

# Matter Matters

**Overview** Students investigate mixtures, solutions, and the physical properties of matter by observing “mystery substances.”

**Related Standards of Learning** 3.3a

## Objectives

The students should be able to

- conclude that materials have their own set of physical properties that are observable.

## Materials needed

Per group of students:

- One tsp. salt sealed in plastic bag labeled “Mystery Substance 1”
- One tsp. sugar sealed in plastic bag labeled “Mystery Substance 2”
- One tsp. sand sealed in plastic bag labeled “Mystery Substance 3”
- One tsp. clay sealed in plastic bag labeled “Mystery Substance 4”
- One tsp. barley flour sealed in plastic bag labeled “Mystery Substance 5”
- Five 4-inch squares of black paper numbered 1, 2, 3, 4, and 5
- Magnifying glass
- One-tsp. measuring spoon
- One-tbsp. measuring spoon
- One small bottle filled with at least 7 tbsp. of warm water
- Handful of dried grass
- Five small plastic cups labeled “Mystery Substance 1, 2, 3, 4, or 5”
- “Mystery Substance Observation Sheet” handout (see. p. **Error! Bookmark not defined.**)

## Instructional activity

### *Content/Teacher Notes*

In this investigation, students use their observation skills to investigate five different powdered substances, some of which dissolve and some of which do not. Students must solve the mystery of which substances would make good bricks and which would make good bread.

Concentrate on describing objects in terms of their *physical* properties. You might want to mention that when salt or sugar form a solution, something happens that we can’t see without magnification. However, once the water evaporates, the salt or sugar is left behind. You might also talk about how sand and clay are formed as rock erodes yet still have many of the same properties as the original rock, which makes them good choices for making bricks.

You may want to go over the following vocabulary words during this activity. The term *dissolve* is hard to define in words at a lower elementary level. Let the students experience what dissolve means and then define it. The students will see that the salt seems to disappear when it is in solution (dissolved in water), but that it appears again once the water has evaporated.

**Dissolve:** to break into component parts or to pass into solution

**Mixture:** something made up of a combination of different substances; two or more elements or compounds that are blended without combining chemically

**Solution:** a mixture in which one substance (the solute) is dissolved in another substance (the solvent).

## ***Introduction***

1. If your class has never done an activity that focuses on observation of physical properties, you may start by asking, “What are the five senses?” As the students name the five senses, write them as headings on the board. Put a handful of dried grass (an ingredient in Egyptian bricks) where everyone can see it. Ask for descriptive words about grass for each of the senses — i.e., a few words to put under the headings Sight, Hearing, Touch, and Smell. Put an *X* over the Taste heading, and stress that scientists never taste their experiments! Ask students why they think this might be.
2. Once the students seem to have the concept of physical properties, summarize their descriptions, and tell them that they have just described the physical properties of grass. Reinforce the definition of *physical property* — something that can be observed using the five senses.

## ***Procedure***

1. Divide the class into five groups, and provide each group with a table or other appropriate surface for this experiment. Put a sheet of newspaper in the middle of the table, and have paper towels available so that the students can clean their fingers as needed.
2. Distribute the five bags of mystery substances to each group, and allow the students to examine them with the proviso that they must keep the bags sealed until you give them permission to open them. Also, tell the students that they must not smell or taste the substances. Good scientists never taste their experiments, and they use special smelling techniques when they use their sense of smell. Distribute the black paper squares and the magnifying glass to each group.
3. Sight Observations: Ask the students to observe each substance and write down at least four things they notice about it, using their unaided eyes. Then, ask them whether they can think of a tool that might help them see the substances more closely. Allow them to use the magnifying glass to make the observations again. If they need guidance, prompt them with questions, such as: “What color is the substance? Does it cling to the bag? How large or small are its particles?” Again, have the students write down at least four things they notice about each substance.
4. Hearing Observations: Warn the class that they must be very quiet during this step. Ask for a volunteer in each group to be the bag opener. The bag opener should carefully open the first bag. One of the other students should take a small pinch of Mystery Substance 1. The bag opener should then reseal the bag. Then the whole group should listen as the pincher lets the substance fall to the sheet of black paper numbered “1.” This procedure is then repeated for each of the other substances with a pause after each “drop” to let the students write down their observations.
5. Touch Observations: Next, the students should take turns touching each of the substances on the numbered sheets. If they need prompting, you might ask if the substance feels grainy or soft. Have the students write down their observations.
6. The class will expect the smell observations to come next. Surprise! Explain that you will come back to the smell observations after the next step. Smelling powdery substances can irritate the sinuses. Pass out the sets of labeled cups and the bottles of warm water.
7. Ask for a volunteer to be the water measurer. The water measurer should use the measuring spoon to measure and pour 1 tbsp. of warm water into each of the cups. Next the bag opener should carefully open the first bag. One of the other students should use the small measuring spoon to measure out 1 tsp. of Mystery Substance 1. The bag opener should then

