box after sitting in the sun?

A. The mass decreases because the ice melted into a liquid.

B. The mass remains the same as the ice melts and then evaporates.

C. The mass increases as the gases inside the box absorb energy and expand.

D. The mass increases as the water vapor condenses into small droplets on the glass.
Q. Sharpening a pencil and tearing paper are examples of physical changes. Which statement describes why these are physical changes?

A. There is a change in how the objects are used.
B. There is a change in the appearance of the objects.
C. There is a change in the materials from which the objects are made.
D. There is a change in both the appearance of the objects and the materials from which they are made.

A teacher put a beaker of water on a hot plate. The beaker is shown before and after the hot plate is turned on.

What is the evidence that water is changing state?

A. The hot plate is turned on.
B. The temperature increases.
C. The water bubbles and the steam is visible.
D. The mass of water in the beaker increases.
Chemical and Physical Change-Pre Visit Activities

Identify Chemical and Physical Change

Key Words/Concepts:
Chemical change
Physical change

Objectives:
Students will be able to identify physical and chemical changes.

Materials:
Worksheet

Academic Content standards:
Science, Physical Sciences, 4.1, 4.2, 6.2, 6.3, 6.4
Physical and Chemical Changes

Worksheet

Name: __________________________

Fill in the blanks using the word bank:

1. In a chemical change, 
   a new substance _______ formed.
2. A physical change _______ be reversed.

Put an “X” in the correct column to indicate whether the experiment demonstrates a physical change or a chemical change.

<table>
<thead>
<tr>
<th>Chemical Change</th>
<th>Physical Change</th>
<th>Experiment</th>
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<tbody>
<tr>
<td></td>
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<td>Adding salt to warm water creates a saltwater solution.</td>
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<td>Ripping up a piece of paper produces little pieces.</td>
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<td>Adding oxygen to iron creates iron oxide (rust).</td>
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<td>Boiling water produces water vapor.</td>
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<td>Burning logs in a fireplace produces ashes.</td>
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Give two examples of a physical change:

Give two examples of a chemical change:

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Chromatography

Key Words/Concepts:
- Physical Change
- Chromatography

Objectives:
- Students will learn that pens and markers of a seemingly single color can actually be made of multiple colors
- Students will observe a physical change.

Materials:
- Coffee filters or Chromatography papers
- A wide variety of water soluble/felt tipped black pens, markers
- Shallow containers or many paper towels
- Paper towels
- Water
- Rulers
- Scissors
- Dropper or Pipette (if desired)

Procedures:
1. Cut the coffee filters, if desired into strips (about 1-2”)
2. Follow one of the two methods below:
   a. Method A:
      i. Using a felt tipped pen, make a thick circle on one of the strips about 1” from the bottom.
      ii. Pour ½ ” of water into a glass.
      iii. Dip the end of the strip with the circle on it into the glass, but make sure the water does not touch the circle.
      iv. Watch the water creep up the strip until it reaches the top of the strip.
      v. Take the strip out of the water and place it on the paper towel.
   b. Method B:
i. Using a felt tipped pen, make a design (doesn’t have to be anything fancy – could be a line or a shape or a doodle – spirals look fun) on one of the strips, leaving room at the top to write the name of the marker (don’t do it yet).

ii. Put the strip into the glass or onto several sheets of paper towels.

iii. Taking the dropper or pipette, drop several drops of water onto the design.

iv. Observe what happens

3. Write the name of the pen, using the same pen, at the top of the filter.
4. Pick a couple of other pens and markers.
5. Make some predictions as to what you think will happen.
6. Repeat the experiment with the chosen pens and markers and record your results.

Possible Interactive Questions:
Were you surprised at your results? Why?
Do you think this is a physical or chemical change?

What Happened/What’s Going On:
A “single color” ink pen or marker can be made up of a variety of other (surprising) colors. This demonstrates a physical change since no new material is made, we are simply separating the colors from one another. A component of it being a physical change is that it is reversible, and this process is reversible, but it would be a very complex process.

Further Exploration:
Try playing a game in which partners try to determine the correct pen used to write a message. Can you utilize chromatography to determine which pen your partner used to write the message?

Academic Content standards:
Science, Physical Sciences, 4.1, 6.3
Science, Scientific Inquiry, 5.3
Name: ________________________________

WORKSHEET - Chromatography

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<th>Type of Pen/Marker</th>
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Edible Ink

Key Words/Concepts:
- Chemical change
- Steganography

Objectives:
- Students will write and reveal a secret message using edible ink.
- Students will observe a chemical change.
- Students will infer why heat and time reveal the message.

