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Geology of Connecticut Soil, Rock and Minerals

Curriculum Unit 84.06.01
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Introduction

Most middle school students are not familiar with the geology of Connecticut. This unit will introduce students to the geology of Connecticut through its history, rocks, soil, and the minerals that are contained in the rocks.

The purpose of the unit is to give the student some of the history of Connecticut landforms, rocks, minerals and to show how these were formed and how all this came about. Also, it is intended to give students hands on experience with geological materials and to describe a unique cultural landscape which has played an important role in the development of Connecticut which, still is an important visual element in maintaining Connecticut's environmental character.

GOAL

1. To provide experience with soils, rocks and their minerals through hands-on materials within the classroom.
2. To provide basic data through geologic mapping and research for use in science and math.
3. Familiarize the student with the fundamentals of geological language and usage.

OBJECTIVE

1. Field trips—East Rock Park and a quarry.
2. The students will be able to identify rocks and soils and to read charts and maps.
3. Students will be able to solve math problems.
4. They will be able to write simple math problems using a simple four-step plan and solve them.

FOUR STEP PLAN

To make batons for relay events we cut a rod 2.28m into 8 equal pieces. How long is each piece?

1. Understand the problem?	What do you know?	What do you want to know?	2.28m			
2. Make a plan.	What do you do to solve the problem?		Divide 2.28 by 8			
3. Do the arithmetic.		Show your work.		0.285	8) 2.28	
4. Give the answer		How long is each piece?		0.285m		or 28.5cm

Connecticut Land Surface

Connecticut was once a rugged land, shaped by violent forces in the earth and by the sea. It was carved by glaciers that left a heritage of rolling land, rivers, lakes, hills, and valleys.

The general shape of the land surface was developed by erosion over tens of millions of years before the ice age. The principal rivers were established then, though they were often altered by glaciation. Erosion is the process that moves rock and soil particles on the earth surface from one place to another. It can be caused by running water, glacial ice, waves and wind. The ice age began about two million years ago. The most recent Ice Age began about 100,000 years ago and ended about 15,000 years ago.

The present land surface is due to the ice age. Thousands of years ago when the climate was much colder an ice sheet known as a glacier was formed. All of Connecticut was covered with ice. This ice moved slowly, coming southward over the hills, mountains and rocks in its pathway. Some rocks were frozen into the ice at its lowest level and it acted like a piece of sandpaper, smoothing down the rocky surface. Although, the valleys and hills were here before the glacier, changes in the surface of Connecticut were made.

After the summers became warmer the glacier was five hundred to eight hundred feet thick over the southern part of Connecticut and much thicker further north. The melting of this ice produced great rivers of water, carving deeper valleys and carried large quantities of clay and sand down to the sea. The larger rocks that the glacier had picked up and carried were dropped directly on the ground. After the ice sheet finally melted, the land lay bare of all vegetation. It was a great rocky muddy region in the summer—but the climate was cold most of the year. Vegetation established itself quickly after the ice left.

There are four present land forms in Connecticut. There is a low coastal strip which extends along the sea coast from New York to Rhode Island. It is the old rocky surface broken by small rivers and three large ones that have carved out valleys which reach the Sound. On the west the land is made up of many small hills and

valleys that rises to a point of 2,315 feet in the northwest corner of the state. The Central Valley is quite low and it is about a hundred feet above sea level on the Connecticut River near Massachusetts. The valley has a number of trap rock ridges and most of the other rocks are sandstone and shales.

East of the Central Valley is the Eastern Upland which is a hilly region cut by many river valleys. The Western Upland is much higher than the eastern uplands. (See Appendix A) Connecticut land is about one hundred miles east and west along the sound and fifty miles north to the Massachusetts line. Its area is 5,004 square miles counting the lakes.