reseal the bag. The whole group should watch carefully as the substance measurer pours the tsp. of Mystery Substance 1 into the cup labeled Mystery Substance 1. The substance measurer should then gently swirl the cup around until the substance is completely wet. Repeat this procedure for each of the substances. Some will dissolve, others will not. Pause between each step to let the students record their observations.

8. **Smell Observations:** Tell the students that scientists have a special technique for smelling unknown substances. It's called wafting. The scientist gently waves a hand above the substance toward the nose and sniffs gently. (There are no dangerous substances in this experiment; however, it's never a good idea to take a deep lungful of a completely unknown substance.) Let the students take turns wafting and smelling the substances in the cups and writing down their observations.
9. At the end of the exercise, let each group pick a different place to put their cups on a tray or piece of cardboard. You might suggest the windowsill, a shady corner, a shelf in a closet, an area far away from the heating source, and an area near the heating source. Remind the students to check on the substances every day for the next week or so. Have students record their observations, and discuss them with the class.

### ***Observations and Conclusions***

1. Review the observations that the students made of the substances. You may want to make a list on the board. Let students hypothesize as to what each substance may be.
2. You may want to give them the list of possibilities for the substances at this point to see if they can match the correct name to each substance.
3. After students have matched names to the substances, have them tell what each substance is and describe how they came to each conclusion. Then, reveal the true names of the substances, and compare these to the students' conclusions. Discuss any incorrect conclusions.
4. Review which of the substances dissolve in water and which do not.

### **Sample assessment**

Have students explain in their science journals what physical properties helped them to distinguish between one substance and another.

Provide students with two very different objects and have students compare and contrast their physical properties.

### **Resources**

*Connections: Connecting Books to the Virginia SOLs.* Fairfax County Public Schools and The College of William and Mary. <http://www.fcps.edu/cpsapps/connections>. Presents a database of more than 1,000 works of children's literature and their connection to the Virginia Standards of Learning.

*Jefferson Lab: Science Education Teacher Resources.*

<http://education.jlab.org/indexpages/teachers.html>. Provides general physical science resources.

Moore, Kathleen, and O. W. Holmes. "States of Matter." *Illinois Institute of Technology: Science and Mathematics Initiative for Learning Enhancement (SMILE)*.

<http://www.iit.edu/~smile/ph9516.html>. Offers a lesson plan.

*Outstanding Science Trade Books for Students K–12*. National Science Teachers Association (NSTA). <http://www.nsta.org/ostbc>.

*Physical Science SOLutions*. Science Museum of Virginia. <http://www.smv.org/pubs/index.html>.  
This lesson is adapted from a lesson in this resource.

*Search for Literature: Literature for Science and Mathematics*. California Department of Education. <http://www.cde.ca.gov/ci/sc/ll/ap/searchlist.asp>. Offers a searchable database.

# Mystery Substance Observation Sheet

Group Names: \_\_\_\_\_

Mystery Substance # \_\_\_\_\_

Sight: \_\_\_\_\_

\_\_\_\_\_

Hearing: \_\_\_\_\_

\_\_\_\_\_

Touch: \_\_\_\_\_

\_\_\_\_\_

Smell: \_\_\_\_\_

\_\_\_\_\_

*(WARNING: Do the sense of smell observation only after you mix the mystery substance with water. Powdery substances can irritate your sinuses.)*

Describe what happened when this mystery substance was mixed with water:

Did the substance dissolve? \_\_\_\_\_ (Yes or No)

Did the water get cloudy? \_\_\_\_\_ (Yes or No)

Did the color change? \_\_\_\_\_ (Yes or No)

Did the substance sink immediately? \_\_\_\_\_ (Yes or No)

Did the substance float at first? \_\_\_\_\_ (Yes or No)

Conclusions:

My group's hypothesis is that this mystery substance is \_\_\_\_\_.

This mystery substance turned out to be \_\_\_\_\_.