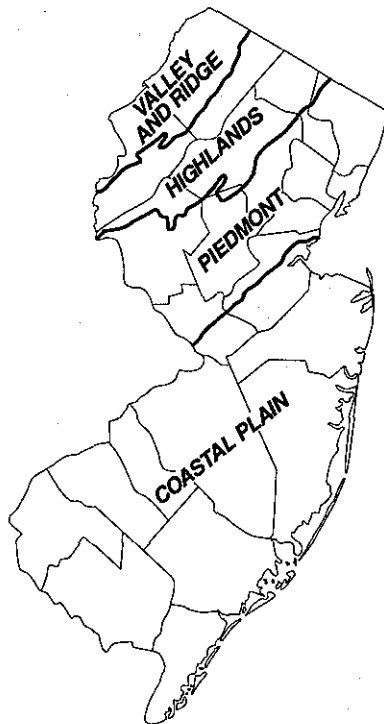


NEW JERSEY ROCKS AND SEDIMENTS KIT

**TEACHING GUIDE
AND STUDENT ACTIVITIES
FOR KINDERGARTEN THROUGH GRADE EIGHT**



**THE STERLING HILL MINING MUSEUM
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Funding for this project has been generously provided by the
GERALDINE R. DODGE FOUNDATION
with in-kind contributions from
NEW JERSEY GEOLOGICAL SURVEY
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Published by the New Jersey Geological Survey, P.O. Box 427, Trenton, NJ 08625.

<http://www.state.nj.us/dep/njgs>

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NEW JERSEY ROCKS AND SEDIMENTS KIT

TEACHING GUIDE AND STUDENT ACTIVITIES FOR KINDERGARTEN THROUGH GRADE EIGHT

For use with the New Jersey Rocks and Sediments samples distributed by:
New Jersey Department of Environmental Protection
Division of Science, Research and Technology
New Jersey Geological Survey

Kim Merlino

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2000

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Acknowledgements

Development of the *New Jersey Rocks and Sediments Kit Teaching Guide* is part of The Sterling Hill Mining Museum's CRYSTALS project, which has been funded by a grant from the Geraldine R. Dodge Foundation of Morristown, New Jersey. Special thanks to New Jersey Geological Survey for publishing this document.

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What's Your Favorite Rock Group?

NJ Core Curriculum Standards:

- Describe and sort objects according to the materials from which they are made and their physical properties. (Science 5.8.1.)
- Investigate materials that make up the earth, including rocks, minerals, soils, and fossils, and how they are formed. (Science 5.10.2.)

ESPA Content/Skill Outlines:

- Classify—Arrange and distribute objects, events or information in groups according to some method or system. (5.2.1.2.3.4.5—Skills)
- Observe, describe, and sort objects according to their physical properties and the materials from which they are made. (5.8.1.2.3—Skills)

Teacher Background: Read about the properties of the rock samples on pages 9–15 of the *New Jersey Rocks and Sediments* booklet. In this activity, children are encouraged to sort objects into two groups based on one property—for example, rocks that have sharp edges and rocks that do not have sharp edges.

Materials: Samples 6–17 from New Jersey Rocks and Sediments kit, hand lenses, red crayons or markers.

Advance Preparation: Decide whether children will work individually (at a learning station), in small groups, or as a large group. For children who are not able to read the Student Activity Sheet, you may wish to read it to them or eliminate the sheet and provide children with two paper plates on which to place the rocks.

Directions:

- Introduce the activity by showing children how to classify objects into two groups based on one property. For example, show them how pencils can be sorted into those that have erasers and those that do not have erasers.
- Demonstrate for children how to use a hand lens to see details that cannot not be seen with the unaided eye.
- Make sure nonreaders understand the directions on the Student Activity Sheet. Explain that there are many ways to group the rocks—and, therefore, many solutions to the problem.

Discussion/Journal Entry Questions:

- How did you sort your rocks? (*Classifying*)
- Can you think of another way to sort the rocks? (*Hypothesizing*)
- Which of the two rock groups was your favorite? Why? (*Evaluating*)

Suggested Evaluation: Have each child or group show you the two groups of rocks and tell what property was used to sort them. Make sure that each child has accurately recorded the numbers of the rock samples that belong in each group.

Name _____

Date _____

Student Activity Sheet for Activity 1

WHAT'S YOUR FAVORITE ROCK GROUP?

1. Use a hand lens to observe all the rocks.
2. Sort the rocks into two groups. Put one group of rocks in each box below.
3. Fill in the sentence in each box. Tell how the groups of rocks are different.

<p>These rocks are _____.</p>	<p>These rocks are _____.</p>
-------------------------------	-------------------------------

4. Write the number of each rock in its box.
5. Pick your favorite rock group. Draw a red dot in its box.

Prospecting for Iron

NJ Core Curriculum Standards:

- Describe and sort objects according to the materials from which they are made and their physical properties. (Science 5.8.1.)
- Investigate materials that make up the earth, including rocks, minerals, soils, and fossils, and how they are formed. (Science 5.10.2.)

ESPA Content/Skill Outlines:

- Different kinds of materials have different properties, For example, 1) Weight, 2) Color, 3) Texture, 4) Hardness, 5) Luster, 6) Reflectiveness (mirrors) to light, sound, and heat, 7) Transparency to light, 8) Sound when struck, plucked, or vibrated. (5.8.1.2.3—Knowledge)
- Observe, describe, and sort objects according to their physical properties and the materials from which they are made. (5.8.1.2.3—Skills)

Teacher Background: Physical properties of matter include a substance's magnetic properties. Read about magnetite on page 15 of the *New Jersey Rocks and Sediments* booklet.

Materials: Samples 6–17 from the New Jersey Rocks and Sediments Kit, magnet, small steel paper clips, pennies

Advance Preparation: Make sure that the magnets you have are attracted to sample 17 (magnetite). Have the names of the rocks, listed on the inside cover of the kit, available when children are ready to answer question 3. You may wish to set up this activity in a learning center, where it can be done effectively by two children at a time. However, if there are nonreaders in the class, you will want to first read the Student Activity Sheet to the whole class.

Directions:

- Introduce the activity by allowing children to experiment with a magnet, paper clips, and pennies. Make sure they understand that a magnet attracts some materials (paper clips) but not others (pennies).
- Explain to children that people get the iron to make paper clips, cars, and other steel products from rocks containing iron. Have them imagine that they are prospectors looking for iron in rocks.

Discussion/Journal Entry Questions:

- Of the rocks you tested, which do you think had the most iron? (*Inferring*)
- Did you put under "yes" the same rock as your classmates? Explain. (*Analyzing*)
- How would you find rocks that have iron in them outdoors? (*Applying*)

Suggested Evaluation: Have children communicate to you how they knew which group to place each rock in.

Name _____

Date _____

Student Activity Sheet for Activity 2

PROSPECTING FOR IRON

1. Hold a magnet near a New Jersey rock.
2. If you feel a pull, put the rock under "yes" on the chart.

If you do not feel a pull, put the rock under "no."

Does a magnet pull on it?	
Yes	No

3. Test the rocks on the "yes" side again.
Which one has the biggest pull?

Rock Print Detective

NJ Core Curriculum Standards:

- Develop strategies and skills for information-gathering and problem-solving, using appropriate tools and technologies. (Science 5.2.2.)
- Investigate materials that make up the earth, including rocks, minerals, soils, and fossils, and how they are formed. (Science 5.10.2.)

ESPA Content/Skill Outlines:

- Observe—Become aware of an object or event by using any of the senses or extensions of the sense to identify properties. (5.2.1.2.3.4.5—Skills)
- Observe, describe, and sort objects according to their physical properties and the materials from which they are made. (5.8.1.2.3—Skills)

Teacher Background: Although many of the rock samples may have been obtained by mechanical crushing, the surfaces of each rock have typical textures and ways of breaking that are used in identifying it.