There are major forces that created landforms. They are the ice riding over the hills, the volcanic eruption that gave Connecticut the trap rock and the rivers that leveled the mountains causing landforms. Many years ago landforms were quite different in Connecticut from what they are today. Over the years several forces have shaped what we see today. Some of Connecticut landforms rose to thousands of feet. Weather conditions produce brooks and rivers; flowing water which has a lot of power, wore away the surface. The material worn off the mountains was deposited in valleys and became soil.

SOIL

Soil is not just dirt. It is a combination of tiny rock fragments; water, air, dead vegetable particles, tiny living plants and animals. There are four different kinds of soils found in the state. These soils differ because they have been produced on different kinds of glacial deposits.

Glaciers are not the only agents that move parent materials about from their place of origin. Others, such as gravity, water, and wind, are also important in moving rock material about. These agents may move the parent material of soil many times. Each time this occurs the rock particles may be further broken down and sorted as to size.

Each agent distributes soil making materials in a characteristic manner. The geological classification of these materials that give rise to our Connecticut soil is made as follows:

TILL OR GLACIAL TILL . This is a mixture of rocky material. It contains varying amounts of gravel, sand, silt and clay that was deposited by the ice with little or no water transportation.

STRATIFIED DRIFT . This rock material is sorted by waters from glaciers and left in layers as partially sorted gravel. The finer silt and clay particles generally were carried off and deposited separately.

ALLUVIUM . These materials are moved by water and later deposited along stream banks. These alluvial deposits form the terraces found along many streams and rivers.

LOESS . This deposit is relatively uniform, fine material, mostly silt. It was presumably transported by wind during dry weather periods right after the melting of glacial ice.

GLACIOLACUSTRINE . These are very fine sands, silts, and clays picked up by glacial action, carried in the melting ice water and deposited in glacial lakes. In some instances the deposited material looks like a layered cake. The layers vary in thickness.

ORGANIC DEPOSITS . These plant materials are accumulated in shallow water. As successive generations of plants died, the residues gradually filled the shallow, saucer-like depressions. The deposits are identified as either peat or muck. Plant material that can still be identified is regarded as peat. Organic accumulations that

have decomposed so as to make identification of the plant material impossible are called muck.

COLOR . The color of soil is its most obvious characteristic. Along with structure and texture, color forms the basis for distinguishing the various soil horizons.

Many soils are red and yellow in color. Their color is directly related to the presence of several iron and manganese compounds. For example, if a soil is derived from parent material rich in iron minerals, it is generally highly colored, with the exact color depending on the mineral form of the iron. The mineral form is dependent on oxygen supply. Red color in a soil usually indicates good drainage and good aeration, especially in the lower horizons. Our red Connecticut Valley soils are derived from sandstone parent materials high in iron content.

Gray and whitish colors in soil are caused by several substances. These are mainly quartz, kaolin and other clay minerals, and carbonates of lime and magnesium. The gray or blue-gray soils of poor drainage and low aeration owe their color to iron in the reduced form. Low amounts soft organic matter and concentrations of reduced iron are the basis of the gray colors of some Connecticut soils.

TEXTURE . Soil texture refers to its coarseness or fineness. It is determined by the proportions of individual soil grains or particles.

Soil particles are classified by size into groups called “soil separates.” These are sand, silt, and clay.

The proportions of these particles of different sizes determine soil textural classes such as sand, loamy sand, clay loam, silt loam and others. Textural determinations are generally made within the surface layer or topsoil, and any reference to texture is understood to be that of topsoil. Some aspects of particle size are indicated below:

SAND. Sand serves as a framework for the chemically active part of the soil, such as clay. Sand particles feel gritty when rubbed between the fingers. Sand is usually single grained, and, unless coated by silt or clay, shows practically no stickiness when wet. The sand particles are larger than those of silt and clay, with diameters from 0.05 to 2.0 millimeters.

The water-holding capacity of sand is low. This is due to large pore space between particles which allows water to drain readily from the soil. Soils with large amounts of sand possess good drainage and aeration, and are usually referred to as “light soils” or “coarse soil.”

