Mystery Powders

Grade Level: 5

Standards:
1a. Students know that during chemical reactions the atoms in the reactants rearrange to form products with different properties.
1f. Students know differences in chemical and physical properties of substances are used to separate mixtures and identify compounds.
1g. Students know properties of solid, liquid, and gaseous substances, such as sugar (C₆H₁₂O₆), water (H₂O), helium (He), oxygen (O₂), nitrogen (N₂), and carbon dioxide.

Description: Students will learn about chemical reactions and physical changes through their investigation of several mystery powders.

Objectives: Students will be able to:
1. Use touch, smell, and sight, to hypothesize what they think each unknown powder is.
2. Work as a team to gather and record information.
3. Correctly identify the unknown powder by testing each powder.
4. Complete each experiment in a safe and responsible manner.
5. Explain the concept of change, both physical and chemical.

Materials:
- Three unknown powders (baking soda, corn starch and baking powder) in salsa cups or small short Styrofoam cups, labeled A, B and C respectively.
- Nine test tubes (or nine salsa cups) per group
- Three 7.5” wooden coffee stirrers per group (used as a spatula)
- magnifying lenses (optional)
- test tube rack
- three disposable plastic transfer pipettes (you can cut them shorter to stabilize them in the cups of vinegar, water, iodine solution)
- vinegar in a labeled salsa cup
- dilute iodine solution* in a labeled salsa cup
- water in a labeled salsa cup
- Sharpie, permanent ink marker

*Make the dilute iodine solution using Strong Tincture of iodine available in Longs drug stores or on-line. It is a reddish brown solution, ingredients: ~7% iodine and 5% potassium iodide. Fill a small (5-12 oz) clear juice bottle with water, add drops of iodine until the water turns the color of filtered apple juice – for best results the solution should be made fresh – the solution is sensitive to light and will degrade over time – it will have a longer shelf life when stored in a dark bottle.

Safety: Iodine solution is often used as a topical antiseptic or disinfectant. Students will be using a very dilute solution of iodine. It is generally non-irritating to the skin but may cause eye irritation. Spills must be cleaned up immediately. In case of contact with skin, rinse with plenty of water and wash thoroughly with soap and water.

During the lab, there will be NO eating or drinking allowed. Wash your hands with soap and water after you complete the experiment.
Background:
1. As an introduction to this lesson students will take a pre-video test on the first five minutes of the video All About Properties of Matter. Students take the quiz answering with a light pencil mark. Language learners are given extra time to look up all the vocabulary needed to understand all the questions on the quiz while other students complete a math worksheet or some other assignment that language learners can complete at home.
2. As they watch the video, they are required to correct their answers before turning in the quiz for a final grade.
3. Do Baking Soda/Vinegar activity before doing this lesson.
4. Have students do background reading about chemical and physical properties and about starches before this lesson. An interesting article for students to read is Keeping Energy Levels: Emphasize Starchy Foods  http://www.urbanext.uiuc.edu/hsnut/hsath1c.html.
5. From student textbook or other sources summarize the evidence of a chemical reaction: a change in temperature, gas is produced, light is produced, a change in color, a precipitate forms.
6. Before this lesson, demonstrate that iodine is an indicator for starch. Pick several foods, which can include rice, wheat, corn, potatoes, or pasta and have students predict if a food has starch in it before dropping a few drops of diluted iodine on it. Depending on how diluted your iodine is any food that has starch will turn purple or black. Ask students to write in their journal which foods contain starch and how they know this. You may want to include some foods that do not have starch, such as an apple.
7. Hand out copies of the fill-in the blank Chemical Properties song and then play the song several times as the students make corrections. www.musicallyaligned.com

Vocabulary:
react: to undergo a reaction.
reaction: a process involving changes of substances. (a process that changes the molecular composition of a substance by redistributing atoms or groups of atoms without altering the structure of the nuclei of the atoms).
bubbles: a thin film of something, usually spherical-shaped and filled with air or a gas
vigorous bubbling: strong, energetic or active bubbling
foam: a mass of bubbles of gas or air on the surface of a liquid
foaming: to produce a mass of bubbles
dissolve: to cause to pass into solution: dissolve salt in water
violet: a deep purplish-blue color like that of a violet flower
purple: a dark red-blue color; purple is formed by combining red and blue
solubility: the extent to which one substance is able to dissolve in another
fizz: to produce bubbles of gas
fizzing: the sparkling quality of a drink caused by bubbles of gas (e.g. carbonated drinks)
foamy: covered with, full of, or consisting of foam
Procedure:

1. Hand out a copy of the chemical reaction data table to each student.

2. **Demonstrate** how to take a very small amount of one of the powders on the end of the wooden spatula and put it in a test tube. Using the sharpie permanent ink marker, students label the test tube A, B or C for each of the unknown powders – they write the letter directly on the test tube. Show students the plastic transfer pipette they will use to add a few drops of water, vinegar or iodine. For each reaction, they are to record all the different phases of the reaction: 1<sup>st</sup> – their initial observation of the reaction, 2<sup>nd</sup> – record how the reaction progresses, and finally – record their observations when no further changes appear to occur.

3. On a food service tray, give each group 3 plastic transfer pipettes, 3 wooden coffee stirrers (7.5” long), 9 test tubes in a test tube rack, a sharpie pen, and ~2 tsp of each powder in salsa cups labeled A, B or C (A for baking soda, B for corn starch and C for baking powder).

4. **Show** students how to look at their reaction data table and label their test tubes using the sharpie marker. One test tube should read A and H₂O, another test tube should read B and H₂O, etc. Once they have finished labeling their test tubes tell them that they will be testing the first column, reactions with water.

