topic XI

How Are Rocks Formed?

Time Emphasis: 12 days

TOPIC OUTLINE		A-1a	B-2a	B-2b	C-1a	C-2a	FE - #4
INVESTIGATION		A-1a	B-2a	B-2b	C-1a	C-2a	FE - #4
Estimated Time (Periods)		1	3	2	1	1	
A. Rocks and sediments							
A-1 Comparative properties	*What Similarities Do Rocks Have to Sediments?*						
A-1.1 Similarities	A-1.11	■					
A-1.2 Differences	A-1.21	■					
B. Minerals							
B-1 Relation to rocks	*What Is the Composition of Rock?*						
B-1.1 Composition	B-1.11	■					■
	B-1.12	■					
	B-1.13	■					■
B-2 Characteristics	*What Are Some Characteristics of Minerals?*						
B-2.1 Physical, chemical properties	B-2.11	■	■				
B-2.2 Chemical composition	B-2.21		■				
	B-2.22						
B-2.3 Structure	B-2.31			■			
	B-2.32			■			
C. Rock formation							
C-1 Sedimentary rocks	*How Are Sedimentary Rocks Formed?*						
C-1.1 Compression cementation	C-1.11				■		
C-1.2 Chemical processes	C-1.21				■		
C-1.3 Biological processes	C-1.31				■		
C-2 Nonsedimentary rocks	*How are Nonsedimentary Rocks Formed?*						
C-2.1 Solidification process	C-2.11					■	
	C-2.12					■	
C-2.2 Recrystallization process	C-2.21						
C-3 Environment of formation	*What Is the Environment in Which a Rock Forms?*						
C-3.1 Inferred characteristics	C-3.11						
C-3.2 Distribution	C-3.21						
	C-3.22						
D. Rock cycle							
D-1 Evidence	*What Evidence Suggests a Cyclic Model of Rock Formation?*						
D-1.1 Transition zones	D-1.11						
D-1.2 Rock composition	D-1.21						
	D-1.22						
PROCESS OF INQUIRY OBJECTIVES							
Mathematical Skill	PIO-1						
Measurement Skill	PIO-2						
Creating Models	PIO-3			■	■	■	
Analysis of Error	PIO-4						
Data Analysis	PIO-5	■	■				
TITLES		Rock Properties	Properties of Minerals	Structure of Minerals	Formation of Sedimentary Rocks	Formation of Nonsedimentary Rocks	Cemetery

Multimedia: Check Multimedia Section of Supplement for Reference to This Topic

Easy (1)

XI-A-1a: ROCK PROPERTIES

QUESTION:

What similarities do rocks have to sediments?

MATERIALS:

Each group of two students should have a piece of coarse-grained granite with clearly distinguishable minerals (preferably pink feldspar, quartz, and black mica); a crushed sample of the same granite; about 15 rock samples including both sedimentary and nonsedimentary types (e.g., sandstone, limestone, shale, conglomerate, basalt,granite, gabbro, obsidian, banded gneiss, schist, slate, marble, and quartzite); a sample of sand or gravel; magnifying glasses; and a teasing needle. (It may be convenient to prepare permanent kits of the above items and place each in a shoebox.)

SUGGESTED APPROACH:

Part I Have the students observe their rock samples and describe them. This can be accomplished by having an individual describe a rock, then ask the other students to hold up the rock sample they think is being described. Repeat this several times and place a master list of the various terms used to describe the rocks on the chalkboard. Ask students to indicate which of the terms on the master list best describe rocks; underline or circle these. Most of these will be textural terms that describe the way individual parts of the rocks are put together.

Conduct a concluding discussion exphasizing the following:

a) Some rocks have characteristics that are very similar to loose sediments (these are called sedimentary rocks). Other rocks have different, but distinctive, characteristics (these are called nonsedimentary rocks).

b) All rocks are composed of minerals, most having more than one mineral present.

Have the students examine the loose gravel (using their hand lenses) and compare the material with the material composing their rock samples. Have them identify any similarities and differences.

Part II Ask students to observe the granite specimen carefully. Is it composed of one, or more than one, kind of mineral?

Have the students examine their sample of crushed granite and divide the pieces into piles of similar materials. Have them make a list of terms that describe how the various rock pieces (minerals) look.

PRECAUTIONS:

1. Students are not expected to learn rock and mineral names, they should, however, learn to recognize sedimentary rocks as opposed to nonsedimentary rocks.
2. It is best to use local rocks and minerals whenever possible, so that the student will be familiar with his local rock types.

