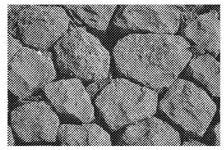
Walch Hands-on Science Series



Rocks and Minerals

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Contents

To the Teacher

This is one in a series of hands-on science activities for middle school and early high school students. A recent survey of middle school students conducted by the National Science Foundation (NSF) found that

- more than half listed science as their favorite subject.
- more than half wanted more hands-on activities.
- 90 percent stated that the best way for them to learn science was to do experiments themselves.

The books in this series seek to capitalize on that NSF survey. These books are not texts but supplements. They offer hands-on, fun activities that will turn some students on to science. You and your students should select which activities are to be carried out. All of the activities need not be done. Pick and choose those activities that best meet the needs of your students. All of these activities can be done in school, and some can be done at home. The authors are teachers, and the activities have been field tested in a public middle school and/or high school.

Students will need only basic, standard scientific equipment that can be found in most middle and high school science laboratories. The activities range from the simple (How Are Crystals Created?) to the difficult (How Do We Use Rocks to Examine Geologic History?). There is something for every student.

THE ACTIVITIES CAN BE USED:

- to provide hands-on experiences pertaining to textbook content.
- to give verbally limited children a chance to succeed and gain extra credit.
- as the basis for class or school science fair projects or for other science competitions.
- to involve students in science club activities.
- as homework assignments.
- to involve parents in their child's science education and experiences.

The students will discover the special properties of rocks and minerals and how scientists use these properties to learn about the formation of the planet and the evolution of life on earth. Hands-on activities explain why we use rocks to examine geological history, how rocks and minerals weather, how different types of rocks form, and what we learn about the evolution of life from fossils.

Each activity has a Teacher Resource section that includes, besides helpful hints and suggestions, a scoring rubric, quiz questions, and Internet connections for those students who wish to go further and carry out the follow-up activities. Instructional objectives and the National Science Standards that apply to each activity are provided to help you meet state and local expectations.

Name ______________________ Date ______________________

How Can We Determine the Weathering Rate of Rocks and Minerals?

STUDENT ACTIVITY PAGE

BEFORE YOU BEGIN

Look at a picture of the Grand Canyon and try to imagine how it was formed. Most of it was shaped by physical and chemical weathering and erosion. Chemical weathering takes place when a rock's reaction to chemicals causes the rock material to change. For example, acids in the environment react chemically with rocks, causing them to break down. Physical weathering results from a rock's contact with such materials as water, wind, ice and other rocks. This physical contact can change the size and/or shape of the original rock. Erosion happens when wind and/or water move the weathered material from its original site.

While you were looking at the picture of the Grand Canyon, you may have noticed that some areas are more weathered than others. What determines the weathering rate of rock materials? The rate of chemical weathering is based on several properties. These include the climate and the way the rock reacts to chemicals in rain and gases in the atmosphere, such as carbon dioxide. The speed of weathering is determined by how resistant the rock is to these processes. Several factors influence this resistance. They include the amount of surface exposed, the minerals in the rock, and the additional damage caused by the weathered particles rubbing against the rock. Keep in mind that weathering takes millions of years to form canyons and caverns. Scientists study the effects of weathering to explain a variety of natural rock formations that beautify our Earth.

In this activity, you will measure and graph the rate at which sample rocks weather, and their acid reactivity. You will also identify the mineral composition of any material dissolved from your sample rocks or minerals.

MATERIALS

- Picture of the Grand Canyon
- Granite, limestone, and calcite specimens (chips)
- Tray kit containing a hand lens, dilute HCl, filter paper, weighing paper, matches or striker, 2-ounce plastic cups, grease pencil, colored pencils
- 100-ml graduated cylinders
- Three 250-ml beakers
- Three watch glasses or three evaporating dishes
- Ring stand, ring, and wire gauze
- Bunsen burner
- Three 250-ml polyethylene plastic bottles
- 4-inch square fine wire mesh (or screen wire)
- Triple beam balance scale
- Paper towels
- Safety goggles, laboratory aprons, latex gloves
- Stopwatch (optional)

= Safety icon

PROCEDURE: SECTION A

1. Obtain granite, limestone, and calcite chips from your teacher.

(continued)

Name ______________________________ Date ________________

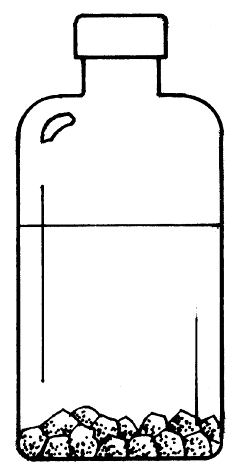
How Can We Determine the Weathering Rate of Rocks and Minerals? *(continued)*