SILT . Silt particles vary from 0.002 to 0.05 millimeters in diameter. These are so small that it is hard to identify single particles with the naked eye. The coarser silt particles are similar to the fine sands in shape. However, the former have a greater surface area of exposure than does sand. Like sand, silt takes little part in the chemical process of the soil.

Soils in which silt predominates have a fine texture, and water movement through the soil is slow. Soils high in silt are hard to work and are referred to as “heavy soils.”

CLAY . The finest of soil particles is clay. These are smaller than 0.002 millimeters in diameter. Clay is also the most chemically active soil separate.

The sediments deposited in the lakes that used to fill the valleys may be either sand and gravel, or clay. Soil that is developed on clay is wet because water doesn’t pass through it easily. This soil is wet and sticky. The

second soil which is developed in sands and gravels is dry soil. The rain passes through it easily and it is light and good for farming root crops. The third type of soil is formed on till. Till is a mixture of large and small particles that the glacier dropped helter-skelter on the ground as it melted. This soil falls between extremes of wetness and dryness that the clay and sandy soils represent. It holds enough water for crops. The main disadvantage to this soil is the number for rocks in it. The fourth type of soil is alluvial soil deposited by rivers. It is deposited by sedimentary materials and it is a mixture of sand and clay particles of various sizes.

SAMPLE LESSON PLANS

Activity
Materials
Soil Samples
Paper
Toothpick
Magnifying Lens
Pencil and Paper

In this activity students are going to take a close look at samples of soils to see what it is made of.

A. Obtain the above material
B. Place one or two spoonfuls of soil on the paper
C. Use the toothpick to separate the soil into many different materials: Eq. light grains, dark grains and soft materials. Put similar materials together. On a sheet of paper make a table and label each sample.

(figure available in print form)

ACTIVITY II

small flower pots
different samples of soils
seeds
water

Students may use flower and vegetable seeds or average six to eight weeks will be required before results can be expected.

Have students obtain the above materials and plant the seeds in the different soil samples. Observe which soils are best for growing plants.

Below is a table they may be useful to students when doing this activity.

(figure available in print form)

ROCKS

Rocks are an important part of Connecticut geology. Every boy and girl who has ever picked up a few strange-looking rocks is gradually becoming a rock collector. The real interest is being able to identify and find, knowing something of their history, how they came to be in that particular place. There are rocks that can be traced back to an origin of living things such as coal and coral. There are logs of stones, such as those that can be seen in the famous Petrified Forest.

The rock you might hold in your hand tomorrow could contain evidence of a world once filled with dinosaurs or a continent once under water. Rocks are all around us. They are in the walls of rushing streams, along cliff faces and mountain sides. If a rock was taken apart and examined closely one would find that it is made up of bits and pieces of minerals. Some minerals are the building blocks of rocks.

The kind of rocks included in this unit are the ones found in Connecticut as well as in other places.

IGNEOUS ROCKS are formed from molten minerals or lavas deep within the earth's crust. Granite and basalt are examples of this kind of rock. (See Appendix C)

SEDIMENTARY ROCKS generally result from the cementing together, under pressure, of weathered particles from other rocks that have been deposited from suspension in water. Sandstone, limestone and shale are examples of sedimentary rocks. (See Appendix D)

METAMORPHIC ROCKS are those formed from either igenous or sedimentary rocks which have been under great pressure or under high temperature or both. Under these conditions the size of the mineral crystals were

changed to create a denser rock material. Gneiss, schist, marble, slate and quartzite are the most common metamorphic rocks. (See Appendix E)

In eastern Connecticut we find mostly metamorphic rocks such as gneiss, schist, and quartzite, with some igneous rock, granite. We also find metamorphic rocks mostly in the western part of the state. However, some limestone, a sedimentary rock exists along the western boundaries and particularly in the northwestern corner of the state. In the central part of the state is a low land, consisting of red sandstone and shale, both sedimentary rocks. Within this low land arise hills, consisting of the igneous rock, basalt, commonly called traprock.