Materials: Any five rock samples from the New Jersey Rocks and Sediments Kit that have varied textures and shapes, modeling clay or dough

Advance Preparation: Make one or more mystery rock prints by selecting one of the rocks from the kit and pressing it into 1/2-inch slabs of modeling clay or dough. Do not press the side of the rock with the number on it into the clay because the paper with the number might fall off. You may want to do this activity with the whole class, reading the directions on the Student Activity Sheet aloud.

Directions:

- Introduce the activity by discussing how footprints are made and identified at a crime scene. Tell children that rocks can make prints when they are pressed into soft earth or clay, too. Explain that while only the bottom of a shoe makes a footprint, a rock print can be made from any of a rock's sides.
- Before children get started on the activity, have them share their plans for matching the print to a rock. Encourage them to make their own rocks prints and try to match them to the mystery print.
- Tell children that the sides of the rocks with the numbers on them were not used to make the mystery print.

Discussion/Journal Entry Question: How did you know when you found the rock that made the mystery print? (*Analyzing*)

Suggested Evaluation: Have children explain how the mystery print matches the rock from which it was made.

Name _____

Date _____

Student Activity Sheet for Activity 3

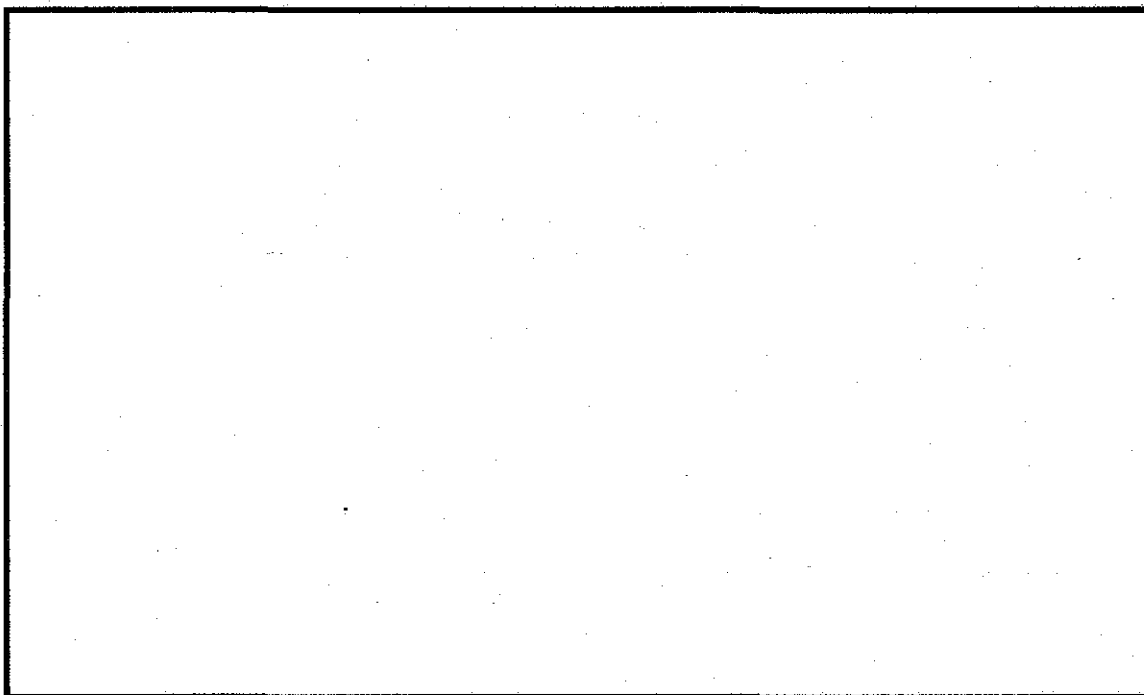
ROCK PRINT DETECTIVE

1. Look at the rock print in clay your teacher made.
2. Plan how to find the rock that made the print.

Do not touch the print.

Use another piece of clay to test your ideas.

3. Write the number of the rock you think made the print. _____
4. Draw or write how you found the rock that made the print.



Smoothies and Roughies

NJ Core Curriculum Standards:

- Use tables and graphs to represent and interpret data. (Science 5.5.4.)
- Describe and sort objects according to the materials from which they are made and their physical properties. (Science 5.8.1.)

ESPA Content/Skill Outlines:

- Different kinds of materials have different properties, For example, 1) Weight, 2) Color, 3) Texture, 4) Hardness, 5) Luster, 6) Reflectiveness (mirrors) to light, sound, and heat, 7) Transparency to light, 8) Sound when struck, plucked, or vibrated. (5.8.1.2.3—Knowledge)
- Read tables and graphs to represent and interpret data. (5.5.1.2.3.4—Skills)

Teacher Background: Geologically speaking, texture refers to the way the grains or crystals are arranged in a rock, making it a property that can be detected visually. However, in this activity, children should focus on using their sense of touch to compare the surfaces of the rock samples.

Materials: Samples 7, 10, 14, and 16 from New Jersey Rocks and Sediments kit

Advance Preparation: Decide whether children will work individually (at a learning station), in small groups, or as a large group. Have the names of the rocks, listed on the inside cover of the kit, available when children are ready to answer questions 4 and 5. If there are nonreaders in the class, you will want to reading the directions on the Student Activity Sheet to them.

Directions:

- Make sure that children understand the meaning of the words *smooth* and *rough*. Discuss common examples of smooth surfaces, such as ice or glass, and rough surfaces, such as burlap or concrete.
- Encourage children to use their sense of touch rather than sight. Have them hold the rocks under a tabletop to compare how they feel. Make sure they feel a flat side of the rock, rather than a corner.

Discussion/Journal Entry Questions:

- What did you think about as you sorted the rocks? (*Classifying*)
- Can you think of another way to sort the rocks? (*Hypothesizing*)

Suggested Evaluation: Although answers will vary from child to child, and because of differences in the samples from kit to kit, a likely response for ordering the rocks from smoothest to roughest would be slate (10), diabase (14), sandstone (7), and ironstone (16).

Name _____

Date _____

Student Activity Sheet for Activity 4

SMOOTHIES AND ROUGHIES

1. Rub each rock with your finger. Think about how it feels.
2. Put the rocks on the line in order from smoothest to roughest.

--	--	--	--

Smoothest Roughest

- 3 Write the number of each rock in its place on the line .

- 4 Which rock feels the smoothest?

- 5 Which rock feels the roughest?

Heavyweight Champion

NJ Core Curriculum Standards:

- Use a variety of measuring instruments, emphasizing appropriate units. (Science 5.5.1.)
- Use mathematical skills and concepts in ordering, counting, identifying, measuring, and describing. (Science 5.5.3.)

ESPA Content/Skill Outlines:

- Different kinds of materials have different properties, For example, 1) Weight, 2) Color, 3) Texture, 4) Hardness, 5) Luster, 6) Reflectiveness (mirrors) to light, sound, and heat, 7) Transparency to light, 8) Sound when struck, plucked, or vibrated. (5.8.1.2.3.—Knowledge)
- Use tools to make accurate measurements. (5.4.1.2.3.—Skills)

Teacher Background: Mass, the amount of matter in an object, is measured with a balance in gram units. Weight, a measure of the gravitational force exerted on an object, is measured with a spring scale in newtons (a unit of force).

Materials: Any four rock samples from New Jersey Rocks and Sediments Kit, balance

Advance Preparation: If you do not have a balance in your classroom, borrow one from another teacher. Set up the balance and rocks at a learning center where children can work individually or in small groups. If there are nonreaders in the class, you will want to reading the directions on the Student Activity Sheet to them before sending them to the center.

Directions:

- Introduce the activity by explaining that some sports have contests in which a person can become champion of the world. Ask children to imagine that the rocks are in a contest to be recognized as the heaviest (having the most mass).
- Make sure children know how to compare the masses of two objects by placing each on one side of a balance.
- When children have completed the activity, bring the class together to find the mass of each sample in grams or nonstandard units (such as paper clips). Have children identify the heaviest (most massive) rock by comparing the masses of the samples.