BACKGROUND INFORMATION:

ROCK AND MINERAL EXCHANGE SERVICE

Teachers interested in swapping rocks, minerals, fossils, and earth science curriculum materials are hereby notified that a clearinghouse for the exchange of earth science materials has been established in McFarland, Wisconsin.

To take advantage of this free, voluntary service, send a list (size and quantity) of the rocks, minerals, fossils, and earth science curriculum materials YOU NEED, along with a list (size and quantity) of the rocks, minerals, fossils, and earth science curriculum materials YOU CAN SWAP, to: J. E. Wall, RMES, c/o Science Department, McFarland High School, McFarland, Wisconsin 53558.

You will be supplied with the names and addresses of those science teachers who can supply your needs on a SWAP basis. To receive additional RMES "Swap Sheets," send a stamped, self-addressed envelope (business size) to the RMES.

Due to the free, voluntary nature of the RMES, only those inquiries accompanied by stamped, self-addressed envelopes will be processed.

Sample RMES "Swap Sheet"

ROCK AND MINERAL EXCHANGE SERVICE

Your name________________ Your home address________________
School name________________ City & Zip Code________________
Street________________
City & Zip Code________________ RMES Code Number________________

I OFFER FOR TRADE (size & quantity):	I NEED (size and quantity):

REFERENCES:

Investigating the Earth, pp. 39-42, 48-50, 332; Teacher's Guide pp. 70-74, 76-77, 87-88, 89-90, 409-411.

XI-A-1a: ROCK PROPERTIES

QUESTION:

What similarities do rocks have to sediments?

INTRODUCTION:

If you were to examine the pebbles or boulders found near a river bank, in a road cut, or at a construction site, you would probably notice the wide variety of types present. If you were to travel to different places around the State or the country you would notice many similarities and differences among the rocks you observed. Since there are potentially an unlimited number of differences among rock samples, scientists find it convenient to group them on the basis of certain characteristics.

OBJECTIVES:

When you have finished this investigation, you should be able to:

1. describe the characteristics of sedimentary and nonsedimentary rocks.
2. describe the characteristics of rock components (minerals).

METHOD:

Part I Study your rock samples closely and describe their properties. Check your descriptions by verbally describing one of your rocks and asking your fellow students to hold up their sample of the same rock. If they cannot, then you need to work more on your description. You or your classmates may want to place a master list of terms used to describe rock samples on the chalkboard.

Next, examine the loose gravel with a hand lens and compare it to the rock samples. Place in a pile all those rocks which are composed of one or more of the same types of materials observed in the gravel. Place all the other rocks in another pile. Make a list of all the identifying characteristics of the rocks in each pile.

Part II In part one, you probably recognized that most rocks are composed of small grains. Examine the rock specimen called granite, and then look at the crushed sample of granite. Separate the crushed materials into piles of materials having similar properties (minerals). Describe the characteristics of each pile. Decide which was easier to describe, the piles of minerals or the rocks in part I.

QUESTIONS:

(A-1.11) 1. Describe the properties that you observed in the rocks that contained particles similar to those in the gravel sample. What are these kinds of rocks called?

(A-1.21) 2. Describe the properties of the rocks that did not appear similar to the gravel particles. What are these rocks called?

(B-1.11)
(B-1.12) 3. Describe the minerals that you were able to observe in more than one rock. List the number of different minerals you were able to observe in each of your rock samples.
(B-1.13)

(B-1.11)
(B-1.12) 4. Which was easier to describe, the piles of minerals or the rocks in part I? Explain why.
(B-1.13)
(B-2.11)

Easy (3)

XI-B-2a: PROPERTIES OF MINERALS

QUESTION:

What are some characteristics of minerals?

MATERIALS:

Samples of some important rock-forming minerals (e.g., quartz, feldspar, hornblende, mica, magnetite, calcite, hematite, etc.) and any minerals of local significance, balance, graduated cylinder, streak plate, nail, glass plate, penny, dilute HCl, and supplementary sheets 1-3.

SUGGESTED APPROACH

1. Discuss with the students the various tests you wish them to perform. Some, such as color and density, should need little discussion while others, such as hardness, streak, and acid test, will need more.
2. Provide students with a mineral identification chart (See Supplementary Sheets) and several mineral samples.
3. Have students attempt to identify the samples. Stress that in some cases they may only be able to limit their identification to several possibilities. (This will be governed by the number of different tests and the number of minerals on the identification chart.)