Materials Per Group:
- Small Containers
- Lemon, Orange or Grapefruit Juice, Milk, Baking Soda or Sugar Solution
  - To make the baking soda or sugar solution, add a pinch of baking soda or sugar to an ounce of warm water. Mix well. Add more baking soda or sugar a pinch at a time until the liquid is saturated.
- Cotton Swabs
- Paper
- Electric Iron, Hair Dryer or some other heat source (NOT an open flame)
- Cloth Towels
- Plastic Tray

Procedures:
1. Place a piece of white paper on your tray.
2. Dip a cotton swab into one of the edible inks and write a message on the paper. Your message will be nearly invisible when it dries.
3. Answer Possible Interactive Questions below
4. When the messages are dry, allow a few at a time to take their message to the teacher. The teacher will heat the paper using the iron, hair dryer or other heat source.
5. Watch the messages appear as the paper is heated.
Possible Interactive Questions:
How can we make your message easier to read? What do the edible inks have in common? (They are all found in your kitchen, and can be used in baking). What happens when you bake cookies for too long? They burn turning brown or black. We can “bake” or “cook” our edible ink messages, which will allow us to see our secret message. How can we “bake” our messages? By heating the paper with an electric iron or hair dryer, we can make your message appear. Predict how your message will look.

What Happened/What’s Going On:
Steganography is the science of concealing that you’re sending a secret message. A popular version of this is using invisible ink. It looks like you’re just sending a blank piece of paper (or you can write an innocuous note on it in regular ink and no one would be the wiser). What we’re seeing here is a chemical change. A chemical change occurs when a new substance (in this case the burnt revealed message) is formed and energy is either given off or absorbed.

Further Exploration:
Make hypotheses as to what will happen when you make secret messages with each of the other inks.

Academic Content standards:
Science, Physical Sciences, 4.2, 6.2, 6.4
Name:

WORKSHEET-Edible Ink

<table>
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Chemical and Physical Change-Post Visit Activities

Sugar/Salt Crystals

Key Words/Concepts:
- Physical change
- Phase change
- Crystal

Objectives:
- Students will observe and identify physical changes and see how a physical change can be reversed.

Materials:
- Clear jar or other clear containers
- Popsicle stick or other straight object, long enough to lay across the top of the clear jar/container
- Yarn or rough string
- Hot/warm water
- Sugar and/or Salt
- Teaspoon
- Cup
- Windowsill or other location that gets sunlight

Procedures:
1. Put warm or hot water (as hot as you can get if from the tap or you can boil it if you wish) into a clear container and add one teaspoonful of sugar or salt and stir until it has dissolved.
2. Continue to add teaspoonfuls, stirring in between, until solution is saturated (there will be a small layer of sugar or salt on the bottom of the container).
3. Tie a piece of yarn or rough string around the middle of the popsicle stick (these work well because they can’t roll off the jar top. If you use a pencil or other round object, you may have to use tape or clay to anchor the pencil so it doesn’t roll off). The piece of yarn should reach almost to the bottom of the clear container (but not touching the bottom).
4. Place the Popsicle stick with string over the top of the clear container and place entire apparatus in a windowsill where it will get sunlight.

5. Check on the apparatus periodically through the next couple of weeks. What do you notice?

Possible Interactive Questions:
Why do you think we’re putting the jar in the sun?
What do you think will happen when the sunlight heats the salt/sugar water?

What Happened/What’s Going On:
There are two physical changes occurring. The first is the dissolution of the sugar or salt into the water. The second is then the evaporation of the water in the sunlight (a phase change), which separates our water and sugar or salt again, showing that physical changes are reversible.

Academic Content standards:
Science, Physical Sciences, 4.1, 6.3
CHECKING FOR STARCH

Key Words
- Starch test
- Conversion
- Chemical change
- Inference

Objectives
- Students will observe what happens to the iodine when it is applied to ripe and unripe apples.
- Students will infer that as fruit ripens, the starch which is present in unripe fruit changes to something else (sugar).

MATERIALS:
Per room:
- 1 potato for demonstration purposes
- Ripe apples – enough for each student to have a slice
- Unripe apples – enough for each student to have a slice

Per student:
- 1 plastic pipette
- 1 small artists brush
- 1 small paper plate
- 1 golf pencil

Per group:
- 1 bin or tote
- 1 bottle of iodine in non-spill bottle
- wet wipes

PROCEDURES:

1. Slice the unripe apple horizontally into enough slices so each participant has one slice. This can also be done ahead of time by the teacher. If you soak the slices in lemon-lime soda, they won’t brown (yet another experiment for another time). Do the same with the ripe apples. Make sure to keep them separated.
2. Have the students mark the left side of their plates with a “U” and the right side of their plates with an “R.”