Discussion/Journal Entry Question: How did your prediction compare to your measurement with a tool? (*Concluding*)

Suggested Evaluation: The heaviest rock will vary from kit to kit due to differences in the samples. Have children explain how they used the balance to compare the rocks.

Name _____

Date _____

Student Activity Sheet for Activity 5

HEAVYWEIGHT CHAMPION

1. Which of the four rocks do you think is heaviest?

2. Put one rock on each side of a balance.

Leave the heaviest rock on the balance.

Take off the other rock and put it away.

3. Put another rock on the balance.

Leave the heaviest rock on the balance.

Take off the other rock and put it away.

4. Do step 2 again.

5. Write the number and name of the heaviest rock.

I Know That Rock!

NJ Core Curriculum Standards:

- Describe and sort objects according to the materials from which they are made and their physical properties. (Science 5.8.1.)
- Investigate materials that make up the earth, including rocks, minerals, soils, and fossils, and how they are formed. (Science 5.10.2.)

ESPA Content/Skill Outlines:

- Collect and Record Data—Collect information about objects and events related to a specific situation and record then in some way such as in a journal, on a table, list, graph, etc. (5.2.1.2.3.4.5—Skills)
- Observe, describe, and sort objects according to their physical properties and the materials from which they are made. (5.8.1.2.3 —Skills)
- Observe and identify earth materials such as rocks and soil. (5.10.2.3.4 —Skills)

Teacher Background: Although identifying the scientific name of a rock may require the use of microscopes and laboratory tests, there are many obvious physical properties by which students can distinguish one kind of rock from another. They may recognize a few of the minerals in a rock—such as specks of shiny mica or translucent quartz. They can also note a rock's color and grain size. The specimens in this kit have been sized to fit in the box; therefore, the properties of shape and size should be used to identify only a particular specimen. They are not necessarily typical of the kind of rock.

Materials: Samples 6–17 from New Jersey Rocks and Sediments Kit, cup of water

Advance Preparation: Grouping is flexible for this activity. One student may go to a learning station and carry out steps 1–4. The student may then leave the written description at the station for another student to carry out step 5. You may also do the activity with the whole class by giving each group of 2–3 students one rock and having them collaborate on recording properties.

Directions: Distribute the Student Activity Sheet and allow students to follow the directions. Students may wish to observe classmates using their lists to identify the rocks. If the list of properties is not sufficient for correct identification, allow students to evaluate and revise their lists.

Discussion/Journal Entry Questions:

- Which properties were most important in helping your classmate pick out your rock from all the others? (*Evaluating*)
- How do prospectors identify the valuable rocks they are looking for? (*Applying*)

Suggested Evaluation: Assess the clarity and accuracy of students' tables.

Name _____

Date _____

Student Activity Sheet for Activity 1

I KNOW THAT ROCK!

1. Your teacher will give you one rock. Write down its number on a slip of paper. Put the paper in your pocket or desk.
2. Observe and record the properties of your rock in the table.
3. Describe any other properties of your rock that make it different from other rocks.

Property	Observations
Colors	
Size	
Shape	
Luster (shiny or dull)	
Texture	
Odor (dipped in water)	
Other	

4. Put your rock back with the others.
5. Give your list to a classmate. See if the classmate can pick your rock out of all the others by using the properties you have listed.

My Rock Is "Heavier" Than Your Rock

NJ Core Curriculum Standards:

- Demonstrate how tools are used to do things better and more easily or to do tasks that could not otherwise be done. (Science 5.4.2.)
- Describe and sort objects according to the materials from which they are made and their physical properties. (Science 5.8.1.)

ESPA Content/Skill Outlines:

- Observe, describe, and sort objects according to their physical properties and the materials from which they are made. (5.8.1.2.3—Skills)
- Use tools to make accurate measurements. (5.4.1.2.3—Skills)

Teacher Background: Although many people use the terms *mass* and *weight* interchangeably, they are not synonymous. Mass is the amount of matter in an object or a measure of an object's inertia (resistance to changes in motion). The mass of an object, which is measured with a balance in gram units, does not change with a change in the object's location. Weight is a measure of the gravitational force exerted on an object. The weight of an object, which is measured with a spring scale in newtons (a unit of force), varies with the object's location. For example, your weight on the moon would be different from your weight on Earth.

Materials: Samples 6–10 from New Jersey Rocks and Sediments kit, three-foot-long strips of paper or adding machine tape, balance with gram masses

Advance Preparation: You may wish to set up this activity in a learning station and allow one student or pairs of students to complete the activity independently. Make sure students know how to measure mass with a balance. You may also want to complete step one for the students on a worksheet.

Directions: Distribute the student page and have students follow the directions.

Discussion/Journal Entry Questions:

- How did your prediction compare to your measurements? (*Analyzing*)
- When is using a scale or balance useful in daily life? (*Applying*)
- When is estimating weight or mass useful in daily life? (*Applying*)

Suggested Evaluation: Have students describe and explain any differences between their estimates and actual measurements.

Name _____

Date _____

Student Activity Sheet for Activity 2

MY ROCK IS "HEAVIER" THAN YOUR ROCK

1. On a strip of paper, draw a line and label it like the one shown.

Lightest			Heaviest

2. Pick up any two rocks. Put one rock in each hand and compare how heavy the rocks feel.
3. Place the lighter rock at the left end of the line you made. Place the heavier rock at the right end of the line.
4. Repeat steps 2 and 3 for the remaining rocks. Compare them to the rocks you already put on the line. Continue to arrange the rocks until they are all in order. Record their order by writing each rock's number on the line. This is your prediction.
5. Use the balance to find the actual mass of each rock. Record the mass in the table.

Rock Number	6	7	8	9	10
Mass (g)					

6. Place the rocks in order, from lightest to heaviest on the line you made. How did your prediction compare to your measurements?

Where Did That Come From?

NJ Core Curriculum Standards:

- Use maps, globes, diagrams, and computer-based references and information systems to generate and interpret information. (Social Studies 6.7.1.)
- Compare the effects of geography on economic activities locally and in New Jersey, the United States, and different parts of the world. (Social Studies 6.8.3.)

ESPA Content/Skill Outlines:

- Predict—Make a forecast of future events or conditions expected to exist. (5.2.1.2.3.4.5—Skills)
- Maps are used to present information about the Earth, e.g., land features and weather conditions. (5.10.2.3.4—Knowledge)
- Demonstrate the use of different kinds of maps. (5.10.2.3.4—Skills)

Teacher Background: Read about the sources and economic value of each sediment and rock sample on pages 6–15 of the *New Jersey Rocks and Sediments* booklet.

Materials: Samples 1–17 from the New Jersey Rocks and Sediments Kit, colored pencils

Advance Preparation: Enlarge and photocopy the map on the cover of the *New Jersey Rocks and Sediments* booklet. Make a reference copy for each group of students.

Directions:

- Provide students with the photocopies of the map entitled New Jersey Rocks and Sediments. Tell students to write on the Student Activity Sheet map the number and name of each rock and sediment sample, showing the place from which it comes.
- Have students use the small map as a reference as they color each region of New Jersey as follows: Coastal Plain—yellow; Piedmont—green; Highlands—blue; Valley and Ridge—red.

