5th GRADE
PHYSICAL AND CHEMICAL TESTS

Summary: Students investigate 5 unknown white powders. They gather clues by observing the physical and chemical changes of the powders. At the end of the activity, students use their recorded observations to guess the identity of the 5 powders.

Intended Learning Outcomes for 5th Grade:
1a. Observe simple objects, patterns, and events and report their observations.
1d. Compare things, processes, and events.
1h. Predict results of investigations based on prior data.
3a. Know and explain science information specified for the grade level.
3b. Distinguish between examples and non-examples of concepts that have been taught.
4a. Record data accurately when given the appropriate form.
4b. Describe or explain observations carefully and report with pictures, sentences, and models.
4c. Use scientific language in oral and written communication.

Utah State Core Curriculum Tie:
Standard 1 Objective 2:
a. Identify the physical properties of matter.
b. Compare changes in substances that indicate a physical change has occurred.
c. Describe the appearance of a substance before and after a physical change.
Standard 1 Objective 3:
a. Identify observable evidence of a chemical reaction.
d. Compare a physical change to a chemical change.

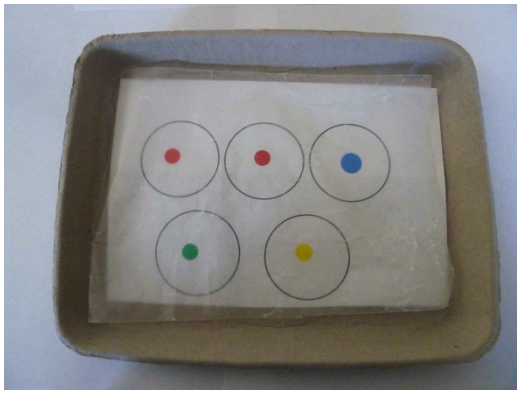
Preparation time: 1 hour
Lesson time: 1 hour initially and 40 min follow up lesson
Small group size: Works best with one adult for every 5 students.

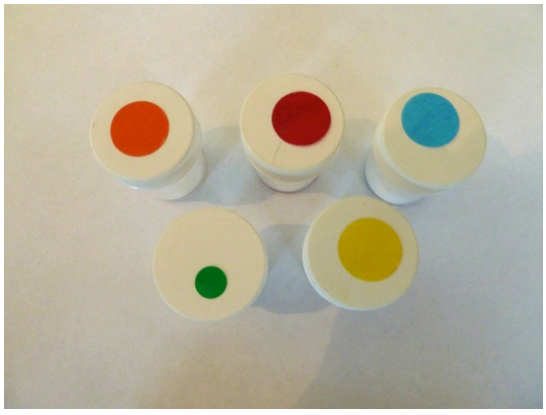
Materials: All the materials, and many more, may be obtained when purchasing the STC Program: Chemical Tests Unit Kit, 972101AV, Carolina.com, $779.95. This kit also includes more curriculum ideas than are found in this adapted version of the lesson. The materials below are required for this version of the lesson found in the Chemical Tests Kit. Unless noted all materials are from Carolina.com.
1. sugar, cornstarch, baby powder, alum, baking soda
2. cardboard paper tray, pack of 20, 972109, $5.95
3. toothpicks
4. red cabbage jiffy indicator, WCJI – 100, stevespanglerscience.com, $9.99, make 50 ml of solution as per directions, will need to be remade each year

5. iodine from drugstore, dilute it down about 1/10, store in a dark container, will need to be remade each year
6. very small plastic spoons, pack of 80, 972121, $4.95, 5 spoons per group
7. 60 mm petri dish (or larger is fine if you already have them), 972134, pack of 40, $10.95, 5 dishes per group
8. wax paper
9. jar, ½ oz. with lid, pack of 80 with color coded dotes needed for the lab, 972119, $29.95, 5 jars per group filled with the powders
10. 65 mm plastic funnels, amazon.com, Karter Scientific 210S3 65 mm, pack of 25, $11.99, 5 funnels per group
11. graduated 1 oz. cup, pack of 80 with assorted color coded dots, 972133, $4.95, 5 cups per group
12. small coffee filters, grocery store, 5 per group
13. bottle dropper, pack of 114, 972129, $31.95, 4 bottles per group

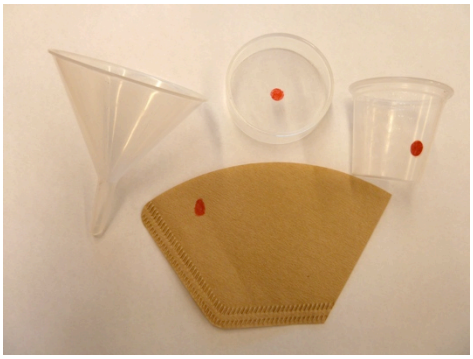
Alternatives to purchasing most of the materials: Cardboard trays are nice but not necessary. Cabbage juice indicator can be made – there are many directions on the Internet. Regular plastic spoons can be used in place of small ones. Small bowls or containers can be used in place of petri dishes. Samples can be placed on the table in bowls instead of the small jars. Instead of funnels, students can just hold the filter papers with their hands as they drip their contents into bowls or petri dishes. Instead of bottle droppers, liquids can be measured out with any small jars and water droppers.