PRECAUTIONS:

1. It is the process of identification of minerals NOT the actual identification that is of importance in this investigation. Students often form the impression that all samples of a given mineral have a similar appearance to the sample they have worked with. Point out that this is not always the case.
2. If your students use pieces of window glass to determine hardness, make certain that they place the glass flat on the table and scratch it with the mineral specimen. Never have chem attempt to scratch the mineral specimen with the glass, since small particles of glass may break and cause injury.

REFERENCES:

Investigating the Earth, p. 575

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XI-B-2a: PROPERTIES OF MINERALS

QUESTION:

What are some characteristics of minerals?

INTRODUCTION:

Scientists have distinguished several thousand mineral species. Many are quite rare. A few together constitute 99 percent of all the minerals found in the earth's crust. Each mineral has a distinct composition and structure, however, for practical purposes most can be identified by observing a few of their basic properties. In this investigation, you will study some basic properties of minerals and use these properties to identify the particular mineral.

OBJECTIVES:

When you finish this investigation, you should be able to:

1. make observations and perform tests to determine some mineral properties such as color, density, hardness, streak, etc.

2. identify some common minerals by observing their properties and using a mineral reference table.

3. identify some of the most abundant elements found in minerals.

METHOD:

1. Obtain a set of minerals for identification, and run the tests indicated by your instructor. Use a table to record the results of your tests (Supplementary Sheet #3).

2. Using a mineral identification table, identify the minerals based upon the results of your tests.

QUESTIONS:

(B-2.11) 1. Did any two of the minerals you tested yield the same results for all tests? If not, do you think that, given additional samples of different minerals, this could happen? Explain.

2. Of the general properties you tested which do you think are most reliable? Least reliable? Explain.

3. Do you think that different samples of the same mineral could yield different results for any of the tests you constructed? If so, which tests?

(B-2.21) 4. Refer to your identification chart and make a list of all the different elements found in the minerals studied. Indicate how many different minerals each element appeared in. Which elements appear to be quite abundant?

(MINERAL IDENTIFICATION CHART)

Luster -- The way a mineral's surface appears in reflected light.
Streak -- The color of a fine powder of the mineral - usually rubbed on a streak plate.
Hardness: Soft - can be scratched by your fingernail; medium - cannot be scratched by fingernail but can be scratched by a piece of window glass; hard - cannot be scratched by a piece of window glass.

MINERAL NAME AND COMPOSITION	COLOR	WAY IT BREAKS	LUSTER	STREAK	HARDNESS	OTHER CHARACTERISTICS
Quartz SiO_2	white, gray, pink	shell-like	glassy	white	hard	translucent
Feldspar $KAlSi_3O_8$	white, pink, green	uneven	glassy, pearly	white	hard	translucent on edges
Calcite $CaCO_3$	all colors	Splits into forms like bent over cubes	glassy, dull	white	medium	transparent to opaque - bubbles in HCl
Mica $K(Mg,Fe)_3(OH_1F)_2$-$AlSi_3O_{10}$	black to brown or colorless	splits into thin sheets	glassy, pearly	white	medium	Elastic, transparent thin sheets, flexible
Hornblende $Ca_2(Mg,Fe)_5(OH)_2$-$(Al,Si)_8O_{22}$	black to green	uneven splinters	glassy	dark green	hard	long 6-sided crystals
Garnet $Fe_3Al_2(SiO_4)_3$	red to black	uneven	waxy to glassy	white	hard	brittle, rounded, translucent
Olivine $(Mg,Fe)_2SiO_4$	yellow-black	uneven	pearly-glassy	pale green	hard	granular masses, sugary, glassy grains
Talc $Mg_3(OH)_2Si_4)_{10}$	white, light green	splits smooth in one plane	pearly-glassy	white to green	soft	greasy feel, foliate foliated, massive
Magnetite Fe_3O_4	black	uneven	metallic	black	hard	magnetic, brittle, heavy
Hematite Fe_2O_3	red to black	uneven	metallic to dull	red-brown	hard	brittle, opaque, never in crystals
Limonite $H\ Fe\ O_2$	yellow, brown	shell-like	dull	yellow-brown	soft to hard	earthy, dull, brittle
Malachite $Cu_2(OH)_2CO_3$	green	fibrous	dull	light green	medium to hard	bubbles in acid (HCl)
Azurite $Cu_3(OH)_2(CO_3)_2$	blue	fibrous	glassy	light blue	medium	bubbles in acid, ore of copper
Cassiterite SnO_2	red-brown	uneven	dull	white-brown	hard	heavy rounded masses, ore of tin

(MINERAL IDENTIFICATION CHART)

Luster -- The way a mineral's surface appears in reflected light.
Streak -- The color of a fine powder of the mineral - usually rubbed on a streak plate.
Hardness: Soft - can be scratched by your fingernail; medium - cannot be scratched by fingernail but can be scratched by a piece of window glass; hard - cannot be scratched by a piece of window glass.