Discussion/Journal Entry Questions:

- Why do you think the sands are all from the Coastal Plain? (*Inferring*)
- From what region do the basalt and diabase samples come? (*Interpreting Data*)
- Which sample comes from a place closest to where you live? (*Interpreting Data*)

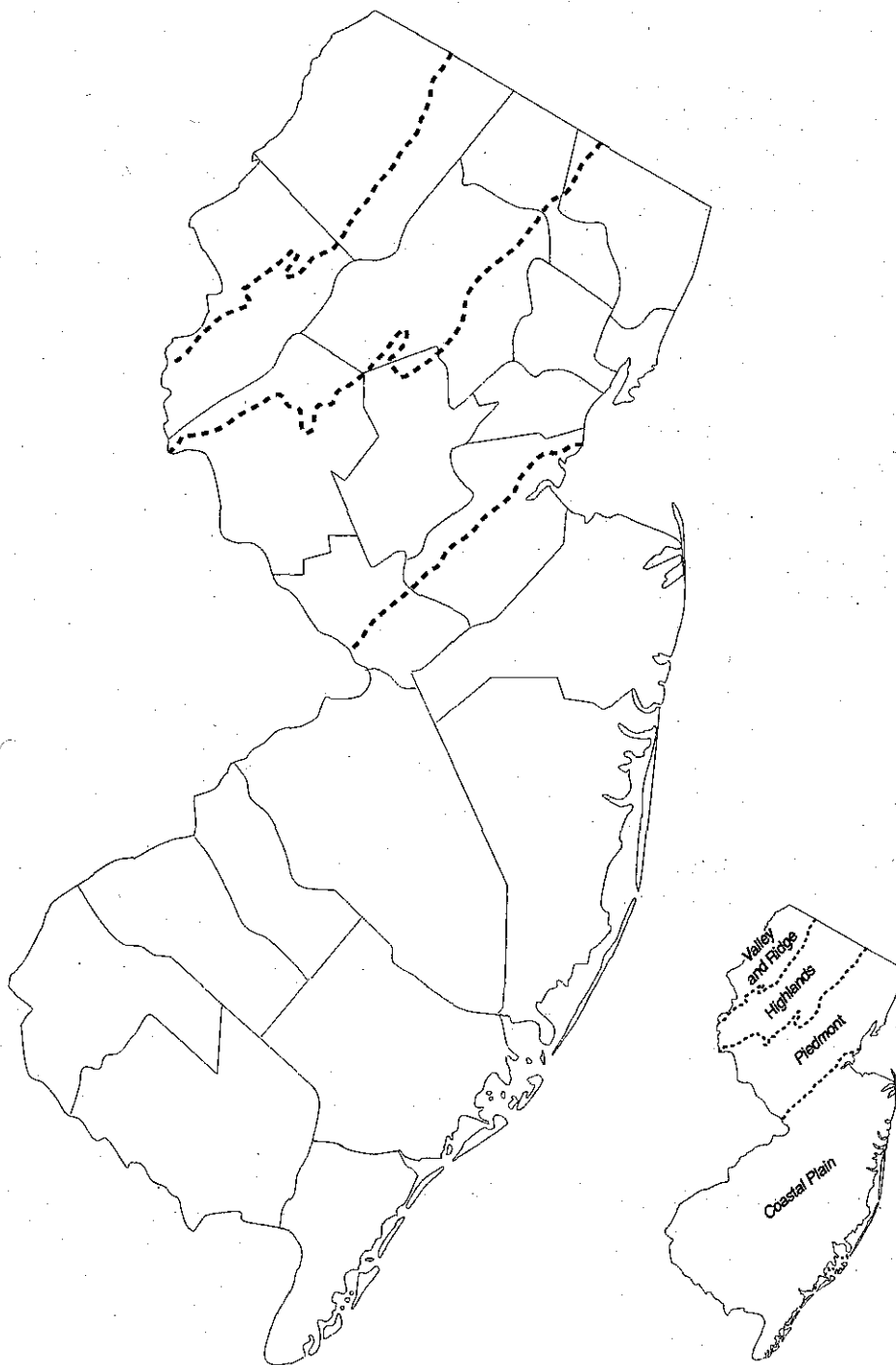
Suggested Evaluation: Assess students' maps for accuracy by calling out the name of a rock or sediment and having students use their maps to respond with the region of origin.

Name _____

Date _____

Student Activity Sheet for Activity 3

WHERE DID THAT COME FROM?



Find the Fossils

NJ Core Curriculum Standards:

- Investigate matter by observing materials under magnification. (Science 5.8.3.)
- Investigate materials that make up the earth, including rocks, minerals, soils, and fossils, and how they are formed. (Science 5.10.2.)

ESPA Content/Skill Outlines:

- Manipulate Materials—Handle or treat materials and equipment skillfully and effectively; perform acts that replicate demonstrated symbols, patterns, or procedures. (5.2.1.2.3.4.5—Skills)
- Tools are to be used to do things better and more easily. (5.4.1.2.3—Knowledge)
- Observe and identify earth materials such as rocks and soils. (5.10.2.3.4—Skills)

Teacher Background: You may wish to do this activity in conjunction with units on the ocean or classification of living things. Read about the contents of lime sand on pages 8–9 of the *New Jersey Rocks and Sediments* booklet. Most bryozoans, which look more like plants than animals, are less than a millimeter in diameter. They live in colonies attached to hard materials in shallow water and cemented to one another by their hard external skeletons. Foraminifera are one-celled organisms that construct shells, some of which are strikingly beautiful. Their fossilized shells are plentiful in ancient sediments; however, a microscope is needed to see them.

Materials: Sample 4 (Lime Sand) from New Jersey Rocks and Sediments Kit, clear plastic zip-lock bag, tape, sheet of white paper, hand lens (6X magnification, if possible)

Advance Preparation: You may wish to set up this activity at a learning station or do it with the entire class at once. If you wish to have the entire class work at once, divide the lime sand sample into several zip-lock bags. Tape over the zippers to insure that the bags do not open accidentally.

Directions: Provide a place for students to work that has bright light. Do not display the fossil pictures until students have made their sketches.

Discussion/Journal Entry Questions:

- What fossils do you think you found in the lime sand? (*Inferring*)
- What organisms alive today do the fossils remind you of? (*Classifying*)
- How do you think this sediment formed? (*Hypothesizing*)
- Why might your drawing look different from those of other students? (*Analyzing*)

Suggested Evaluation: Collect the Student Activity Sheets to assess the detail and accuracy of students' sketches.

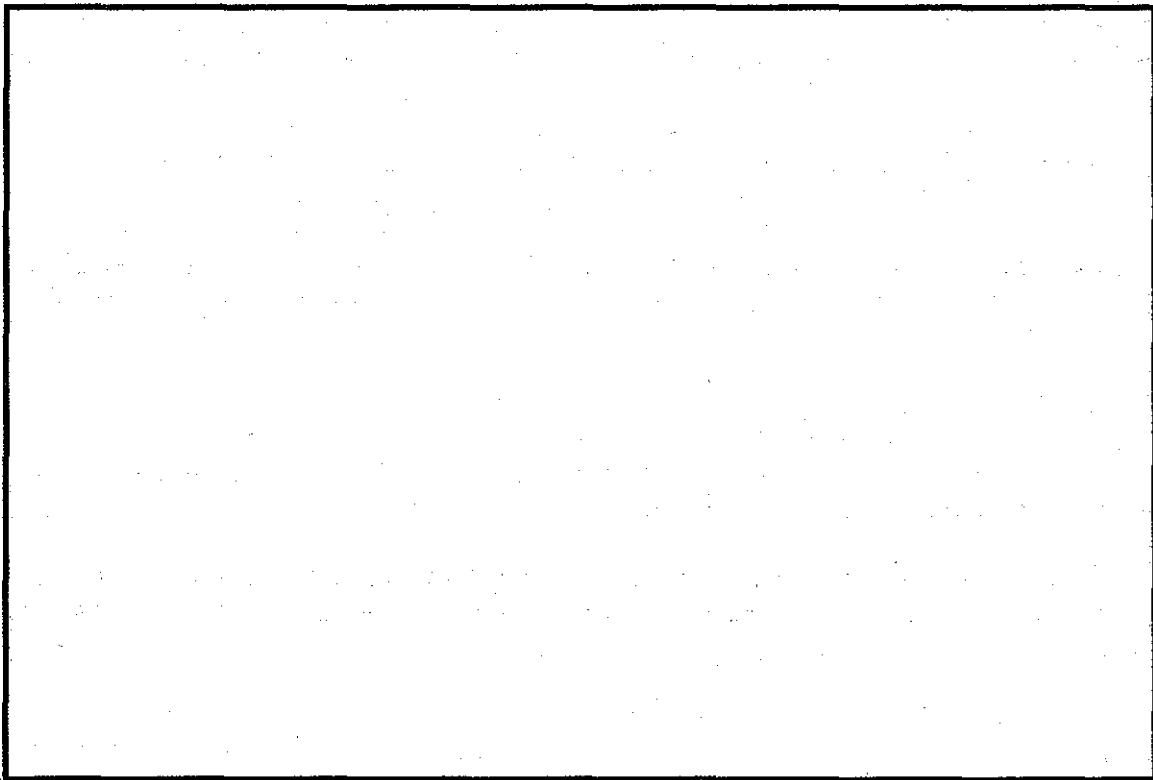
Name _____

Date _____

Student Activity Sheet for Activity 4

FIND THE FOSSILS

1. Place a bag of lime sand on a sheet of white paper.
2. Gently wiggle the bag to move around the lime sand. Use your hand lens to look for shapes that remind you of parts of living things found in the ocean.
3. Sketch what you find below. Make your sketches large enough to show all the details you observed.



