ChromaCool!

Summary

These activities give students the opportunity to compare a physical and chemical change that both involve a change in color.

Materials

Activity #1

Coffee filter paper
Blue and green food coloring
Clear plastic cups
Water
Pencil
Colored pencils

- *Physical or Chemical Change?*

Plastic plates
Toothpicks

Activity #2

Red cabbage juice indicator
Lemon juice
Clear plastic cups
Baking soda
Safety goggles
Toothpicks
Sharpie markers
Pipettes
Alka Seltzer tablets (optional)

- *Physical or Chemical Change?*
- Experimental Design Sheet

100ml or 200ml graduated cylinder

Additional Resources

Books

- *Kitchen Chemistry*
, by John B. Bath, Ph D. and Sally C. Mayberry, Ed.D. ISBN 4-4222-1137-6
- *Chemistry Matters*
, AIMS Education Foundation, ISBN 1-3203-03-06
- *Simple Science Experiments With Everday Materials*
, by Muriel Mandell ISBN 0-8069-5764-6
- *Hands--On Physical Science Activities*
, by Marvin N. Tolman ISBN 0-13-230178-4
- *Science Experiments You Can Eat*
, by Vicki Cobb ISBN 0-06-446002-9

Videos

- *Chemical Reaction*
, part of the Bill Nye The Science Guy Classroom Edition, by Disney
http://dep.disney.go.com/educational/index Item #77AO7VLLOO

Organizations

The Children's Museum Of Utah, 840 N. 300 W. SLC, UT, 801-322-5268, www.childmuseum.org

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Background for Teachers

The purpose of conducting these activities together is to give students the opportunity to compare a physical and chemical change that both involve a change in color. Students often generalize that a color change is always an indicator of a chemical change. It is helpful to introduce them to the concept of "expected" and "unexpected" color changes. In other words, when red coloring is mixed with water, you expect the water to turn red, when you use a blue marker on paper, you expect the mark on the paper to be blue. These expected changes in color usually indicate a physical change. Unexpected changes in color such as red cabbage juice and ammonia turning green or bromphenol blue turning yellow in the presence of an acid are usually chemical in nature. It is important to reinforce that physical changes are reversible and new substances are not formed. Chemical changes in matter involve the formation of a new substance.

Students will use the *Physical or Chemical Change?* checklist as they conduct each investigation. It is helpful to make two copies of the checklist so they can compare observations from the two investigations.

In the first activity students mix colors and then use a process called chromatography to separate colors. Color particles (molecules) separate according to size and solubility. Mixing and separating colors is a physical change.

In the second activity, red cabbage juice is used as an indicator to determine if certain substances are acids or bases. The red cabbage juice acts as an acid/base indicator. Red cabbage juice turns different colors in the presence of acids and bases, creating a chemical color change.

Intended Learning Outcomes

1. Use Science Processes and Thinking Skills
5. Understand the Nature of Science

Instructional Procedures

Invitation to Learn

Show students an uncapped dry erase marker and ask them what color of mark it will leave on the whiteboard. Make a mark on the whiteboard and point out that the color they expected appeared on the whiteboard. Repeat the same type of questioning using nail polish. Refer to or repeat the Alka-Seltzer bromphenol blue activity. Was the bromphenol blue and water solution turning yellow in the presence of an acid an *expected* or *unexpected* (surprise)color change?

Instructional Procedures

Activity 1

Make a crease about three centimeters from the end of a coffee filter strip (about two point five centimeters wide), by folding the strip. Students will skim the creased section of the strip through a drop of blue food coloring. It is important that students avoid getting too much food coloring on the strip. A color spot can be used in place of a color stripe by using a toothpick to make a color dot on the filter. Hang the strip of filter paper from a pencil over a glass of water (about one-fourth full) Hang the coffee strip from a pencil so that the colored line is about five centimeters above the water line. When hanging the filter strip from the pencil, put the color strip or dot end of the strip furthest from the pencil. Hang the strip of filter paper into a cup of water (about one-fourth full). The bottom of the filter should be in the water, but the ink should not go below the surface of the water. Allow the strip to dry.

Illustrate observations in student journals. Repeat the process using yellow food coloring. Allow the strip to dry.

On a plastic plate, instruct students to use a toothpick to mix one drop of blue and one drop of yellow food coloring.

Discuss how and if it is possible to separate or unmix the colors. (Repeating the same process used in Steps 1 and 2 with the droplet made from blue and yellow food coloring). How will we use the results to determine if mixing dyes to create a new color is a physical or chemical change? (if the colors separate into blue and yellow, we can conclude that mixing color dyes is a physical change.) Allow adequate time for the strip to dry.

Students make and record predictions in their science journals. Students will illustrate their observations in their science journals using colored pencils.

Using the *Physical or Chemical Change?* checklist and discussion, determine if mixing colors is a physical or chemical change.

Activity 2

Each group of two to three students will pour 30 mililiters of red cabbage juice into a cup labeled "A" and 30 mililiters of red cabbage juice indicator into a cup labeled "B".

Fill a separate cup with 30 mililiters cup of water labeled "C"

Place two Alka Seltzer tablet or into cup "C" or two and a half tablespoons of baking soda and wait for it to dissolve.

Use a pipette to place five drops of Alka Seltzer solution from cup "C" into cup "A". Swirl if necessary. Record observations on *Physical or Chemical Change?* checklist.

Place a dropper full of lemon juice into the indicator in cup "B". Record observations on *Physical or Chemical Change?* checklist.

Read the ingredients from the Alka Seltzer box to the students. Sodium bicarbonate (baking soda) is a base and citric acid is an acid found in fruits such as lemon and oranges. Think about the way Alka Seltzer works in your stomach. Citric acid and sodium bicarbonate form a weak base to ease the discomfort in your stomach caused by excess acid.

