



Dynamic Crystals

Activity Overview

In this activity, students use a digital microscope to capture crystal formation in hot and cold saltwater using time-lapse photography. Through analysis of the time-lapse video clips, students identify differences in the size and appearance of the two salt crystal samples. Conclusions from this activity can be applied to the formation of intrusive and extrusive igneous rocks.

The object of this lesson is for students to develop understandings of the role of cooling time in the development of crystals through an inductive, hands-on activity.



Advantages of Technology

Traditionally, students learn about differences in crystal size between intrusive and extrusive igneous rocks didactically through lecture and readings. The time-lapse photography feature of today's digital microscopes allows students to discover for themselves the relationship between cooling time and crystal formation. Using digital imaging technology promotes data analysis and questioning skills in learning situations where students have typically been *told* the answers.

Educational Standards

Virginia Earth Science Standards of Learning addressed in this activity:

ES.1 The student will plan and conduct investigations in which:

- Elapsed time, temperature are calculated utilizing the most appropriate tools;
- Technologies, including computers, are used to collect data and to demonstrate concepts.
- Variables are manipulated with repeated trials.

Materials

Technology:

- Intel Play QX3 digital microscope (or other digital microscope with time lapse capability)
- Computer (PC with Windows 98 or higher)

Other Supplies:

- Saturated salt solution using hot tap water (add salt until no more will dissolve)
- Saturated salt solution using cool tap water (add salt until no more will dissolve)
- 2 eyedroppers
- 2 microscope slides (no cover slip)
- Timer or clock
- 5 or 6 cm² dark sheet of construction paper (optional, for color contrast)



Procedure

NOTE TO TEACHERS:

These procedures are written to show you how you might use these technologies to teach science concepts. Suggested questions, approaches, and expected answers are all provided. Therefore, these activity descriptions should be used as a guide for your instructional planning, rather than as step-by-step directions for students.

Getting Started

How do you think the evaporation of a drop of hot saltwater will compare to that of a drop of cold saltwater?

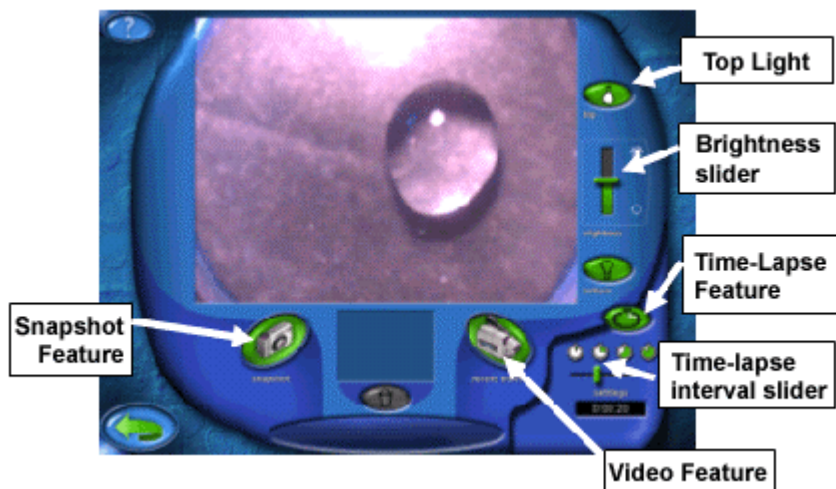
The results may surprise you. In this activity you will be able actually to watch what happens as drops of hot and cold saltwater evaporate!

Before beginning this activity, practice using the time-lapse photography feature on the QX3 microscope. You may want to try photographing a wristwatch with moving hands.

Mix the salt solution just before you are ready to try this activity. The hot water needs to still be hot when you begin the time-lapse photography.

Teacher: Note that the exact time needed for crystal formation depends somewhat on the

climate of your classroom, so you should try this activity before using it with students. In drier climates crystals will take less time to form than in more humid climates (20 minutes or more). Evaporation time also depends on the size of the water drop.



Time-Lapse Set Up

Open the QX3 program, set it to Live View, and set the microscope to 10X power. (The water droplet can be recorded at 60X, but this is only practical if you are using a very small drop.)

Using the slider bar, set the time-lapse feature to record images every 10-30 seconds. A shorter interval will show more detail but will also take longer to play back.

Using an eyedropper, place one drop of the solution on the slide. To get a smaller drop that will evaporate faster, use a toothpick to get the drop and then spread it out on the slide to increase its surface area.

Place the slide on the microscope stage. (For better contrast, place a small piece of dark colored construction paper under the slide.)

You may record your observations before and after evaporation in a chart like the one below.

Slide	Saltwater Crystal Observations		
	Before Evaporation	Total Evap. Time (min.)	After Evaporation
Cold saltwater	One drop of clear liquid	15 min.	Large, distinct white crystals formed in a circle around edge of original drop.
Hot saltwater	One drop of clear liquid	9 min.	Very tiny crystals formed around the edges of the original drop.

Now, activate the time-lapse photography by clicking on the Movie Camera icon on the computer screen.

See appendix for a suggested activity to complete while students are waiting for samples to evaporate.