4. What kinds fossils do you think you found? How could you find out?

Can You See Them?

NJ Core Curriculum Standards:

- Investigate materials that make up the earth, including rocks, minerals, soils, and fossils, and how they are formed. (Science 5.10. 2.)
- Investigate matter by observing materials under magnification. (Science 5.8.3.)

ESPA Content/Skill Outlines:

- Classify—Arrange and distribute objects, events or information in groups according to some method or system. (5.2.1.2.3.4.5—Skills)
- Observe and identify earth materials such as rocks and soils. (5.10.2.3.4—Skills)

Teacher Background: Read about the difference between rocks and minerals on pages 2–3 of the *New Jersey Rocks and Sediments* booklet. The size of the mineral crystals, or grains, in a rock sample can be clues to its origin. Make sure students look at the overall grain, not any particularly large crystal that may be set into it.

Materials: Samples 6–17 from New Jersey Rocks and Sediments Kit, hand lens

Advance Preparation: None

Directions: Because the classification method is subjective, students' results may vary from those below. These results were obtained with a 6X hand lens.

Comparing Grain Sizes		
Grains are too small to see with a hand lens.	Small grains can be seen with a hand lens.	Grains are large and can be seen without a hand lens.
6. shale 10. slate	7. sandstone 8. limestone 9. dolomite 12. marble 15. basalt 17. magnetite	11. quartzite 13. gneiss 14. diabase 16. ironstone

Discussion/Journal Entry Question: Were there differences between your results and those of other students? Explain why. (Interpreting Data)

Suggested Evaluation: Ask each student to explain how he or she classified one rock sample.

Name _____

Date _____

Student Activity Sheet for Activity 5

CAN YOU SEE THEM?

1. Find a side of each rock that looks like it was recently broken. Use a hand lens to observe the rock. Look for mineral grains.
2. Compare the rocks based on the sizes of their grains. If a rock is smooth, the grains are too small to see.
3. Write the name of each rock in one of the columns in the chart.

Comparing Grain Sizes		
Grains are too small to see with a hand lens	Can see small grains with a hand lens	Grains are large and can be seen without a hand lens

4. Compare your results to those of others. Explain any differences.

A Never-Ending Story

NJ Core Curriculum Standards:

- Describe components of a system and how they influence one another. (Science 5.1.4.)
- Describe and explain the causes of the natural processes and events that shaped the earth's surface and interior. (Science 5.10.8.)

GEPA in Science Content/Skill Outlines:

- State and support a conclusion based on data. (5.2.6.7.8.9.10.11—Skill)
- New features on the earth's crust are formed as a result of dynamic forces. (5.10.5.6.7.8.9.10—Knowledge)
- Describe a sequence of events that explains how the earth's surface has been changed over time. (5.10.5.6.7.8.9.10—Skill)

Teacher Background: Read about the three main types of rocks on pages 4–5 of the *New Jersey Rocks and Sediments* booklet.

Materials: Samples 2, 3, 6, 7, 10, 11, and 15 from the New Jersey Rocks and Sediments Kit, sheets of paper

Advance Preparation: Students should be familiar with the rock cycle diagram before starting this activity. This activity can be done individually at a learning center. It may also be done by two groups of students at the same time if one group starts with the rocks listed in step 2 and the other group starts with the rocks listed in step 5.

Directions: Provide each student, or group of students, with a copy of Student Activity Sheet A, the rock cycle diagram on Student Activity Sheet B, and two sheets of paper.

Discussion/Journal Entry Questions:

- How do the rocks in step 2 make a complete loop of the rock cycle?
(Concluding)
- How do the rocks in step 5 make a complete loop of the rock cycle?
(Concluding)

Suggested Evaluation: Collect the rock cycle diagrams and assess them for accuracy and completeness. Samples of completed diagrams follow the Student Activity Sheets.

Name _____

Date _____

Student Activity Sheet A for Activity 1

A NEVER-ENDING STORY

Rocks can be changed in many ways, including by heat, pressure, and chemical reactions. As a matter of fact, rocks are always changing. These changes are called the rock cycle.

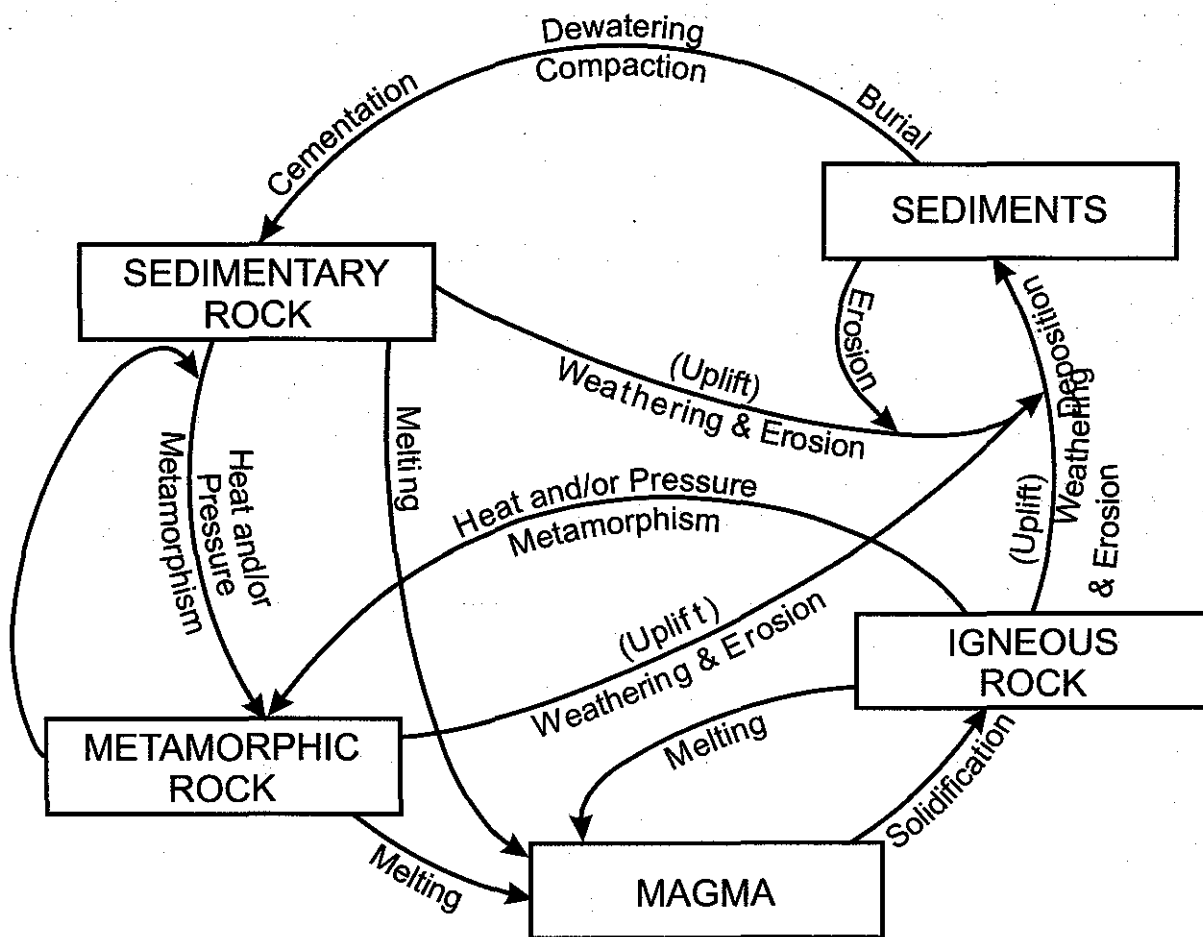
1. Look at the rock cycle diagram on Student Activity Sheet B that shows all the ways rocks can change.
2. Use the clues in the table to place the samples of New Jersey quartzite, sandstone, and sand on the diagram.