MINERAL NAME AND COMPOSITION	COLOR	WAY IT BREAKS	LUSTER	STREAK	HARDNESS	OTHER CHARACTERISTICS
Sphalerite ZnS	brown to black	splits into shiny surfaces	waxy	light	medium to hard	brittle, ore of zinc
Galena PbS	gray to black	splits into cubic forms	metallic	gray to black	medium	cubic crystals, ore of lead, heavy
Bauxite $Al(OH)_3$	red to brown	uneven	dull	red to brown	soft to medium	lumpy appearance, massive, odor of wet clay when wet, ore of aluminum
Sulfur S	yellow	shell-like	greasy	white	medium	crackles in heat of hand, brittle
Gypsum $CaSO_4 \cdot 2H_2O$	colorless to white or gray	brittle	pearly to dull	white	soft	used for wallboard and plaster
Graphite C	dark gray to black	splits in one plane	dull opaque	black	soft	used in lead pencils
Pyrite FeS_2	brass-yellow	uneven	metallic opaque	greenish-black	hard	called fool's gold
Asbestos $Mg_6(OH)_8Si_4O_{10}$	white to greenish-white	fibrous	silky	white	soft	used to make heat-insulating cloth
Corundum Al_2O_3	yellow-brown	uneven	dull	white	very hard	next in hardness to diamond
Kaolin $Al_4(OH)_8Si_4O_{10}$	white	earthy	dull	white	very soft	used as a clay to make pottery
Fluorite CaF_2	colorless to purple	brittle	transparent to translucent	white	medium	some forms fluoresce under ultraviolet lamp
Halite $NaCl$	colorless	blocky	glassy	white	soft	tastes salty.

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STUDENT WORKSHEET

MINERAL NAME	COLOR	WAY IT BREAKS	LUSTER	STREAK	HARDNESS	OTHER CHARACTERISTICS

Challenging (2)

XI-B-2b: STRUCTURE OF MINERALS

QUESTION:

What are some characteristics of minerals?

MATERIALS:

Fifteen 1½-inch styrofoam spheres and four ½-inch styrofoam or plastic spheres per group, pipe cleaners, silicate mineral samples (quartz, feldspar, olivine, mica, hornblende, asbestos, etc.), a halite specimen of approximately 2 cubic centimeters, steel knife or scalpel, clay, and a hammer.

SUGGESTED APPROACH:

Part I 1. Discuss with students the relative abundance of silicon and oxygen in the earth's crust.

2. Have students attempt to build a silicon-oxygen tetrahedron and, having done so, have them attempt a double tetrahedra and then a chain of tetrahedra.

3. Construct for the students, or illustrate with a diagram, a double chain and a sheet of tetrahedra.

4. Ask the students what forms they think the minerals would have if the minerals had the various structures that have been considered.

5. Give students samples of silicate minerals that show good crystal form, and ask them to suggest tetrahedral structures for each.

Part II 1. Have the students split a halite specimen, or do it yourself as demonstration. Relate this to the idea of diamond "cutting."

2. Have the students construct a model, using the styrofoam balls, that would explain why halite can be split.

PRECAUTIONS:

1. Construction of double chain and sheet silicate models is difficult, and it is suggested that the instructor practice making them before attempting them with a class.
2. Safety precautions should be discussed and followed to prevent the students from cutting themselves when splitting halite.

TYPICAL RESULTS:

Students will usually construct several incorrect models of the tetrahedron before obtaining the correct one.

MODIFICATIONS:

Give the students prepared models of mineral structures, and have them suggest a form for that mineral's appearance.

REFERENCES:

Investigating the Earth, p. 50, Teacher's Guide, p. 74, pp. 77-82.

XI-B-2b: STRUCTURE OF MINERALS

QUESTION:

What are some characteristics of minerals?

INTRODUCTION:

Some mineral samples appear to have regular or crystal forms. Scientists have found through X-ray studies that these samples have a regular atomic arrangement. In fact, all minerals have, at least to some extent, a regular arrangement. In this investigation, you will be studying models that scientists have constructed for some of the silicate (silicon-oxygen) minerals. You will also investigate a non-silicate mineral (halite).