STUDENT ACTIVITY PAGE

2. Observe and record the appearance of each of your samples in the appropriate place in Data Table 1 of the Data Collection and Analysis section. Use your hand lens to describe any such characteristics as particles, crystal shapes, and colors that you detect.
3. Test your specimens for acid-reacting properties by doing the following:
   Be sure to do this under the strict supervision of your teacher. Wear latex gloves, a laboratory apron, and safety goggles during the acid tests.
   (a) Place five granite chips into a 2-ounce plastic cup.
   (b) Place three to five drops of dilute HCl onto the sample in the plastic cup.
   (c) If bubbling is observed, then the mineral is **acid reactive**. If no bubbling of the crushed mineral chips occurs, then the sample is **nonreactive** to acid.
   (d) Record your findings in Data Table 1.
   (e) Repeat the procedure outlined in Steps 3(a) through 3(d), using the limestone chips.
   (f) Repeat, using the calcite chips.
   (g) At the end of the lab activity, call your teacher to pick up the acid-containing cups for safe removal and disposal.

PROCEDURE: SECTION B

1. Review how to use the triple beam balance with your teacher. Then use this scale to measure out 30 grams of each sample. Be certain to subtract the mass of the weighing paper. Record this data as the zero-minute time value in Data Table 2 of the Data Collection and Analysis section.
2. Label three plastic bottles and three 250-ml beakers, one for each of the samples studied in this activity.
3. Place the rock/mineral chips into their respective plastic bottles. Measure out and add 100-ml of distilled water to each bottle.
4. Screw the cap onto each bottle and shake at a slow, steady, rate for two minutes.
5. Unscrew the cap, place a fine wire mesh (or screen wire) over the mouth of the bottle, and pour out the liquid (**slurry**) into prelabeled 250-ml beakers, one for each specimen. *You need to save the liquid slurry from each sample to use during the rest of this exercise and during* ***Section C*** *of this laboratory activity.*
6. Remove the chips from each container, and pat dry each sample with a paper towel.
7. Use the triple beam balance to determine the mass of chips from each sample, and record the data as the two-minute time value in Data Table 2.
8. Put the samples back into their respective plastic bottles and add to each the matching liquid slurry from the 250-ml beakers.



Procedures 2–3

(continued)

Name ______________________ Date ______________

How Can We Determine the Weathering Rate of Rocks and Minerals? *(continued)*

STUDENT ACTIVITY PAGE

9. Repeat steps 3 through 7 above at two-minute intervals to obtain data for four minutes, six minutes, and eight minutes. **Be certain to add back the correct slurry mixture to the plastic bottle containing its respective sample rock or mineral.**
10. Calculate the percent of mass remaining for each sample at each time interval using the equation below:

$$\text{percent of mass remaining} = \frac{\text{mass at each time interval}}{\text{original mass of the sample}} \times 100$$

    Place your results for the calculated percent of mass remaining for each sample in the appropriate spaces in Data Table 2.
11. Label the *x*- and *y*-axes and then plot your data using the line graph in Figure 1 of the Data Collection and Analysis section. Each rock or mineral will have its own set of points for each time interval (zero minutes through eight minutes). Place the time (**in minutes**) on the *x*-axis, and the percent of mass remaining on the *y*-axis. Use three different colored pencils, one to draw the graph for each rock or mineral. Enter the points for each mineral and then draw a line to connect each point.

PROCEDURE: SECTION C

1. Gently swirl each slurry sample (**in the beakers**) left over from Section B to uniformly mix any sediments that may have settled on the bottom. Pour enough of each liquid solution to fill each prelabeled watch glass or evaporating dish.
2. Place each watch glass or evaporating dish on the ring stand.
3. **Under the strict supervision of your teacher, carefully light a bunsen burner, and gently warm the solution to evaporate the water completely.**
4. Allow what remains in each watch glass to cool down completely before moving to the next step.
5. Using a hand lens, examine each sample for dissolved minerals. Record your results in Data Table 3 of the Data Collection and Analysis section. Sketch any soluble mineral types you observe, and detail any observed particular geometric shapes.