CLUES		
Rock Name	Rock Group	Formed from:
Quartzite	metamorphic	quartz
Sandstone	sedimentary	sand
Basalt	igneous	magma
Slate	metamorphic	shale
Shale	sedimentary	clay

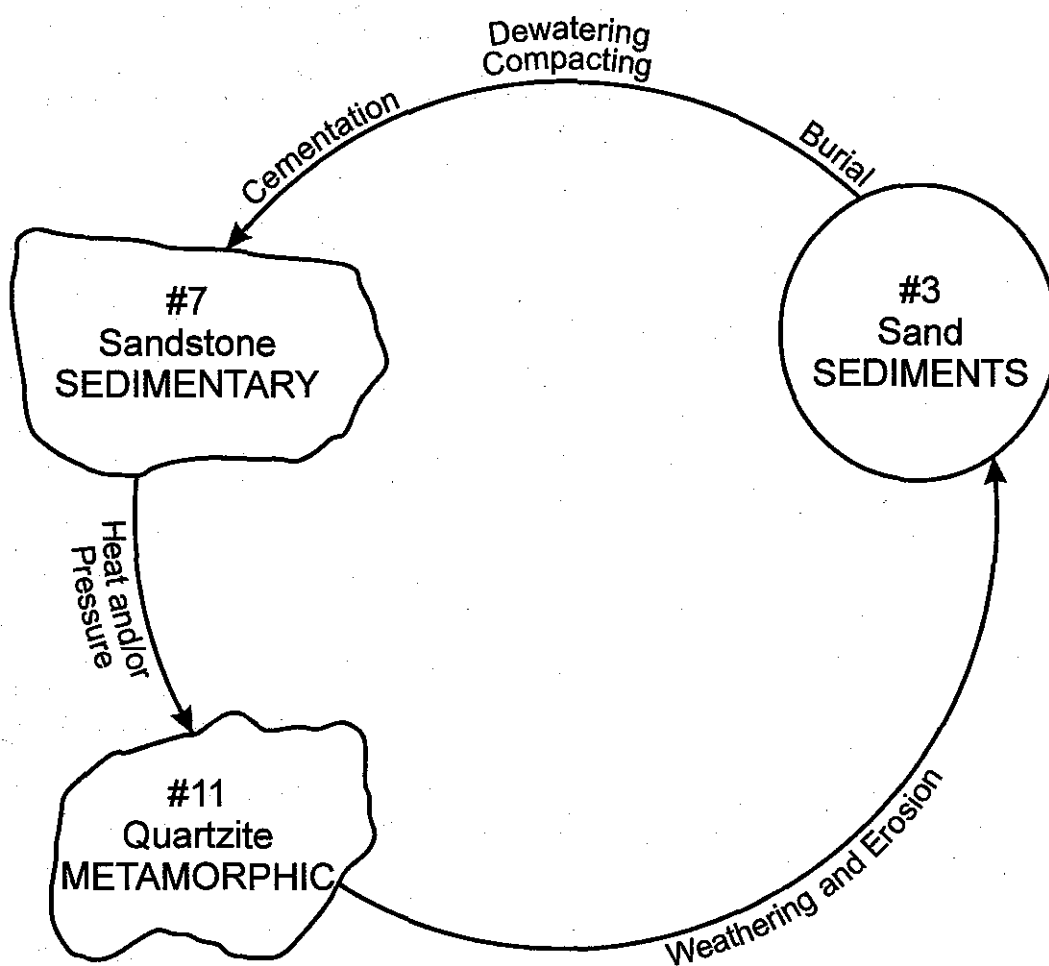
3. On a separate sheet of paper, draw a simplified rock cycle. Trace each sample in its correct position. Draw arrows to show how these rocks form one complete loop of the rock cycle. Label all the parts of your diagram.
4. Put the samples back in the kit.
5. Now get the samples of New Jersey basalt, slate, shale, and clay. Using the clues in the table, draw another diagram. Trace each sample in its correct position. Draw arrows to show how these rocks form another complete loop of the rock cycle. Label all the parts of your diagram.
6. Put the samples back in the kit.

Student Activity Sheet B for Activity 1
A NEVER-ENDING STORY

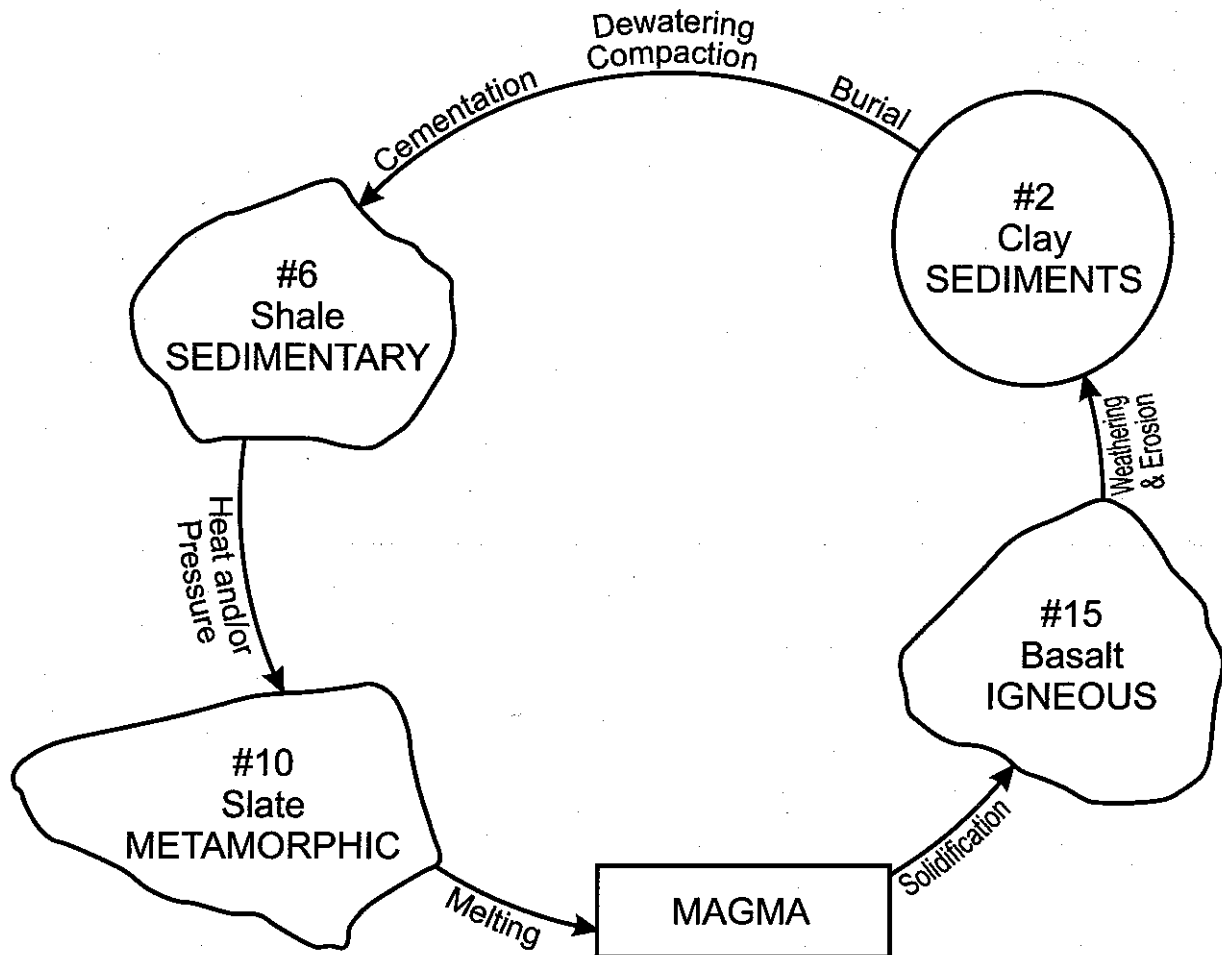
Rock Cycle in Earth's Crust



A Never-ending Story



A Never-ending Story



Comparing New Jersey Sediments

NJ Core Curriculum Standards:

- Describe and explain the causes of the natural processes and events that shaped the earth's surface and interior. (Science 5.10.8.)

