

People & the Palisades

GRADES 6-12

Key Words and Definitions

GEOLOGY : the study of rocks and how they change over time.

SEDIMENTARY ROCK : rock created when layers of sediment from other eroded rocks are deposited on top of each other and compacted and cemented.

METAMORPHIC ROCK : rock formed when any type of rock undergoes heat and pressure. The process does not change the basic chemical composition of these rocks, but forms new minerals and textures within the rock.

IGNEOUS ROCK : rock formed through the cooling and solidification of molten rock. The process of cooling from extremely high temperatures causes minerals to form. The size of the grains inside the rock tells us how quickly the rock cooled (smaller = faster). Intrusive igneous rocks cool inside the earth, while extrusive rocks cool on the earth's surface.

BEDROCK : the solid rock that lies under the softer, looser material on the surface of the earth. (Bedrock of New York City: Inwood Marble, Fordham Gneiss, Manhattan Schist.)

*Look for keywords—**BOLDED**—throughout this lesson extension!*

Activity 1: Geology "Guess Who"

One, approximately 30-minute session; pre-visit

LEARNING OBJECTIVE

Students identify the characteristics of different rock types and accurately match geological descriptions to corresponding rocks.



MATERIALS

- Set of rock cards (1 set per pair of students)
- Game boards (1 set per pair of students)
- Markers

PROCEDURE

Take some time to review the types of rocks and their specific characteristics before playing. Print out game boards and rock cards. Break up your class into pairs of students. There should be one set of cards and two game boards (one of each color) per pair of students.

To begin, give all students a marker, a game board hidden from the view of their opponents and a deck of rock cards. Divide the deck of cards in two and give each student half of the stack, face-down. Have students take turns picking a card from their respective stack and reading the description of the rock aloud *without revealing the name of the rock*. Students not reading the description should try to match that description with one of the rock images on their own game board. Once they have verified with their partner that it is the correct rock, they can check it off with a marker and place the correctly identified rock card to the side.

If students cannot correctly identify the rock on the first try, incorporate the card back into their deck to be used in a future round. If after their third time returning the card to the deck and redrawing it, the student could not correctly identify the rock, it can no longer be played in the game and should be removed from the deck. The game ends when there are no more cards in either student's stack, and the student who correctly identified the most number of rocks based on their descriptions wins.

Activity 2: Uncovering the Composition of NYC's Bedrock

Two, approximately 40-minute sessions; post-visit

LEARNING OBJECTIVE

Students learn the types of rock that make up the bedrock in New York City, and explore how bedrock affects landscape composition over time.



MATERIALS

- Paper
- Pencils
- Colored pencils or markers
- Access to the internet
- Flip-chart paper
- [Interactive maps](#)
- [Interactive map \(aerial view\)](#)
- Sticky notes

PROCEDURE

Assign groups of students an area of New York City: Lower Manhattan or Harlem (Manhattan Schist), Inwood or Kingsbridge (Inwood Marble), Riverdale or Fordham (Fordham Gneiss). Have each group research the neighborhood and use the interactive maps to answer the following questions:

- What kind of rocks make up the **BEDROCK** underneath your assigned area?
- Are there any major **GEOLOGICAL** features in the area? If so, what are they?
- How do bedrock composition and geological features impact the shape of the landscape and the appearance of that part of the city?
- How has the landscape changed since 1924?

Share that students now have the opportunity to create a piece of art that reflects their neighborhood. Hand out flip-chart paper to students and ask them to draw a line down the middle of the paper. Explain that this line will separate their drawings of New York City in the past and from the city today. Their drawings will illustrate geological and developmental changes over time. Have students add notes to their drawings that name the geological features they included and describe how those features may have changed.

After the students complete their drawings, hang the drawings around the classroom as they might in a gallery. Have students walk around this "gallery" to look at everyone's work and use sticky notes to leave comments or questions on their classmates' drawings. Give students time to reflect on the feedback they each received after the gallery walk.



SOURCES

NYC Then & Now. Map. New York City: City of New York, 2018. Web. <https://maps.nyc.gov/then&now/>.