3. Distribute the slices so that each student has one slice of ripened apple and one slice of unripened apple. Make sure that they keep track of which apple is which! (To help with this, you may want to hand out the unripened slices first then go onto step 3, then distribute the ripened slices before proceeding to step 4).

4. Ask each participant to take a small bite of the unripe fruit (leaving about half of the slice for performing the experiment), then put the remaining piece of fruit on the left side of their paper plate.

5. Now, taste the ripe fruit (again, leaving about half of the slice). Put the remaining piece of ripe fruit on the right side of the paper plate.

Possible Interactive Questions:
Did the two slices taste the same? How did they differ? (Hopefully someone will say that the ripe fruit tasted sweeter.) What causes things to taste sweet? (Sugar) Which apple had more sugar in it? What do you think might be in the unripe apple instead of sugar?

6. Cut a fresh slice from the potato and paint with iodine. Iodine turns dark when it reacts with starch.

7. Ask the students to make predictions as to what will happen to each slice when they paint iodine on them.

8. Have each participant take small paint brush and paint iodine onto the remaining section of each slice of apple.

9. Make observations.

Possible Interactive Questions:
What happens to the iodine? Does the color remain the same? We know that when there is starch present, iodine will change to a deep purple. Did the iodine on anyone's slice of ripe apple change to purple? Did the iodine on anyone's unripe slice change to purple? What is present in the unripe fruit that isn't present in the ripe fruit? (starch) What did we taste in the ripe fruit that we didn't taste in the unripe fruit? (sugar). What change do you think takes place when fruit ripens? (the starch changes to sugar--this won't work with storage apples). Is this an observation or an inference?

What Happened/What’s Going On:
As apples ripen, the starch turns into sugar, giving ripe apples a sweeter taste than unripe apples. The turning of starch into sugar is an example of chemical change. Also, in some freshly picked apples, you can see in the center of the apple there is no color change, because the starch there has been converted to sugar. However, along the outer edges, where the starch has not been converted, the iodine will change color.
COMMENTS: Do not use the term "green" when talking about unripe apples. This could be confusing, especially to the younger participants, since some apples, such as Granny Smiths, are green in color even when they are ripe.

Academic Content standards:
Science, Physical Sciences, 4.2, 6.2, 6.4
Science, Scientific Inquiry, 6.3
Plaster of Paris

Key Words/Concepts:
• Chemical change
• Physical change
• Exothermic

Objective:
• Students will differentiate physical and chemical changes by doing an experiment.
• They will also learn what an exothermic reaction is.

Materials:
• Plaster of Paris
  WARNING: Do not inhale powder or to get any of it in your eyes.
• Styrofoam cup(s) for mixing
• Mixing utensil, such as a stir stick, popsicle stick or plastic spoon
• Water
• Object(s) to plaster, such as inflated balloons or boxes
• Newspaper cut into 2” strips
• Thermometers
• Worksheets

Procedures:
(Note: This activity can either be performed as a demonstration for the class or as a hands-on activity. You must be very careful handling the plaster of paris. Depending upon your class, you may want to demonstrate the first part in front of the class, mixing the plaster of paris (you can make several little batches), and then split the class into smaller groups and have each group work on plastering an object.)
1. Have the students make a hypothesis of what they think will happen when the water is mixed with the powder.
2. Measure the temperature of the water and the temperature of the powder and record them on the board.
3. Mix the water in with the plaster of paris (about 1 c. of powder to ½ c. of water)
4. WARNING: Do not touch plaster. (It will get hot!)
5. Record the temperature every 5 minutes for 25 minutes. What is happening?
6. Then take newspaper strips and dip them in the plaster and cover the object(s) with them.
7. Let the object(s) dry overnight. What happened?

Possible Interactive Questions:
What do you think will happen when we mix the powder with the water? Do you think that the mixture of the powder with the water is a chemical or a physical change? Why? Is the temperature increasing or decreasing at a steady rate? What do you think this tells us?

What Happened/What’s Going On:
When the water is mixed with the plaster, a new substance is formed with new properties, meaning that this is a chemical change. One piece of evidence of this chemical change is that heat is given off. When a reaction produces or gives off heat, it is called an exothermic reaction. When the newspaper strips are dipped in the plaster of paris, no new substance is formed (we still have newspaper strips that happen to be covered with the plaster), so this is a physical change.

Academic Content standards:
Science, Physical Sciences, 4.1, 4.2, 6.2, 6.3
Science, Scientific Inquiry, 4.1, 4.3, 5.1, 5.3, 6.2
Mathematics, Data Analysis and Probability Standard, 4.2, 6.2