GEPA in Science Content/Skill Outlines:

- Observe an object or event by using any of the senses or extensions of the senses to identify properties. (5.2.6.7.8.9.10.11—Skill)
- Forces that wear the earth's surface down include weathering, glaciation and erosion. Features formed as a result of these forces include soil and valleys. (5.10.5.6.7.8.9.10—Knowledge)
- Describe a sequence of events that explains how the earth's surface has been changed over time. (5.10.5.6.7.8.9.10—Skill)

Teacher Background: Read about glass sand, lime sand, and greensand on pages 8–9 of the *New Jersey Rocks and Sediments* booklet. Uniformity of grain size is a clue, among others, that sediments were well sorted during transport from one location to another. Rounded, polished particles were created by abrasion during transport by streams or waves. Grains of sand that look glasslike and rounded are most likely quartz. Shiny sheet-like particles are most likely mica. Quartz sands are typical of continental margin beach sands.

Materials: Samples 3, 4, and 5 from the New Jersey Rocks and Sediments kit, 3 Petri dishes, transparent tape, binocular microscope or hand lens

Advance Preparation: Use transparent tape to seal a small amount of each sample in a Petri dish. Provide students with a binocular microscope with 10X and 20X magnification, making sure there is adequate light for observation. You may wish to set up the microscope or hand lens and the Petri dishes in a learning center, which students can visit individually or in pairs and work independently. If possible, obtain for students a standard chart used by geologists that graphically compares particles by their degree of roundness and sphericity.

Directions: Make sure students know how to use the binocular microscope or hand lens before beginning the activity. You may want to have students compare the observations they recorded in the table and discuss any differences.

Discussion/Journal Entry Questions:

- How would you describe each sample to a friend? (*Communicate*)
- What does each question in the table tell you about that kind of sediment? (*Inferring*)

Suggested Evaluation: Assess the accuracy of students' recorded observations and the logic of their inferences.

Name _____

Date _____

Student Activity Sheet for Activity 2

COMPARING NEW JERSEY SEDIMENTS

Geologists can tell a lot about where sand came from and how it was formed by observing it under magnification. Now you'll try it, too.

1. Place a Petri dish containing sample 3 under the scope. Observe the individual grains. In the table, answer the questions about this sample.
2. Repeat step 1 for specimens 4 and 5.

Question	Sample 3	Sample 4	Sample 5
Does the sample contain grains mostly about the same size or of different sizes?			
Are the grains rounded or angular (jagged)?			
What color or colors are the grains?			
Do the grains look glasslike (translucent and shiny) or not (opaque and dull)?			
Are fossils present?			

3. Think about each sample. On the line below, tell where it might have come from and how it might have formed.

Sample 3: _____

Sample 4: _____

Sample 5: _____

Put It to the Test

NJ Core Curriculum Standards:

- Collect and organize data to support the results of an experiment. (Science 5.2.8.)
- Show how substances can react with each other to form new substances having characteristic properties different from those of the original substances. (Science 5.8.5.)

GEPA in Science Content/Skill Outlines:

- Observe an object or event by using any of the senses or extensions of the senses to identify properties. (5.2.6.7.8.9.10.11—Skill)
- A chemical change occurs when materials form new substances with different properties. (5.8.4.5—Knowledge)

Teacher Background: Samples can be tested with a hydrochloric acid solution for the presence of the mineral calcite (calcium carbonate) because calcite reacts with acid, forming carbon dioxide gas. Lime sand and limestone should effervesce (bubble) quickly. Dolomite will not effervesce easily but may if you first break off a small piece and grind it into powder. *Teachers who have not had laboratory safety training can use white distilled vinegar instead of HCl, however, the reaction will be slower and less dramatic.*

Materials: Samples 1–17 from the New Jersey Rocks and Sediments kit diluted HCl (10 percent concentration) or white vinegar in a dropper bottle, 2 watch glasses or Petri dishes, sheet of black construction paper, goggles, protective gloves

Safety: Anyone handling HCl solutions must wear safety gloves, goggles, and a lab coat. Caution students to avoid inhaling fumes. Clean up spills with water. Have students wash their hands at the completion of the activity.

Advance Preparation: Remove a tiny amount of marble and dolomite by tapping these specimens on a ceramic plate. Brush the powders into separate watch glasses or Petri dishes. Place the glasses on a sheet of black construction paper to provide a dark background for contrast. Label each glass with the number of the sample the powder came from.

Directions: Instruct students to avoid getting acid on the samples' paper labels. To clean up, wipe off the mineral specimens with a damp paper towel and put them away. Have students wash their hands and all surfaces when they are finished.

Discussion/Journal Entry Questions:

- Which kinds of rock and sediments reacted to the acid? (*Analyzing Data*)
- How could you use this knowledge to identify rocks? (*Applying*)

Suggested Evaluation: Assess students' data tables for clarity and accuracy.

Name _____

Date _____

Student Activity Sheet for Activity 3

PUT IT TO THE TEST

The mineral calcite is hard to recognize by sight alone. It comes in many colors. It can be shiny or dull. The best way to find it is by doing the following chemical test. **SAFETY:** wear goggles and gloves when working with acids.

1. Put two drops of acid on a small sample of each sediment. Record in the table any changes you observe.
2. Find the number on each rock sample. Turn the rock over and put 2 drops of acid on the other side. Record your observations.

Sample	Sample Name	Observations (reaction to acid)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		

Millions of Years Ago

NJ Core Curriculum Standards:

- Compare information presented at different scales. (Social Studies 6.7.10.)

GEPA in Science Content/Skill Outlines:

- Use tables, charts, and graphs to describe patterns and infer relationships. (5.5.5.6.7.8.9.10—Skills)
- Data can be represented numerically and graphically. (5.5.5.6.7.8.9.10—Knowledge)
- Use table, charts, and graphs to describe patterns and infer relationships. (5.5.5.6.7.8.9.10—Skills)

Teacher Background: When Earth formed 4.5 billion years ago, it was a planet of hot, molten rock. By about 3 billion years ago, the rock had cooled and solidified and the oceans had formed. At the beginning of the Paleozoic Era, 570 million years ago, living things existed in the ocean but were not yet abundant. There was no life on dry land. These enormous spans of time make the extinction of the dinosaurs 65 millions years ago seem like a recent event. Read how the formation of the rocks and sediments found in New Jersey fit into the history of Earth.

Materials: A roll of adding machine tape; meterstick; metric ruler with millimeters marked; red, blue, yellow, and green markers; photocopies of the "Geologic Time Scale" table on the back cover of the *New Jersey Rocks and Sediments* booklet.

Advance Preparation: Cut a 5-meter strip of adding machine tape for each group of students. Make one photocopy of the table on the back of the *New Jersey Rocks and Sediments* booklet for each group of students.