When a complex rock surface is subjected to sudden changes of temperature, the different minerals within the rock do not expand or contract equally. As a result of unequal pressures developed by unequal expansion and contraction on heating and cooling, the rock tends to crack and flake. Water finds its way into the cracks and crevices. Freezing temperatures transform this water into ice which expands and acts as a wedge to split the rock into smaller fragments. Coarse-grained rocks which develop larger cracks break down faster than do the fine-grained rocks which develop smaller cracks.

As the rocks are reduced in size some of the more soluble minerals combine with water and form new compounds or minerals. Some minerals dissolve completely and are eventually carried off in the drainage water. Others, such as quartz and the clay minerals, remain and these become an important part of the soil.

LESSON PLANS FOR SCIENCE

A. 1. Introduce the three types of rocks
- igneous
- sedimentary
- metamorphic

2. Discuss the three types briefly

3. Review in greater detail the characteristics of each type of rock

4. Have students collect different samples of rock from within their area and examine them. Look for similarities or differences.

5. Obtain different rocks of each; igneous, sedimentary and metamorphic. Have students classify them and name the mineral or minerals contained in each.

6. Discuss with students the difficulties that is encountered when attempting to classify rock samples.

7. Obtain slide of different rocks. Show these to students to help them visualize the similarities and differences among the rock samples.

LESSON PLANS FOR MATH

Field trip to a quarry if possible. Invite someone from the quarry to speak to the class. Provide students with background information about a quarry.

When students visit a quarry, have them collect data for the purpose of writing and computing simple word problems dealing with measurements and costs.

SAMPLE WORK PROBLEMS

1. The Department of Transportation is paving five miles of I-91 highway, two tons of gravel is needed for each 1 1/2 miles. How many tons of gravel are needed to do the job?
2. The city of New Haven installed fifty feet of sidewalk at Troup Middle School. The rock used in the cement cost $18.50 per linear foot. The gravel cost $37.50 per linear foot. Labor cost $75.00 per hour. What was the total cost? Including Labor?
3. Mount St. Helen erupted at 1:00 pm. At 2:00 pm, Lava was flowing at a speed of 120 mph, by 10:00 pm the speed had dropped to one-fourth of the speed at 2:00 pm. What was the speed at 10:00pm?
4. The rock machine at the quarry breaks larger rocks into smaller one. The machine breaks 8 tons of rocks in 6 3/4 hours. How long would it take the machine to break twice the number of tons?
5. How many square yards of concrete are required to cover a lot measuring 14ft. 6in. by 14ft. 6in.?
6. Darrell wants to build a wall to enclose his patio. The measurements are; 18 1/2 feet by 22 1/4 feet at a cost of 7c per brick. How much will it cost Darrell to build the wall?
7. A construction site measuring 34 meters by 42 meters was dug to a depth of 6 meters. How many cubic meters of soil had to be moved?
8. A team of four geologists mapped out a rectangular plot 58 meters by 43 meters to be studied for signs of past civilization. What is the area of the site?
9. Find the cost of cementing a driveway 9 feet by 16 feet at a cost of 55c per square foot.
10. How many square feet of sod are needed for a lawn measuring 42ft by 42ft at .25 per square foot? What is the cost of the sod?

MINERALS

Minerals are contained in rocks and soils. They are an important part of Connecticut geology. Minerals have a definite chemical structure and they are composed of certain elements in specific proportions. The minerals may occur in the rocks in large masses or in mixture. A mineral is a solid element found free in nature. There are some two thousands minerals. About thirty are known as “rock forming” because they are likely to form a large part of each rock they are in.

In Connecticut, minerals were not plentiful. In times past metals were found in tiny quantities scattered through rocks. The combination of metals and rocks are called ore. There were small amounts of great many metals, but only in a few areas was there enough of any one metal worth mining. Some places were discovered and mines were open up. Mining for metals has been abandoned. The copper ores were soon used up in Connecticut and iron mining stopped for several reasons; one, it was too costly. One other type of mining was marble quarrying which was important for a short period but also had to be given up.