DATA COLLECTION AND ANALYSIS

DATA TABLE 1: STUDENT RESULTS TO DESCRIBE PROPERTIES OF ROCK AND MINERAL SAMPLES

Sample	Appearance of Specimens	Reacts with Acid (Yes or No)
Granite		
Limestone		
Calcite		

(continued)

Name ____________________ Date ____________

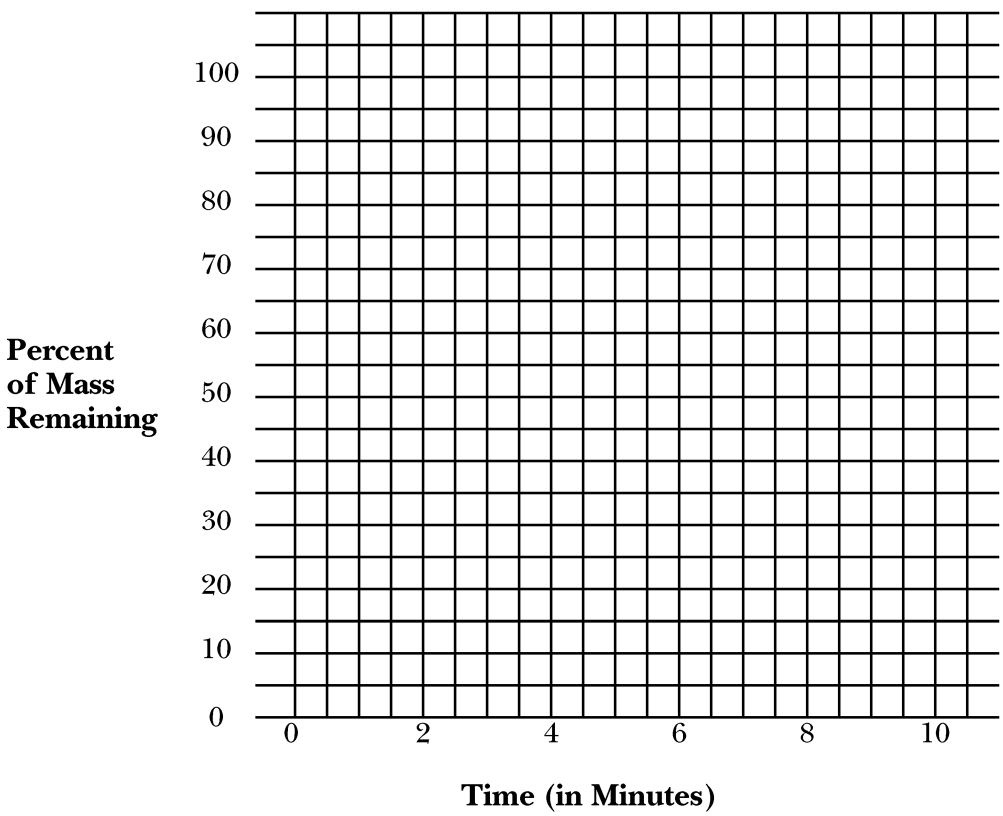
How Can We Determine the Weathering Rate of Rocks and Minerals? *(continued)*

STUDENT ACTIVITY PAGE

DATA TABLE 2: STUDENT RESULTS TO MEASURE THE WEATHERING RATE OF ROCK AND MINERAL SAMPLES

Mass and Percentage (%) Remaining of Rock and Mineral Samples						
Time (Minutes)	Granite (Mass)	Granite (%)	Limestone (Mass)	Limestone (%)	Calcite (Mass)	Calcite (%)
0						
2						
4						
6						
8						

FIGURE 1: WEATHERING RATE OF ROCK AND MINERAL SAMPLES



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Name ______________________________ Date ____________________

How Can We Determine the Weathering Rate of Rocks and Minerals? *(continued)*

STUDENT ACTIVITY PAGE

DATA TABLE 3: STUDENT DESCRIPTIONS OF SOLUBLE MINERALS IN ROCK AND MINERAL SAMPLES

Sample	Visual Characteristics of Solute Minerals	Sketches
Granite		
Limestone		
Calcite		

CONCLUDING QUESTIONS

1. Did certain rocks or minerals weather at a slower rate than others? Why do you think this happened? ____________________

2. Identify which materials displayed a chemical weathering process, and explain why this is chemical weathering. ____________________

3. Why did you add the same "slurry" mixture back to each sample bottle each time? How would your results have differed if you added clean distilled water instead? ____________________

4. Describe the various types of physical weathering that took place in this activity. ____________________

Follow-up Activity

Research how canyons form and write a detailed report on their development.