6-12 Rock Cycle and Layers Activity

South Carolina Aquarium

Overview

Focus Questions
What are the three types of rocks? How are each rock type related through the rock cycle? How do geologists use rock layers and index fossils to determine the relative age of fossils?

Activity Synopsis
Students will create their own rock cycle illustration, describing the processes necessary for each rock to be formed and identifying examples of each rock type. Students will arrange and determine the relative age of the different rock layers based on the Law of Superposition, index fossils and other fossils present.

Time Frame
4 hours

Objectives
The learner will be able to:

- Explain the difference between the three types of rocks
- Explain how each type of rock was formed
- Explain which type(s) of rock(s) may contain fossils
- Create a model of the rock cycle
- Explain the Law of Superposition
- Explain the concept of relative aging of rock layers
- Identify index fossils
- Analyze and interpret data to infer the relative age of the rock layer and the fossils within each layer

Student and Teacher Key Terms
- sedimentary rock
- metamorphic rock
- igneous rock
- intrusive igneous rock
- extrusive igneous rock
- foliated
- rock cycle
- fossil
- relative age
- index fossil
- diversity
- trilobite
- Law of Superposition

Standards

South Carolina College- and Career-Ready Science Standards 2021

6th Grade: 6-ESS1-4, 6-ESS2-1, 6-ESS2-2, 6-ESS2-3
7th Grade: 7-LS2-3, 7-LS2-4
8th Grade: 8-LS4-1, 8-LS4-2
Biology: B-LS4-5
Earth and Space Science: E-ESS2-1, E-ESS2-2, **E-ESS2-7**

6-12 Rock Cycle and Layers Activity

***Bold standards are the main standards addressed in this activity**

Sixth Grade Performance Expectations

6-ESS1-4 Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.
6-ESS2-1 Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
6-ESS2-2 Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
6-ESS2-3 Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.

Seventh Grade Performance Expectations

7-LS2-3 Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
7-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Eighth Grade Performance Expectations

8-LS4-1 Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operated in the past as they do today.
8-LS4-2 Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer their ancestral relationships.

Biology Performance Expectations

B-LS4-5 Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

Earth and Space Science Performance Expectations

E-ESS2-1 Use evidence to argue how Earth's internal and external processes operate to form and modify continental and ocean-floor features throughout Earth's history.
E-ESS2-2 Analyze data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
E-ESS2-7 Communicate scientific information that illustrates how Earth's systems and life on Earth change and influence each other over time.

Cross Curricular Standards

South Carolina College and Career Standards for ELA
Inquiry (I) – 2.1, 5.1
Writing (W) – 1.1, 2.1, 3.1
Communication (C) – 1.1, 1.2, 1.4, 1.5, 2.1

Background

Key Points
Key Points will give you the main information you should know to teach the activity.

- There are three types of rocks; igneous, metamorphic and sedimentary.
- The **rock cycle** is an ongoing process through which one of the three types of rocks becomes another of the three types of rocks.
- **Igneous rocks** form when molten rock (magma) cools and hardens.

- **Metamorphic rocks** form when other types of rocks are changed by great heat and/or pressure.
- **Sedimentary rocks** form when rocks are weathered or eroded, deposited, compacted, cemented together and harden forming rock.
- The **Law of Superposition** states that each rock layer is older than the one above it.
- A **fossil** is the preserved remains or traces of an organism that lived in the past, usually more that 10,000 years ago.
- **Relative age** means the age of one object compared to the age of another object.
- **Index fossils** can be used to help find the relative age of rock layers.
- **Trilobites** are index fossils from hard-shelled animals whose body had three sections.

Detailed Information
Detailed Information gives more in-depth background to increase your own knowledge, in case you want to expand upon the activity or you are asked detailed questions by students.

There are three large classifications or types of rocks – **igneous, metamorphic, and sedimentary**. Rocks are classified based on size, shape and arrangement of mineral crystals. To classify a rock, geologists observe the rock's color and texture (fine- or coarse- grained, banded or not banded, jagged or rounded) to determine its mineral composition. Each type of rock is formed differently and can change from one type to another over time. The **rock cycle** is an ongoing process through which one of the three types of rocks becomes another of the three types of rocks. The rocks we have today are the same rocks we have always had, but the rocks themselves have not stayed the same. Over time rocks are recycled into different rocks.

Igneous means fire. **Igneous rocks** are formed from magma found inside a volcano (called *intrusive)* or lava found outside a volcano (called *extrusive*). **Intrusive igneous rocks** form when magma cools slowly beneath the Earth's surface. **Extrusive igneous rocks** form when lava cools rapidly on Earth's surface.

Metamorphic rocks are formed when an existing rock metamorphoses into a new rock. Both igneous and sedimentary rocks may become metamorphic rocks. Thus metamorphic rocks form when another rock is subjected to intense heat and pressure where it is squeezed, folded and/or chemically changed due to hot fluids. There are two types of metamorphic rocks - **foliated** (layered) or non-foliated (not layered).