OBJECTIVES:

When you have finished this investigation, you should be able to:

1. construct a physical model of a silicon-oxygen tetrahedron and justify that model as opposed to other possible arrangements.
2. construct and explain a physical model that shows how silicon-oxygen tetrahedra join by sharing oxygen atoms.
3. given a silicate mineral in crystal form, suggest a possible arrangement of the tetrahedra.
4. construct a model of the molecular arrangement of a mineral having examined its splitting pattern and crystal shape.

METHOD:

Part I

1. Take four of the large spheres (oxygen atoms) and one of the small spheres (silicon atom) and put the five into as compact an arrangement as possible. Check your model with your instructor before proceeding.
2. Build a second model in the same way as the first. Now join the two tetrahedra in such a way as to share one oxygen.
3. Try to build a chain of tetrahedra.
4. Examine the silicate mineral samples that your instructor will provide and see if you can suggest an appropriate atomic structure for each.

Part II 1. Take a large crystal of halite, fasten it to a lump of clay, and split it with a knife in a particular direction. (The best technique for this is to place the blade on the crystal and tap it gently with a hammer.) Describe what you observe.

2. Try cutting the crystal (as above) in various other directions, and describe what you observe.

3. Stack the styrofoam balls to resemble your idea of the atomic structure of a halite crystal, based upon what you observed in steps 1 and 2.

QUESTIONS:

Part I (B-2.31) 1. What is the ratio of silicon atoms to oxygen atoms in a simple tetrahedron? In a double tetrahedron? In a single chain of tetrahedra?

2. If a mineral has a structure of chains of tetrahedra, what do you think holds the chains together?

(B-2.32) 3. Why do you think the mineral mica breaks the way it does?

Part II 1. Draw a sketch of the model you constructed to represent the structure of halite.

(B-2.32) 2. Why does halite split with a plane surface only in certain directions?

(B-2.32) 3. How do you think the atoms would be arranged in a mineral that did not split with any plane surface.

Easy (1)

XI-C-1a: FORMATION OF SEDIMENTARY ROCKS

QUESTION:

How are sedimentary rocks formed?

MATERIALS:

Sediment (sand, pebbles, dirt, etc.), sugar, salt, Portland cement, epoxy, glue, plaster of paris, dilute HCl, samples of sedimentary rock (sandstone, shale, limestone, conglomerate), paper or plastic cups, glass bottles or beakers, and one or more of the following (alum, potassium nitrate, sodium nitrate, potassium permanganate, copper sulfate).

SUGGESTED APPROACH:

1. Since students will have already considered how sediments are formed, ask them how they think these sediments might be converted, in nature, into rocks. Ask them if they can think of any ways in which sedimentary rocks can be formed other than from sediments.
2. Have the students devise and perform procedures for making "sedimentary rocks" in the laboratory. It may be wise to have them clear procedures with you before proceeding.
3. Have the students grow some "sedimentary rock" crystals from a saturated water solution, using one or more of the salts listed under materials above. This can be done by dissolving as much of the salt as possible in a beaker or jar filled with warm water. Place the jar in a position where it can be left undisturbed for a few days. The crystals will "grow" on the bottom of the jar.
4. In a class discussion, examine the results of the students' efforts.
5. Give students the sedimentary rocks for examination. Discuss their interpretations. Stress the processes of cementation, compaction, and solution.
6. This investigation can be concluded by showing the EB film "Rocks That Form on the Earth's Surface."

PRECAUTIONS:

1. Care must be taken in relating the processes the students use in the laboratory to make sedimentary rocks to the processes active in nature. In some cases, the model may not be a very good approximation to what happens in nature.
2. Some of the chemicals mentioned should be used with caution.

TYPICAL RESULTS:

Since much attention previously has been given to sediments, students will most likely devise procedures that employ cementation and compaction. Less likely to be devised is the process of crystal growing, therefore, this may have to be suggested by the teacher.

MODIFICATIONS:

1. Give students several samples of artificially prepared "sedimentary rocks" and ask them to tell how they were made. They should still be given, however, some real sedimentary rocks to examine.

2. A fishline or piece of nylon can be suspended in the saturated solution (crystal-growing exercise) to act as a support on which crystals will develop.

REFERENCES:

A Sourcebook for the Physical Sciences, pp. 64-65.
Crystals and Crystal Growing, Alan Holden, Science Study Series

XI-C-1a: FORMATION OF SEDIMENTARY ROCKS

QUESTION:

How are sedimentary rocks formed?