5. Students use the end of a wooden spatula, to place a small amount of each powder into the correctly labeled test tubes. After you have verified that students have correctly placed samples in each of the test tubes, pass out the first liquid, water, in a labeled plastic salsa cup. Warn students that the most exciting reactions will come with the later liquids and they must follow instructions and work together to be given the vinegar and the iodine to finish their testing.

6. Using the transfer pipette students add 4 to 5 drops of water to the first three test tubes labeled A + H₂O, B + H₂O and C + H₂O. If they observe no reaction, add a few more drops of water. They must have the first column filled in before they are handed the vinegar to test. The vinegar is provided in a labeled plastic salsa cup. Provide the iodine solution last, in a small salsa cup. After all tests are complete, students answer the questions on the worksheet.

Assessment:

Students will be evaluated on how well they fill in the table and answer the questions on the worksheet. The following day write the following question on the board and ask students to answer it either on their worksheet or in their journal: **If baking powder is made of two ingredients what are they and how do you know?**

Extension:  Write the following equations on the board. For each equation, ask students if it is a chemical reaction or a physical change:

1. Boiling water in a teakettle: \( H₂O \ (l) \rightarrow H₂O \ (g) \)

2. When you put hydrogen peroxide, \( H₂O₂ \ (l) \), on a cut what do you see? Bubbles. Hydrogen peroxide is a liquid. What state of matter are the bubbles? Gas. The bubbles are due to the formation of \( O₂ \ (g) \). \( 2 \ H₂O₂ \ (l) \rightarrow 2 \ H₂O \ (l) + O₂ \ (g) \).

3. An ice cube melts: \( H₂O \ (s) \rightarrow H₂O \ (l) \)

4. NaHCO₃ (s) + CH₃COOH (aq) \( \rightarrow \) NaCH₃COO (aq) + H₂O (l) + CO₂ (g)

**Reference:** Adapted by Nancy Escamilla and Petra van Koppen from Fitch, Dr. Thomas. **Mystery Powders Unit Plan.** Illinois State University. [http://www.iit.edu/~smile/ch9305.html](http://www.iit.edu/~smile/ch9305.html)
Chemical Reactions

Hypotheses:

If the powder is baking soda, then there will be a chemical reaction with__________________________.

If the powder is cornstarch, then there will be a chemical reaction with__________________________.

If the powder is baking powder, then there will be a chemical reaction with__________________________.

For each powder test its reaction with water first. Make sure to write down all your observations: 1<sup>st</sup> – your initial observation of the reaction, 2<sup>nd</sup> – record how the reaction progresses, and finally – record your observations when no further changes appear to occur. Then continue to the next two columns. After each test, write down what happens.

<table>
<thead>
<tr>
<th>Powder</th>
<th>Reaction with water</th>
<th>Reaction with vinegar</th>
<th>Reaction with iodine</th>
<th>Identify the powder</th>
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</table>
How many chemical reactions did you observe and how do you know they were chemical reactions rather than physical changes?
________________________________________________________________________________________________________________________________________________________________________________________________________________________________

How did you identify the baking soda?
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How did you identify the cornstarch?
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Video Test for first 5 minutes of: *All About Properties of Matter*

1. What are all physical objects made of?
   a) gas
   b) metals
   c) minerals
   d) matter

2. In order to describe matter, we usually list its:
   a) physical appearance
   b) properties
   c) chemical composition
   d) smell

3. In science, we describe a substance by comparing it to another substance. We can compare:
   a) its name in English and in Spanish.
   b) how many times it is mentioned in a book.
   c) its properties.

4. What senses do we use to understand the properties of a substance? We use our senses to:
   a) see, sound, smell, feel, or taste a substance.
   b) try an experiment on a substance.
   c) take a substance apart.
5. What properties of matter can we see with our eyes?
   a) shape and sound
   b) color and smell
   c) size and smoothness
   d) color and shape

6. What are some properties of matter we can feel by touching?
   a) shape, size, color, and smell
   b) smoothness, hardness, roughness, and softness
   c) heat, texture, sound, and size

7. What properties does all matter have?
   a) smell, shape, size and color
   b) mass, weight, volume, and density
   c) reactivity, combustibility and solubility

Physical Science for Children[TM]. Schlessinger Science Library
Video test created by Nancy Escamilla revised 2007
Chemical Properties

Elements account for all __________ in the world.
   Like you and me, birds and bees,
Even all the grass and trees are made of ____________.

   You walk down the street and everything you see
   is made of ____________.
   Elements, it’s made of.

Each __________ is made of only ______ kind of ______.
   In the _______________ table all the elements are grouped
   by their ______________ properties, properties, properties.

   A liquid we all should know, H2O, is made of elements.
   Elements, it’s made of.

   During chemical ___________ some atoms rearrange
   (Atoms in reactants)
   To form products with different ___________
   and different names.

   Like in photosynthesis,
   __________ rearrange and names change.
   With chlorophyll, water, sunlight, C02;
   They change to __________ and sugar for me and you.

   ELEMENTS
Chemical Properties

Elements account for all matter in the world.
  Like you and me, birds and bees,
Even all the grass and trees are made of elements.

You walk down the street and everything you see
  is made of elements.
  Elements, it’s made of.

Each element is made of only one kind of atom.
In the periodic table all the elements are grouped
  by their chemical properties, properties, properties.

A liquid we all should know, H20, is made of elements.
  Elements, it’s made of.

During chemical reactions some atoms rearrange
  (Atoms in reactants)
To form products with different properties
  and different names.

  Like in photosynthesis,
  Atoms rearrange and names change.
  With chlorophyll, water, sunlight, C02;
  They change to sugar and 02 for me and you.

ELEMENTS