Preparation: Much of this preparation will only need to be completed once. Most materials can be used again in the future.
1. Copy 5 of the 'sample circles for the paper trays' document. Cut the papers in half. Place each half in a cardboard paper tray. Place one colored dot on each circle in the tray. (orange, red, blue, green, yellow) Cut and lay a piece of wax paper over the circles of the color-coded tray. Each group needs one tray with extra cut wax papers.





2. Place the powders in color coded small containers: sugar – red, green – baby powder, blue – baking soda, yellow – alum, orange – cornstarch. Put a sticker on the lid and the side of the container so they do not get switched. Maintain these color codes throughout the experiments.



3. Prepare cabbage juice and iodine. Pour vinegar, cabbage juice, and iodine into the small dropper bottles that are labeled as to their identity. Fill a dropper bottle of water as well. Prepare 6 bottles of each liquid if dividing your class into 6 groups.
4. Label small containers, filter papers, and petri dishes with the colored stickers. If you have 6 groups you need 6 containers, 6 filter papers, and 6 petri dishes for **each** color.

Background information:

A **physical change** occurs when the appearance of a substance changes but its chemistry remains the same. No new substance is formed in a physical change. For example; water changing from a solid to a liquid to a gas, paper being crumbled, and mixing salt in water are all physical changes.

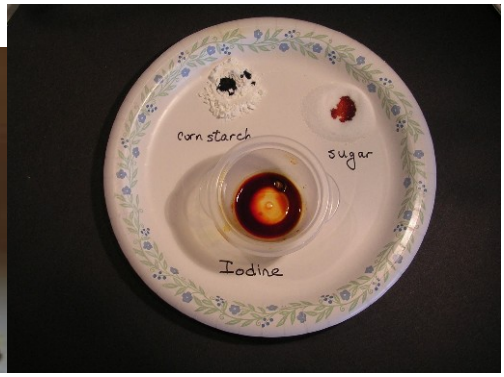
A **chemical change** occurs when bonds are broken between atoms and rearranged into new, entirely different substances. For example; burning a log, frying an egg, and mixing vinegar and baking soda are all chemical changes.

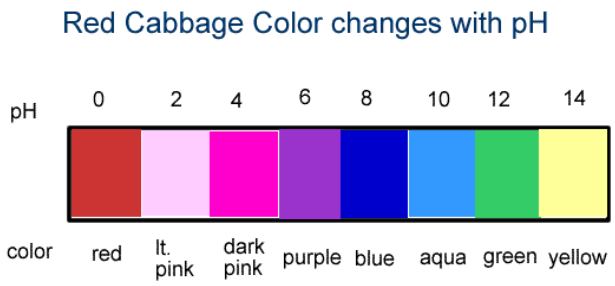
When water mixes with a powder a physical change occurs. A **solution** is a mixture with all the parts uniformly mixed. Powders are no longer seen in the water in because the powder dissolves and the solution is clear. A **suspension** is a mixture when the parts are not mixed evenly throughout. Suspensions are cloudy. We will separate our mixtures with filtration. Suspensions have the unknown remain in the filter but solutions have the unknown move through the filter paper into the petri dish.

Crystallization occurs when individual particles of a substance arrange themselves in an orderly repetitive pattern. After sugar or alum is added to water the crystals dissolve and form a solution. When the solution is left to **evaporate**, crystals form. What happens is that as the water molecules leave the solution, the sugar or alum molecules become concentrated and form crystals in a regular

pattern. In this lab, the alum crystals are beautiful and tend to form a hexagonal shape. The sugar crystals sometimes form a sticky layer on the bottom of the dish and form less regularly shaped crystals. (The first picture is of alum crystals and the second is sugar crystals.)

Signs of a chemical change include: production of a gas, color change, temperature change, or light formation. **Vinegar** is a weak acid and baking soda is a weak base. When vinegar is added to baking soda, carbon dioxide is produced and bubbles can be seen coming off the powder. Since carbon dioxide is a new chemical that is produced; this is a chemical change. **Iodine** tests for the presence of starch. When iodine is added to the cornstarch a new starch - iodine complex forms that has a purple black color. Since the complex is a new chemical, a chemical change occurred. **Red cabbage juice** is an acid/base indicator. Cabbage juice naturally changes color according to pH: red for acidic solutions, neutral solutions are purple, and basic solutions are blue or green. In this experiment, alum is a weak acid and baking soda a weak base. Therefore, alum turns light purple and baking soda turns blue.