INTRODUCTION:

You have already considered how sediments may be formed in nature. The appearances of many rocks found in nature suggest that they may have been formed from sediments. Such rocks are called sedimentary rocks. While many sedimentary rocks are formed from sediments, there are some processes for forming sedimentary rocks that do not require sediments.

OBJECTIVES:

When you have finished this investigation, you should be able to:

1. describe the ways in which sedimentary rocks may form.
2. describe how a given sedimentary rock sample may have formed.

METHOD:

1. Devise some procedures for making "sedimentary rocks." Check your procedures with your instructor, and then try them.
2. When you have completed step 1, your instructor will give you some sedimentary rocks to examine. Describe how you think these rocks might have formed in nature.

QUESTIONS:

(C-1.11) 1. Describe the basic processes by which sediments are changed into sedimentary rocks.

(C-1.21) 2. Some sedimentary rocks do not originate from loose sediment; describe how these rocks may form.

3. Relate the procedures you used in step 1 above to similar processes in nature. How were they similar? different?

4. Do you think that different sedimentary rock forming processes could produce similar rocks?

5. Can you tell from examining a sedimentary rock, where it was formed (e.g. river channel, river delta, lake bottom, ocean floor, etc.)? If so, try to apply this to some of the rock samples?

6. Geologists sometimes use the expression "story in the rocks." How do you think this might apply to the rocks you have examined?

(C-1.21) 7. Describe the relationship between crystallization and sediment changing into rocks.

(C-1.31) 8. Is there any evidence of biologic formation in any of the sedimentary rocks that your teacher has provided for your observation?

Easy (1)

XI-C-2a: FORMATION OF NONSEDIMENTARY ROCKS

QUESTION:

How are nonsedimentary rocks formed?

MATERIALS:

Salol, heat source (e.g., stage on overhead projector, hot plate, Bunsen burner, etc.) microscope slides, petri dishes, stereo-microscopes or hand lenses.

SUGGESTED APPROACH:

1. Discuss with the students some possible ways that nonsedimentary rocks may form.

2. Have the students attempt one or more of the techniques for growing crystals from a melt.

3. Have the students design and carry out an investigation to determine what affect cooling rate has on crystal size.

4. Have the students observe some nonsedimentary rocks using the stereo-microscope or hand lens, and infer probable cooling rates.

5. In a concluding discussion, have the students relate what they have done in this investigation to the actual earth processes that form nonsedimentary rock.

TYPICAL RESULTS:

Possible techniques for growing crystals include:

1. Placing small amount of salol on a microscope slide, melt it, and observe crystal formation as cooling occurs.

2. Melt a small quantity of salol, transfer it to a glass petri dish, and place it on the stage of an overhead projector. As cooling occurs, the crystal-growing process can be projected on a screen. (Note: The microscope slide cannot be used for this technique because the heat from the projector lamp will prevent cooling from occurring.)

3. Different cooling rates may be observed by:

   A. Placing a petri dish containing an ice cube on the stage of the stereo-microscope. Place the slide containing the melted salol on the ice cube and observe the rapid cooling.

   B. Place stereo-microscopes at different temperature locations around the room (e.g., near radiators, near a cold window, etc.). Allow students to observe cooling under first one, and then another, of the microscopes.

XI-C-2a: FORMATION OF NONSEDIMENTARY ROCKS

QUESTION:

How are nonsedimentary rocks formed?

INTRODUCTION:

Many rocks are not composed of particles that resemble loose sediment. These rocks often resemble a mass of tiny intergrown crystals. When examined closely, a wide range in crystal sizes may be observed. What factors influence the development of these characteristics in certain rocks?

OBJECTIVES:

When you finish this investigation, you should be able to:

1. identify crystalline rocks as probably being of nonsedimentary origin.
2. describe the relationship between cooling rate of a melt and the resulting crystal size.
3. explain possible earth processes that may result in the formation of nonsedimentary rocks.

METHOD:

1. Place a small amount of salol powder on a microscope slide. Hold the slide over a heat source until the salol melts. (Caution - if the heat source temperature is too high it may break the slide.)
2. Observe the liquid salol under a hand lens or stereo-microscope as it undergoes cooling. Describe what you see.
3. Devise a method for investigating the relationships between the size of the crystals and the rate at which the melt cools.

QUESTIONS:

(C-2.11) 1. How do some nonsedimentary rocks form?

(C-2.12) 2. Describe at least one factor that influences the size of the crystals formed.