Connecticut still have some minerals that are dug out and being used. The most important are the traprock, clay, and limestone. Traprock is found in ridges throughout the central valley. There was once huge quarries where this rock was blasted out, broken into smaller pieces and sold as road material.

Clay was found in the central valley, it was dug, mixed with sand and baked in huge kilns to make bricks. The third major minerals used in Connecticut was limestone and marble. The limestone and marble was quarried and ground down to powder size and sold. The major uses were for agriculture and construction. (See Appendix F)

APPENDIX A

(figure available in print form)
THIS SIMPLIFIED DIAGRAM OF THE STATE’S LANDFORMS

APPENDIX B

(figure available in print form)
A SIMPLIFIED SOIL MAP TO SHOW HOW SOME OF THE LARGER AREAS OF SOIL TYPES ARE DISTRIBUTED AROUND THE STATE.

APPENDIX C

SOME COMMON IGNEOUS ROCKS

Examples—Most important characteristics.

INTRUSIVE ROCKS

Granite

It has large crystals
It is composed mostly of Feldspar
It is generally pale gray, pink or reddish color

Diorite

It has large crystals
It is composed most of feldspar, also beach mica
It is a dark heavy rock

Synite

This rock contains 90% feldspar
It contains large crystals
It is a light colored rock

EXTRUSIVE ROCKS

Felsite

Contains small crystals
Fine-grained crystalline structure
They are formed by a surface flow of lava that cooled quickly
It is a light colored rock

Basalt

Very small crystals
A fine crystalline structure
It contains feldspar
It is a dark colored rock

Scoria

No crystals
Very hard rock
Filled with large air spaces
It is usually dark, brown or black

APPENDIX D

SOME COMMON SEDIMENTARY ROCKS

(figure available in print form)

APPENDIX E

SOME COMMON METAMORPHIC ROCKS

(figure available in print form)

APPENDIX F

SOME COMMON MINERALS

(figure available in print form)

RESOURCE LIST

East Rock and Edgewood Rangers

P.O. Box 1416

720 Edgewood Ave

New Haven, CT

Sarah Blodgett

787-8022

Transportation for Field Trips

Ralph Golia

21 Wooster Place

New Haven, CT

787-8418

Yale New Haven Teacher's Institute

53 Wall Street

New Haven, CT 06520

(203) 436-3316

Reading List for Students

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1. Carpenter, Allan. Chicago, Children Press—1966

Connecticut

This book is concerned with Connecticut's past to present

2. Fenton, Carroll Lane. New York, Doubleday & Co.—1951

Books and Their Stories

The book explains the difference between stones, rocks, and minerals. Fifty pages of photographs will help the student to recognize their finds.

3. Keene, Melvin. New York, Harper & Row, Publishers—1966

The Beginners' Story of Minerals

The book is simple, easy to read and there are enough basic facts to satisfy the beginner.

4. Gallant, Ray A. & Schuberth, Christopher J. Natural History Press, New York—1967

Discovering Rocks and Minerals

This book is designed for people who want to learn how to collect and identify rocks and minerals.

5. May, Julian. Childrens Press—1960

You and the Earth Beneath Us

Story of our ever-changing earth, how the earth is changed by earthquakes, volcanoes, erosion, and how different plants and animals that lived here over the ages also changed.

Bibliography For Teachers

1. Cohle, Charles R. & Rice, Dale R. *Earth Science:* Prentice Hall—New Hersey 1981
   Unit 4—The Changing Earth: Surface Activity
2. Clayton, Keith, *The Crust of the Earth:* The Natural History—New York 1967
   A scientific explanation of the nature and history of the earth's surface and interior.
3. Hoyt, Joesph, *The Connecticut Story:* W. H. Freeman—San Francisco 1966
   Chapters 16 & 18
5. Vandusen, Albert E., *Connecticut*
   Random House, New York 1961
   An illustrated history of the state from the seventeenth century to the present.