

Middle School Science Experiment

Mystery Powders

During this experiment, you will work in a team to use the ProScope Digital USB Microscope and a computer to collect microscopic images from a variety of chemical specimens. When you compare these specimens, you will be able to determine their identity by investigating their microscopic properties.

Objectives

In this experiment, you will:

- Use a digital microscope to collect images from a variety of mystery chemicals
- Use the images you collect to identify these chemicals based mostly on their crystal structure

Materials

- Power Macintosh G3 or better
- ProScope Digital USB Microscope and software
- Three chemical samples
- Comparable modern specimens
- Reference materials

Procedure

- 1** Prepare the computer for data collection by opening the USB Shot software and connecting the ProScope Digital USB Microscope to one of the computer's USB ports.
- 2** Select a set of three mineral samples.
- 3** Create a folder to store your images.
- 4** Using the ProScope Digital USB Microscope, create two still images, one at 50X and one at 100X. Name each sample image and note the magnification you used to create it. Save the images in your folder.
- 5** Create a data table like the one in the "Data" section on page 2.
- 6** On the computer, choose Insert from the File menu. Select your mineral images and place them in the data table.
- 7** Examine your samples and identify each of the chemicals using the available reference materials.

Data

Chemical name	50X magnification	100X magnification
Sample #1		
Sample #2		
Sample #3		

Processing the data

1. Describe the various shapes of the crystals in your mineral samples using geometric terms.
2. At what level of magnification were you best able to determine the specific crystal structure of the sample?

Extensions

1. In addition to crystal shape or types found in minerals, what other characteristics are used to organize and identify substances?
2. How would these identification techniques be used commercially?

Teacher information

- As detectives, the students are presented with three very similar samples of chemicals. Their job is to identify the chemicals using the various available tools—their computers, the ProScope Digital USB Microscope, and their powers of deduction. The students can use the following websites to find information that will enable them to identify their samples:

<http://www.cbiac.apgea.army.mil/resources/directory/identifi.html>

<http://www.webelements.com/>

<http://www.chemicalelements.com/>

<http://www.jtbaker.com/msds/s7394.htm>

<http://users.rcn.com/sue.interport/food/bakgsoda.html>




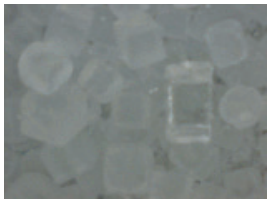


<http://www.armandhammer.com/FrontPorch/fs.htm>

<http://www.mortonsalt.com/faqs/fts2faqs.htm>

<http://www.indigo.com/models/gphmodel/sodium-chloride-model-W.html>

- Once the students do a bit of research, they will discover that the cubic crystal shape of salt is a real give-away. Also, sugar has a more rectangular crystal, rhombohedral shape.

Sample results

Chemical name	50X magnification	100X magnification
Sample 1 Sodium bicarbonate NaHCO_3 (baking soda)		
Sample 2 Sodium chloride (Table salt)		
Sample 3 Sucrose $\text{C}_{12}\text{H}_{22}\text{O}_{11}$		

Answers to questions

Processing the data questions

1. This investigation clearly demonstrates the value of the handheld microscope as a diagnostic tool. A closer look reveals characteristics not obvious to the unaided eye. Answers may vary with regard to the shapes. Students will probably need to do some research on the shapes of crystals to discover the most accurate vocabulary. The most accurate shape for table salt is cubic. This property is pretty obvious at 100X magnification. Table sugar has a more elongated rectangular shape with ends that look like pyramids, a rhombohedral shape. The baking soda is characterized by a very fine grain with irregular crystal shapes, the most prevalent being an elongated rhombohedral shape.
2. With good lighting, each sample can be discerned at 100X.

Extension questions

1. Other characteristics used to organize and identify substances include color, crystal shape, melting point, solubility, which element it reacts with, and flame test.
2. One example would be if a facilities manager brought you some fuzzy white powder and asked if this powder was asbestos. You could start to provide an answer by consulting reference books on mineral properties and a collection of slides made of known substances. You could then conclude whether or not the sample was likely to contain asbestos crystals. This sort of problem happens every day in industry. Chemists use powers of deduction and the process of elimination to identify substances. In many cases, the tools extend beyond just visual recognition to other tests for chemical properties.

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