Comparing Crystal Structures

After the saltwater has evaporated, end the time-lapse recording and write down the time. Take final snap shots of your samples using different powers. You may also want to label photographs as either cold saltwater crystals or hot saltwater crystals using the label feature in the QX3 software.

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Keep the saltwater crystal slides on the microscope stage for further study.

If you wish, you can insert photos of the crystals into your lab report. To do this, **Export** the snapshots to be saved on the appropriate drive. Then insert the images into a word processing document or PowerPoint file.

View your video clips and your final 60X snapshots.

Are the crystals the same in both samples?

What differences do you notice between the two final snapshots? You should notice differences in the size of the crystal formation from the hot and cold saltwater solutions.

What do you think caused this difference?

As the hot and cold saltwater drops evaporated, the solubility of the salt in the water decreased, causing the salt to come out of the solution in the form of crystals. The hot water drop evaporated more quickly, resulting in less time for crystals to develop, which in turn, resulted in smaller crystals.

Making Sense of the Conclusions

Use your observations to formulate a conclusion about the crystals formed from the two saltwater solution samples.

How is this information related to igneous rocks?

Igneous came from the Latin word *ignis*, meaning fire. Similar to the hot saltwater solution, as the molten rock cools, crystals begin to form. The magma under the earth's surface cools over long periods as intrusive igneous rocks. Lava on top of the Earth's surface cools more quickly in the open air, forming extrusive igneous rocks.

What differences would you expect to see in the crystal structures of igneous and extrusive igneous rocks?

Intrusive rocks form as magma cools under the Earth's surface. The long cooling process of intrusive rocks creates large crystals that are easily visible to the unaided eye. Granite is a good example of an intrusive igneous rock with crystals that are easy to see.

Extrusive rocks form as lava cools on the Earth's surface. Extrusive rocks experience a short cooling period so that only small crystals form. Basalt is an example of extrusive igneous rocks with small crystals that are more difficult to see.

Modifications

If time is limited, time-lapse clips can be completed ahead of time and provided to students. You could also prepare a classroom set of hot and cold saltwater crystal slides for students to examine with the microscope.

Complete this activity as a demonstration by preparing time-lapse clips prior to the class or use the clips we have filmed [add link]. Show the video clips to the entire class and

discuss the differences between the hot and cold saltwater crystals.

After your students have completed the crystal structure analysis, they can take snapshots of rock samples and then create a slide show using the QX3 software in which they have grouped rocks into intrusive and extrusive groups.

Assessment Strategies

A variety of assessment strategies can be implemented in this activity. Student's oral responses can be used to informally assess student understanding of the concepts. Other assessment techniques may include the following:

Write a letter to a younger student explaining what occurred in the activity and why the crystals were different in the two samples.

This is an effective assessment technique because the student must understand the processes in order to find a way to describe it to a younger, less knowledgeable individual. Not only do students have to understand the concepts, but they also must use their own vocabulary to explain it. Additionally, the teacher can identify any misconceptions students may have developed during the lesson.

Have students classify a variety of other igneous rock samples into intrusive and extrusive rocks accompanied by an explanation for their classification strategy.

This assessment strategy will provide students with further practice examining rock samples and applying their understanding of differences in crystal structure of intrusive and extrusive igneous rocks.

Resources

Cycles

<http://www.uen.org/themepark/html/cycles/rock.html>

Utah site including basic background information on rock cycles in addition to online fieldtrips to various regions from Mount Saint Helen's in Washington State, to the Grand Canyon and Ayers Rock in Australia. The site was designed for elementary level, however many activities and links are appropriate for all levels.

Rocks and the Rock Cycle

http://www.seismo.berkeley.edu/seismo/istat/9th/building_blocks.html#text

Site developed to support the San Francisco Unified School curriculum project for ninth grade earth science. Includes rock cycle lessons and additional links to sites offering information on the rock cycle, minerals and gems, and classroom activities.

National Mining Association Mining Education Site

<http://www.nma.org/>

Part of the National Mining Association site is dedicated to Mining Education including educational materials, tour information for mines and mining museums around the United States, information on adopt-a-school program for mining companies and schools and other mineral and gems information.

Molecular Expressions: Science Optics and You

<http://micro.magnet.fsu.edu/optics/intelplay/intelanatomy.html>

This site offers detailed information on using the QX3 digital microscope, trouble shooting, and examples of its use in biology, geology, and chemistry.

Appendix
Investigating Igneous Rocks

While waiting for the water drops to evaporate, you may consider the following:

Are all igneous rocks the same?

Examine several samples of intrusive and extrusive igneous rocks (at least two of each type). Use a ruler and hand lens to make observations of each rock, including color, texture, and observable crystal structure.

Use your observations to classify the rocks into two groups: those formed on the Earth's surface or those formed inside the Earth.

Here's an example of one student's observations.

Rock Number	Color	Crystal Structure	Texture
1	Gray and white with black flecks	3 mm square pieces	rough
2	Gray	Too small to measure	smooth
3	Black and shiny	Too small to measure	smooth
4			
5			

What were your criteria for placing the rocks in each category?