Sedimentary rocks form from the compaction and cementation of sediments such as rock pieces, mineral grains and/or shell fragments. Sediments form by the weathering and erosion of rocks on the surface of the Earth. Sediments pile up, become compacted together and then minerals seep between them and glue them together. Sedimentary rocks can also form from the chemical depositing of materials that were once dissolved in water. There are different types of sedimentary rocks.

Relative age does not tell the exact age of an object, instead it's a range of time. The relative age of rocks and **fossils** can be determined using two basic methods: ordering of rock layers and **index fossils**.

Ordering of rock layers means that younger rock layers are deposited on top of older layers. According to the **Law of Superposition**, each rock layer is older than the one above it. Thus the relative age of the rock or the fossil found is older if farther down in the rock layers. Relative dating can be used only when the rock layers have been preserved in their original sequence.

Fossils give clues to the **diversity** of living things over the history of Earth. They also give clues to past climate and surface changes on Earth and changes that have occurred with organisms over time. The fossil record gives important information about past life and environments on Earth.

Certain fossils, called index fossils, can be used to help find the relative age of rock layers. All index fossils are organisms that lived only during a short part of Earth's history. The shorter the time period a species lived the better an index fossil it is. Index fossils are found over a wide area of the Earth and are unique. Generally index fossils are found in large numbers within a rock layer. For example, **trilobites**, a group of hard-shelled animals whose body had three sections and lived in shallow seas. They became extinct about 250 million years ago. They lived from 550-250 million years ago and changed many times into specific forms during specific times. Therefore, when a trilobite is found in a rock layer the age of that rock layer can easily be estimated. Fossils that have lived for

a long period of time and are found in many rock layers cannot be considered index fossils. Ammonites are also well know index fossils that lived between 250-65 million years ago.

Procedure

Materials

- Rock Cycles and Layers Intro PowerPoint
- Scissors
- Transparent tape or glue
- Construction paper

Part 1: Rock Cycle

- Rock Cycle Activity (1 set per group)
- Rock Cycle Answer Key (for teacher)
- Markers (four for each group - red, green, blue and black if possible)

Part 2: Rock Layers

- Rock Layers Activity (1 set per group)
- Rock Layers Answer Key (for teacher)
- Writing utensils

Procedure

Part 1: Rock Cycle

1. Review the types of rocks, how each is formed, the characteristics of each and the rock cycle by using the Rock Cycle and Layers Intro PowerPoint.
2. Divide the class into small groups (3 students). Give each group a set of pictures and terms, four markers, construction paper, tape/glue, scissors and the instructions.
3. Groups should then follow the steps on the instruction sheet to complete their rock cycle diagram.
4. If needed, help them through the steps:
    a. Place construction paper on table between group members and using a black marker label the top: Rock Cycle. Also be sure to put each group member's name on the back.
    b. Cut out the Rock Type's pictures (A, B, C) and tape/glue them on the construction paper (one in the middle at the top, one in the bottom left corner and one in the bottom right corner)
    c. Figure out which Rock picture (Sandstone, Marble, Granite) represents igneous, metamorphic and sedimentary rock formation, cut out the pictures and glue them near the correct rock type.
    d. Using a green marker draw lines and arrows to show the path within the rock cycle for each type of rock to become a SEDIMENTARY ROCK.
    e. Using a red marker draw the lines and arrows to show the path within the rock cycle for each type of rock to become an IGNEOUS ROCK.
    f. Using a blue marker draw the lines and arrows to show the path within the rock cycle for each rock type to become a METAMORPHIC ROCK.
    g. Using each of the rock cycle terms twice, use the appropriate color marker to write where they occur within the rock cycle.
5. Each group should present their Rock Cycle to the class describing the steps.
6. Discuss the following: Were all the cycles exactly alike? How were they similar? How were they different?

Part 2: Rock Layers

6-12 Rock Cycle and Layers Activity

Note: If time is short the teacher could have the rock layer strips already cut out, organized by site and laminated.

1. Review the concepts of rock layers, the Law of Superposition, relative age, fossils and index fossils using the second half of the Rock Cycle and Layers Intro PowerPoint.
2. Divide the class into small groups (3 students). Give each group the rock layers for site 1 and 2 as well as a fossil key and instruction sheet.
3. Groups should then follow the steps on the instruction sheet to complete their rock layers activity.
4. If needed, help them through the steps:
    a. At the top of one piece of construction paper, label Site 1. At the top of another piece of paper label Site 2. List group names on back of each.
    b. Cut the rock layers into strips (paying close attention to site number).
    c. Using the fossil key, arrange the rock layer strips from oldest (bottom) to youngest (top) within each site.
        - Hint: use the index fossils to help guide the layers
    d. Leave room to write down one side of the paper then tape or glue each layer onto construction paper in the correct order for each site.
    e. For each site:
        - List the fossils found in each layer next to the layer.
        - Label each layer with the relative age.
    f. Circle all the index fossils.
    g. Using the layers from each site, match site 1 layers to site 2 layers. Write the answers to the following: Do any layers match-up between sites? If so, which ones and how do you know they match? How is site 2 different from site 1?