Pre-lab discussion: Explain to the students that they are going to be science detectives. They will be given 5 mystery powders and investigate clues that are either physical or chemical to predict the identities of the powders. Explain the background information for the lab and let them begin.

Instructional procedure: For a class of 30, prepare for 6 groups with 5 students each. Designate one student in each group to be in charge of one color throughout all the experiments. Use one cardboard tray per table with all the observations being taken off that one tray.

I. Physical properties - studying the physical properties of the unknowns.

1. Each student puts a level scoop of their unknown onto the correctly labeled spot on the tray. Have the students study each unknown with a hand lens and a toothpick. They can touch each unknown to see how the granules feel. To smell the powder, they should place a small amount on their finger and waft the smell towards their nose. **Do not directly sniff the powders or taste them!**

2. Students should write their observations on the 'mystery powder investigation' data sheet. They should be describing the powders with words such as: white, crystals, powder, no smell, powdery smell, soft, hard, rough, smooth, breakable etc… All of these descriptor words are describing the physical properties of these powders.

II. Physical changes – Describe how the powder physically changes when you add water to it.

1. Add six drops of water to each powder spot. Use a toothpick to mix the water and the powder. Add a few more drops if necessary. Record observations. Students may use words such as: looks like clay, bubbles, sticky, dissolves, disappears, cloudy, mixes easily, doesn't mix easily, etc… These are physical property descriptors on how the powder physically changed when water is added to it. Throw this wax paper away.

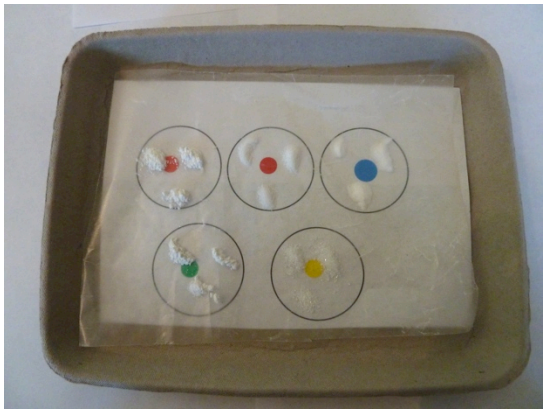
2. Fill water to the 10 ml line on the small cup. Add one level scoop of each unknown to the correct cup. Stir the mixture with a toothpick for 30 seconds. Add one more level spoonful of each unknown to the correct cup. Mix again. Observe whether each unknown dissolves and disappears into the water or remains cloudy. Students should write their observations of solution or suspension on their sheet.

3. Each student needs a filter paper, filter, and petri dish with the correct color sticker on it. Filter each solution by pouring the liquid into a filter containing the filter paper and held over the petri dish. The petri dish will collect the liquid that comes out of the filter. The filter paper will collect the powder that didn't dissolve in the water. Stir the solution before it is poured into the filter and hold the filter paper over the Petri dish until liquid no longer comes out of the filter.

4. Place the Petri dishes and filter papers on a piece of paper with the names of all the group members on it. Put these papers and equipment on the windowsill until the follow-up lesson. The follow-up lesson can take place when the liquid has all evaporated and crystals form in the yellow and red petri dishes. The columns on the data table for powder presence in the paper and crystals in the petri dish will be completed during the follow up lesson.

III. Chemical changes - Some of the powders react with vinegar, iodine, or red cabbage juice indicator. If there is a chemical change students will see a color change or bubbles due to gas formation. These are indicators that new chemicals have been formed.

1. Put a new piece of wax paper on the tray. Put three separate small scoops of each powder on the same circle with the correct color position. Add 3 drops of vinegar to one of the piles of each powder and have students write down their observations. Students may use words like dissolves, bubbles, cloudy, etc…. When the solution bubbles it is due to carbon dioxide being produced (baking soda - blue). This is a chemical change.



2. Repeat the experiment with iodine. Write down their observations with words such as dissolves, still the color of iodine, turns purple-black, etc… The purple-black color indicates the presence of starch (corn starch - orange). This is a chemical change.

3. Repeat the experiment with red cabbage juice. Write down their observations with words such as turns blue, turns light purple, liquid is color of juice, etc… Red cabbage juice tests for the presence of an acid or a base. Light purple indicates an acid (alum - yellow) and blue indicates a base (baking soda - blue). If a color change occurs, this is a chemical change.

IV. Follow-up lesson – After about 1 week the crystals should have completely formed.

1. Students should sit with the same group of students and retrieve their data tables, filter papers, and petri dishes from the previous experiment.

2. Students can now complete their data tables by observing if there is any powder or crystal left in the filter paper. They should look for the presence of crystals or powders in the petri dishes. The alum and sugar should have formed crystals in the petri dish and left very little crystal in the filter paper.

3. After students complete their data tables they should use their information to complete the "What am I?" mystery riddle page. Students can complete this individually or in groups and check if their identifications are correct. If incorrect, they should analyze their data again and make new predictions.