Directions: This activity may be done individually but is most effective when students work in groups of four. Have two students roll out the paper strip, one student interpret the geologic time scale, and the fourth student mark the measurements and labels on the time line. In addition to the steps on the Student Activity Sheet, you may also wish to have students label the geologic periods listed in the third column of the table. When student finish, have them line up and compare their time lines. Ask them to analyze any differences they find and make corrections where needed.

Discussion/Journal Entry Question:

- Which era or eon was the longest? (*Analyzing Data*)
- Our species has existed on Earth for about 1.5 million years old. How would you show this on the time line? (*Communicating*)

Suggested Evaluation: Collect students' time lines and assess them for completeness and accuracy.

Name _____

Date _____

Student Activity Sheet for Activity 4

MILLIONS OF YEARS AGO

Some New Jersey rocks and sediments are old. Others are very, very old. You'll compare their ages in this activity.

1. Use a meterstick to draw a straight line from one end of a 5-m paper strip to the other end. Make a dot at the right end of the line and label it "The Present."
2. Use a scale of 1 millimeter = 1 millions years. With a millimeter ruler, mark a dot 2 mm to the left of your first dot. This shows the past 2 millions years on your time line. Above the line, write the number of the New Jersey rock or sediment sample that was formed during the past 2 million years.
3. Draw a dot on the time line at 67 millions years ago. Write the numbers of the New Jersey rock and sediment samples that were formed between 2 and 67 million years ago.
4. Repeat step 3 for the rest of the dates in first column of the "Geologic Time Scale" table.
5. Read the second column in the table. Use a red marker to underline from the present to 67 million years ago. Label it "Cenozoic Era." Use a green marker for the Mesozoic Era, yellow for the Paleozoic Era, and blue for the Proterozoic, Archean and Pre-Archean Eon.
6. How can you explain the fact that the sediments are mostly the youngest specimens?

It's In the History Books

NJ Core Curriculum Standards:

- Compare and contrast practices that affect the use and management of natural resources. (Science 5.12.5.)
- Describe how changes in technology affect the location of human activities. (Social Studies 6.8.10.)

GEPA in Science Content/Skill Outlines:

- Analyze data by determining patterns or relationships in the data. (5.2.6.7.8.9.10.11—Skill)
- Use table, charts, and graphs to describe patterns and infer relationships. (5.5.5.6.7.8.9.10—Skills)

Teacher Background: The facts in the table were taken from pages 6–15 of the *New Jersey Rocks and Sediments* booklet. Other minerals, not represented in the kit, yet mined historically in New Jersey, include copper and zinc.

Materials: Large sheets of unlined drawing paper or poster board, rulers, markers, and resources about American history

Advance Preparation: None

Directions: Review the information in the table on the Student Activity Sheet with students. Provide them with reference materials about American history and direct them to find other important dates that cover the same span of time as the table. Have students create their own tables with approximately the same number of dates and facts as they have for New Jersey's mining history.

Discussion/Journal Entry Questions:

- What cities do you think might have been built with New Jersey brownstone? (*Hypothesizing*)
- What characteristics of brownstone made it a good building material? (*Inferring*)
- How many years was iron ore mined in New Jersey? (*Interpreting Data*)
- Hypothesize what changes might have lead to the decline of iron mining in New Jersey. (*Hypothesizing*)
- In what ways did New Jersey iron ore contribute to the American Revolutionary War? (*Concluding*)

Suggested Evaluation: Collect the time lines and evaluate them for accuracy of the placement of the New Jersey dates and for appropriateness of the American history dates.

Name _____

Date _____

Student Activity Sheet for Activity 5

IT'S IN THE HISTORY BOOKS

How were New Jersey's rocks and sediments used during our nation's history?
Make a time line to find out.

1. Draw a vertical line down the middle of a large sheet of paper.
2. Calculate the span of years between the earliest and most recent dates in the table. Create a scale in which each segment of the line represents the same number of years. For example, each centimeter could represent ten years. Label all or some of the segments with the year.
3. On the left side of the time line, label the facts from the table about New Jersey rocks and sediments. Think of a way to show those dates that are a span of years.
4. On the right side of the time line, label some important dates from American history.

Dates	Facts About New Jersey Rocks and Sediments
1674	Bog iron ore, found along NJ riverbanks, is first heated in a furnace to produce iron for tools and weapons.
1685	Magnetite, an iron ore, is first mined in NJ.
1700s	Greensand is mined in NJ for use as fertilizer.
1700-1900	NJ sandstone, or brownstone, is quarried to build houses, apartments, churches, and train stations in nearby growing cities.
1710	Mining of magnetite, an iron ore, is first successful in NJ.
1739	First successful glass factory in America's British colonies uses NJ glass sand.
1778	Iron from NJ magnetite is used to forge a chain to span the Hudson River to keep British ships from reaching West Point during the American Revolution.
1800s	NJ limestone is quarried and roasted to make lime powder used to improve farm soil.
1800s	NJ slate is quarried for roofing material.
1868	Greensand mining reaches its peak in NJ.
1890s	NJ is the leading iron producer in the United States.
1900	Most greensand producers go out of business.
1978	The last NJ iron mine closes down.

Rockin' Around New Jersey

NJ Core Curriculum Standards:

- Evaluate the strengths and weaknesses of claims, arguments, and data. (Science 5.2.10.)
- Identify the major features of the earth's crust, the processes and events that change them, and the impact of those changes on people. (Science 5.10.6.)

GEPA in Science Content/Skill Outlines:

- Analyze data by determining patterns or relationships in the data. (5.2.6.7.8.9.10.11—Skills)

Teacher Background: Read about the kinds of rocks found in New Jersey and the different areas they come from on pages 4–5 of the *New Jersey Rocks and Sediments* booklet.

Materials: One or more detailed maps of New Jersey that include counties and municipalities, photocopies of the table on the inside front cover of the *New Jersey Rocks and Sediments* booklet, books containing information about rocks and minerals, relief map of New Jersey

Advance Preparation: Put the cover of the *New Jersey Rocks and Sediments* booklet out of students' sight while they do this activity.

Directions: Many maps have an index to the municipalities with grid coordinates that will help students locate them. Students should use reference materials to find out which specimens are igneous or metamorphic. Have students answer the questions on their Student Activity Sheets before answering the questions below.

Discussion/Journal Entry Questions:

- What are the average differences in elevation of the regions of New Jersey? (*Researching*)
- What relationship can you find between the elevation of the land and the specimens found there? (*Concluding*)
- Where do you think much of southern New Jersey's sands originated? (*Hypothesizing*)

Suggested Evaluation: Students' answers to the questions on the Student Activity Sheets should include the following.

Step 4: The igneous rocks (samples 14 and 15) were collected in the Piedmont region.

Step 5: The metamorphic rocks (samples 10–13) are found in the Highlands, although the quartzite comes from the Valley and Ridge region.

Step 6: Most of the sediments (samples 2–5) are found in the Coastal Plain region. Peat (sample 1) is found in the Valley and Ridge region because it forms in areas where glaciers recently receded.

Name _____

Date _____

Student Activity Sheet A for Activity 6

ROCKIN' AROUND NEW JERSEY

Take a geologic tour of New Jersey and see what's rockin'!

1. Read the table provided by your teacher to find out from what municipality sample 1 was collected. Find the location by using a political map of New Jersey. On Student Activity Sheet B, mark the location on the large outline map of New Jersey. Label it with the number 1.
2. Repeat step 1 for samples 2–17.
3. Using the smaller map as a guide, color each geologic region on the large map.
4. Which samples are igneous? Is there a pattern to where igneous rocks in the kit are found in New Jersey? Explain.

5. Which samples are metamorphic? Is there a pattern to where the metamorphic rocks in the kit are found in New Jersey? Explain.

6. Which samples are sediments? Is there a pattern to where the sediments in the kit are found in New Jersey? Explain.

7. Compare your results to those of others. Explain the differences.

Name _____

Date _____

Student Activity Sheet B for Activity 6

ROCKIN' AROUND NEW JERSEY