At-home Learning and Virtual Modifications

At-home or Virtual Learning: Use one or both of these nearpod links for students to do at home or choose to teach them virtually. The first focuses on the different types of rocks and the rock cycle. The second takes them through using index fossils within rock layers to figure out relative age.

Rock Cycle Nearpod
Rock Layers Nearpod

If you would like to see the results of their nearpod activities, you can set it up as a Student-Paced activity following these directions.

1. Create a free nearpod account (https://nearpod.com/)
2. Ask Aquarium to send you the Rock Cycle and Rock Layers nearpod links (email education@scaquarium.org)
3. After you receive Aquarium links, add lessons to your nearpod activities by clicking “Add to My Library”
4. Send to students using Student-Paced option
5. You’ll be able to see their answers and interactions

Follow-up questions

1. Why do we find most fossils in sedimentary rock? Which type of fossils are possible in igneous rocks? Why can’t you find any fossils in metamorphic rocks?
2. Why would a layer of rock not have any fossils? What type of rock is it?
3. If the two sites are found several miles away from each other, how can you explain why site 2 is missing some of the layers found at site 1 - give at least one natural reason and one man-made reason.

Assessments

Assessment 1

Grade the Rock Cycle Activity.

Scoring rubric out of 100 points

The rock type pictures are identified correctly (A, B, C):	**20 points**
The rock pictures are correctly identified by rock type (1, 2, 3):	**20 points**
The terms are used correctly twice:	**40 points**
The Rock Cycle is properly demonstrated (by lines and arrows):	**20 points**

Assessment 2

Grade the Rock Layers Activity.

Scoring rubric out of 100 points:

Correctly position each layer at both sites (10 layers total, 3 points per layer):	**30 points**
Correctly identify fossils at each layer (10 layers total, 2 points per layer):	**20 points**
Correctly identify the relative age at each layer (10 layers total, 2 points per layer):	**20 points**
Correctly identify the index fossils:	**10 points**
Correctly match site 1 layers to site 2 layers with explanation:	**20 points**

Cross Curricular Extensions

STEM Extension
Have students research an animal that existed for a specific geologic period. Have them figure out when the organism lived and what other organisms were alive at that time. They can then build a rock layer of that time using materials from the classroom.

Science Extension
To connect this activity to our Plate Tectonics Activity you could use a map with the plate boundaries outlined and have the students label the types of rocks found at each.

Resources

Teacher Reference Books

Cvancara, Alan M. *A Field Manual for The Amateur Geologist: Tools and Activities for Exploring Our Planet*. John Wiley & Sons, Inc., New York, 1995.
This field guide contains information on the physical environment.
Murphy, Carolyn Hanna. *Carolina Rocks!: The Geology of South Carolina*. Sandlapper Publishing Co., Inc., Orangeburg, 1995.
Information on the geology, topography and formation of all of the regions in South Carolina.

Plummer, Charles C. and David McGeary. *Physical Geology*. Wm. C. Brown Publishers, Iowa, 1991.
Though admittedly college textbooks are often a little too dry and in-depth, with their text, photographs and illustrations they are often the best resources for finding information on a particular subject. This college textbook is an excellent resource for anyone wanting to know more about geology.

Teacher Reference Websites

Explore Learning
www.explorelearning.com
This site offers interactive activities on many math and science topics.

BrainPop

www.BrainPop.com
This site offers background information and activities on many science and math topics.

Fossils Sites - especially Index Fossils such as Trilobites and Ammonites
http://www.enchantedlearning.com/subjects/Geologictime.html
http://www.discoveringfossils.co.uk
http://www.ucmp.berkeley.edu/help/timeform.php
http://www.geosociety.org/science/timescale/
http://www.kgs.ku.edu/Extension/fossils/about.html
These sites offer background information and pictures of various fossils and dates of 1st appearance.

Rock Types Sites
http://3dparks.wr.usgs.gov/coloradoplateau/lexicon/tapeats.htm - sedimentary rocks
https://www.mineralseducationcoalition.org/minerals - metamorphic rocks
http://www.eschooltoday.com/rocks/what-are-metamorphic-rocks.html
http://www.eoearth.org/view/article/156285/
http://www.britannica.com/science/lithosphere

Student Reference Books

Van Rose, Susanna and Dorling Kindersley. *Eyewitness Books: Earth*. London, 1994.
These very attractive books use photographs, illustrations and text to teach the reader about the earth.

Taylor, Barbara. *Earth Explained: A Beginner's Guide to Our Planet*. Henry Holt and Company, New York 1997.
This book uses photographs, illustrations and text to teach the reader about the earth.

Field Trip Sites

Bob Campbell Museum, Clemson, SC
On the grounds of the South Carolina Botanical Gardens.

South Carolina State Museum, Columbia, SC
Many exhibits concerning geology and fossils of South Carolina.

Charleston Museum, Charleston, SC
A few exhibits designated for rocks and fossils.

College of Charleston Mace Brown Natural History Museum, Charleston, SC
Many local and international fossils, highlighting whales.