Extensions

Curriculum Extensions/Adaptations/Integration

Markers can be used in place of food coloring for a quick way to offer more practice for students struggling with the concept of a physical change that involves a color change and can be reversed.

Challenge students to experiment with other solutions and determine if they are acids or bases.

Design an experiment to compare different brands of (washable/non washable) markers to see which separate through chromatography.

Paper or cloth tie-dyeing is a great way to observe the physical change of mixing colors and dye use.

For extra practice with chromatography and physical changes, the following investigation can be used:

Explain to students that will try to separate the colors that make up the candy shells. Ask, "Do you think candy makers use a chemical or physical reaction to color candy shells?" If a prompt is necessary, you can ask them to think of a time they may have touched candy with wet hands and what happened? The only materials required for this activity that were not used in Activity 1 are Skittles and table salt.

Each group will:

Cut the coffee filter paper into a eight centimeters by eight centimeters square.

Draw a pencil line about 1 cm from the edge of the paper.

Make six dots with the pencil equally spaced along the line, leaving about 0.5 centimeters between the first and last dots and the edge of the paper.

Below the line, use the pencil to label each dot for the different colors of candy that you have. For example, "Y" for yellow.

Each group will make solutions of the colors in each candy with these steps:

- Take a 20 centimeters by 10 centimeters piece of aluminum foil and laying flat on the desk. Using pipettes, place six drops of water spaced evenly along the foil. Place one color of candy on each drop. Wait about a minute for the color to come off the candy and dissolve in the water.
- Remove and dispose of the candy
- After all of the color spots on the filter paper have dried, go back and repeat the same process with the toothpicks to get more color on each spot. Do this three times, waiting for the spots to dry each time.
- When the paper is dry, fold it in half so that it stands up on its own, with the fold standing vertically with the dots on the bottom.

Stop and discuss, using the Physical or Chemical Change? Checklist, if the color dissolving on the paper a physical or chemical change? Why?

Next we will make a developing solution.

- Measure a teaspoon of salt (1 cm3) and a liter of water and put them in a well rinsed two-liter bottle. Screw on the cap and shake the contents until all of the salt is dissolved in the water. This will make a one percent salt solution. Refer to the Solar Still activity and ask, "Is mixing salt and water to make a solution a chemical or physical change?"
- Pour the salt solution into a tall clear glass to a depth of about 0.5 centimeters. The level of the solution should be low enough so that when you put the filter paper in, the dots will initially be above the water level.
- Have the students predict what they think will happen when the filter paper with the dots at the bottom is set in the salt solution. Test predictions. When the salt solution is about one centimeter from the top edge of the paper, remove the paper from the solution. Lay the paper on a flat surface to dry.
- Record predictions and observations in journals. Allow students to use colored pencils to make diagrams of their observations. Compare the spots from the different candies, noting the similarities and differences.

Family Connections

- Use chromatography to separate the colors in products like food coloring and Kool-Aid.
- Look at a variety of recipes that call for baking soda and a type of acid-based ingredient. Think about the chemical reaction of Alka-Seltzer to explain why a recipe would call for both ingredients.
- Make a red cabbage juice indicator and with the help of an adult test various household items to determine if they are acidic or basic.

Assessment Plan

- Design an experiment to demonstrate how Alka Seltzer neutralizes acids in the stomach. Challenge students to design and carry out an experiment in a separate cups "D" and "E" to try various combination amounts of lemon juice (representative of the citric acid in Alka Seltzer) and baking soda (representative of sodium bicarbonate found in Alka Seltzer) to produce a weak base. When added to red cabbage juice indicator, the base (color) should resemble the base formed by Alka Seltzer. Refer to cup "A" as a model to measure by. Students must plan their experiments before conducting them, following the steps of the Scientific Method. This can be done in their science journals. They will use the *Experiment Design Sheet* to record each trial. Lemon juice amounts will be measured in drops and baking soda amounts by toothpick scoops. While you won't explicitly point this out to students that the goal is to use lemon juice and baking soda to produce the color of the solution in cup "A".
- Design an experiment after completing Activity 1, and change the variables (e.g., colors,

temperatures of water, using pure water vs. salt water). Students must note, follow, and use each step of the Scientific Method in their journals when designing and conducting the experiments. Compare the checklist used for Activity 1 to the checklist used for Activity 2. Then write or verbally explain how you could help another student understand the difference between a change in color as a result of a physical change and a change in color as the result of a chemical change. Use *Experiment Design Sheets* .

Bibliography

Hackling, M.W. (Mar2000). Using open investigation for improving scientific literacy. *Professional development*, 16.1, pp. 2-4.

One of the assessments in this activity involves a student conducting open investigation. In open investigations, it is the student who plans and conducts the investigation. The teacher sets the context and introduces the problem, but the students work in small groups to plan and conduct their own investigations. Open investigations can be scaffolded for students using questions, prompts, and/or report sheets. Report sheets, such as an Experiment Design sheet used in this activity help guide students through the decision making steps of an investigation and elicit from students information about their thinking and doing at each phase of the investigation. Open investigations are useful in gaining insight into students thinking and reasoning.

Marzano, R., Pickering, D., Pollock, J., (2001) *Classroom instruction that works*, Alexandria, VA.ASCD

This text covers multiple research based strategies for increasing student learning and achievement. Explicitly teaching similarities and differences in relation to what students are learning "enhances their learning and ability to use knowledge." As encouraged in this text, these activities were designed to include both teacher and student directed opportunities to identify similarities and differences in chemical and physical changes. Research indicated that classifying is a "highly effective" form of comparing similarities and differences. Students use the *Physical or Chemical Change?* checklist to help guide them through the comparison process and eventually classify the reactions they observe.

Authors

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