

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## Student Exploration: Mystery Powder Analysis

**Vocabulary:** Biuret solution, iodine solution, litmus paper, vinegar

**Prior Knowledge Questions** (Do these BEFORE using the Gizmo.)

A white powder is found spilled on the kitchen floor of a crime scene. A similar powder is found on the shoes of a suspect in the crime.

1. What are some powders that you might find on the kitchen floor? \_\_\_\_\_

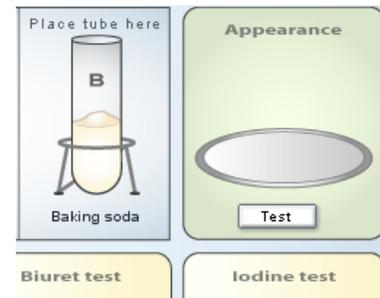
\_\_\_\_\_

2. How could you tell if the powder was salt, sugar, flour, or baking soda? \_\_\_\_\_

\_\_\_\_\_

### Gizmo Warm-up

The *Mystery Powder Analysis* Gizmo™ allows you to use a variety of tests to identify unknown substances. To start, drag the **Baking soda** test tube into the “Place tube here” area.



1. Under **Appearance**, click **Test**. Is baking soda a fine powder (no visible grains), or is it coarse (visible grains)?

\_\_\_\_\_

2. **Litmus paper** is an indicator of acids and bases. Under **Litmus test**, click **Test**. Which of the following results occurred? (Circle the answer.)

A. Both strips red (acid)

C. One red, one blue strip (neutral)

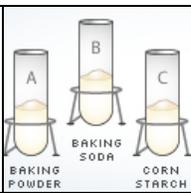
B. Both strips blue (base)

3. Some substances react with **vinegar** to produce carbon dioxide, visible as bubbles.

Under **Vinegar test**, click **Test**. Does the vinegar bubble? \_\_\_\_\_

4. The blue **Biuret solution** turns bright purple in the presence of proteins. **Iodine solution** turns dark purple in the presence of starch. Try each of these tests.

Does baking soda contain protein? \_\_\_\_\_ Does baking soda contain starch? \_\_\_\_\_

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|---|--|---|
| <b>Activity A:</b><br><br><b>Known substances</b> | <u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> <li>• Click <b>Reset</b>.</li> <li>• Be sure the <b>Known</b> substances are selected.</li> </ul> |  |
|---|--|---|

**Question: What are the properties of baking powder, baking soda, corn starch, gelatin, and salt?**

1. Collect data: Use the Gizmo to test the five known substances. Fill in the results below.

| Substance     | Appearance (coarse or fine?) | Litmus (acid or base?) | Vinegar (bubbles?) | Biuret (protein?) | Iodine (starch?) |
|---------------|------------------------------|------------------------|--------------------|-------------------|------------------|
| Baking powder |                              |                        |                    |                   |                  |
| Baking soda   |                              |                        |                    |                   |                  |
| Corn starch   |                              |                        |                    |                   |                  |
| Gelatin       |                              |                        |                    |                   |                  |
| Salt          |                              |                        |                    |                   |                  |

2. Analyze: Look at the results of your tests.

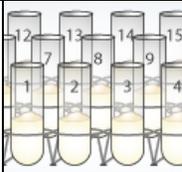
- A. Which substance(s) are acids? \_\_\_\_\_
- B. Which substance(s) are bases? \_\_\_\_\_
- C. Which substance(s) react with vinegar? \_\_\_\_\_
- D. Which substance(s) contain protein? \_\_\_\_\_
- E. Which substance(s) contain starch? \_\_\_\_\_

3. Apply: Suppose you find a mystery powder. It is coarse in appearance, has a neutral pH, and does not react with vinegar, Biuret solution, or iodine.

Of the five substances listed here, which is it most likely to be? \_\_\_\_\_

4. Challenge: Baking powder is a combination of three substances, two of which are other "known" substances in the Gizmo. What are the two "known" substances in baking powder?

\_\_\_\_\_

|   |  |   |
|---|--|---|
| <b>Activity B:</b><br><b>Unknown substances</b> | <u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> <li>• Click <b>Reset</b>.</li> <li>• Under <b>Select a sample</b>, choose <b>Unknown</b>.</li> <li>• Check that the <b>Standard mystery set</b> is displayed. (If not, click <b>Refresh</b> or <b>Reload</b> on your browser.)</li> </ul> |  <p>Standard mystery set</p> |
|---|--|---|

**Question: How can you identify unknown substances?**

1. Identify: Test tubes 1-5 are all contain single substances. Run the five tests on these powders, and identify the substance in each tube.

| Sample | Appearance | Litmus | Vinegar | Biuret | Iodine | Substance |
|--------|------------|--------|---------|--------|--------|-----------|
| 1      |            |        |         |        |        |           |
| 2      |            |        |         |        |        |           |
| 3      |            |        |         |        |        |           |
| 4      |            |        |         |        |        |           |
| 5      |            |        |         |        |        |           |

2. Identify: Test tubes 6-10 all contain mixtures of two substances. Run the five tests on these powders, and identify the TWO substances in each tube.

| Sample | Appearance | Litmus | Vinegar | Biuret | Iodine | Substances |
|--------|------------|--------|---------|--------|--------|------------|
| 6      |            |        |         |        |        |            |
| 7      |            |        |         |        |        |            |
| 8      |            |        |         |        |        |            |
| 9      |            |        |         |        |        |            |
| 10     |            |        |         |        |        |            |

3. Analyze: Are there any situations where there is more than one correct answer? Explain.

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**(Activity B continued on next page)**

**Activity B (continued from previous page)**

4. **Challenge:** Test tubes 11-15 all contain mixtures of three substances. Run the five tests on these powders, and identify the THREE substances in each tube. (Note: Sometimes there will be more than one possible answer.)

| Sample | Appearance | Litmus | Vinegar | Biuret | Iodine | Substances |
|--------|------------|--------|---------|--------|--------|------------|
| 11     |            |        |         |        |        |            |
| 12     |            |        |         |        |        |            |
| 13     |            |        |         |        |        |            |
| 14     |            |        |         |        |        |            |
| 15     |            |        |         |        |        |            |

5. **Analyze:** Based on your experiences, answer the following.

A. Why is it hard to tell if a mixture contains salt? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

B. How can you tell if a sample contains baking soda and cornstarch or baking powder?

\_\_\_\_\_  
\_\_\_\_\_

6. **On your own:** For further practice, click **New sample**. As in the **Standard mystery set**, the test tubes in the first row each contain one substance, the test tubes in the second row contain two, and the test tubes in the third row contain three. You may find new substances you haven't seen before. Good luck!

(Note: At this point, the contents of the tubes are randomized, so results will vary.)