Mineral Resources Online Spatial Data. Map. USA: United States Geological Survey, 2018. Web. <https://mrdata.usgs.gov/geology/state/map-us.html#home>.

BACKGROUND INFORMATION

[30 minute film on the History of the Palisades](#)

"A New Deal for the Palisades Interstate Park." *Vimeo*, Palisades Parks, 6 Apr. 2011, www.vimeo.com/22023989.

[Information on Specific Rocks](#)

"Rocks: Igneous, Metamorphic and Sedimentary." *Geology.com*, 2018, www.geology.com/rocks/.

[NYC Exposed Bedrock Areas](#)

Brock, Pamela Chase, and Patrick W. G. Brock. "Bedrock Geology of New York City: More than 600 M.y. of Geologic History." *An Introduction to Science*, Queens College School of Earth and Environmental Sciences, 27 Oct. 2001, www.geo.sunysb.edu/reports/ny-city/.



Chalk



Basalt



Conglomerate



Coal



Sandstone



Quartzite



Schist



Granite



Flint



Pumice



Shale



Limestone



Obsidian



Diabase



Gneiss



Marble



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Shale



Obsidian



Limestone



Marble



Sandstone



Flint



Schist



Quartzite



Conglomerate



Coal



Chalk



Gneiss



Basalt



Pumice





Schist

A metamorphic rock, typically formed at a convergent boundary where sedimentary rock is exposed to heat and pressure.

This rock has red-colored gems in it that are visible to the naked eye.

This rock makes up the bedrock of Manhattan.



Chalk

This soft and porous sedimentary rock is a type of limestone known for its white or gray color.

It forms when sediments rich in calcium carbonate settle at the sea floor.

For thousands of years, this rock was used as a tool for writing.



Basalt

This dark-colored igneous rock is the most abundant on earth and on the moon. Fine-grained, it is usually extrusive, forming from lava flows at divergent boundaries and hotspots.

It is mostly used in construction.



Conglomerate

A sedimentary rock with many different compositions that is made up of large rounded sediments called clasts. They are bound together by smaller particles or a type of cement in the spaces between the sediments.



Coal

This sedimentary rock is formed when plant matter is accumulated and preserved in a wet environment like swamps and deltas. The formation of this rock requires thousands of years and very specific conditions. It is one of the three most sought after fossil fuels in the world.



Gneiss

This metamorphic rock has easily identifiable bands composed of varying minerals and textures. It is formed by intense heat and pressure at convergent plate boundaries. It makes up the bedrock of Fordham and other parts of the Bronx.



Flint

This tough, sedimentary rock is made up of microscopic particles of quartz. It can be found wherever there was once an ocean.

This rock was used by early humans to make tools arrowheads, knives, spears and other tools.



Sandstone

This common sedimentary rock is made up of sand-sized particles of rocks, minerals or other material. These particles are weathered, transported, deposited and then compacted. It is used as a construction material all over the world.



Quartzite

This white or gray metamorphic rock is made almost completely of quartz. It forms when sandstone is exposed to intense heat and pressure at convergent plate boundaries.



Marble

This metamorphic rock is formed when limestone is transformed by intense heat and pressure. This rock makes up the bedrock of Inwood and other parts of Manhattan and is often used for tiles, countertops and sculptures.



Granite

This light-colored, igneous rock contains crystals big enough to see with the naked eye. It is formed by the slow cooling of magma below the surface. It is the best known igneous rock and is commonly used in countertops and tiles.



Diabase

This dark-colored, igneous rock forms when molten rock is pushed up through cracks in other rocks. It contains fine to medium-sized grains. This is the type of rock that makes up the Palisades.



Pumice

This light-colored, igneous rock forms by the quick cooling of magma during volcanic eruptions. It is a very porous and light-weight rock because of the gas bubbles trapped in the rock as it cools.



Obsidian

This shiny, dark-colored, igneous rock is formed by the rapid cooling of molten rock. Because the cooling occurs so quickly it is unable to form any crystals and is smooth and uniform in texture. It was used by early humans to make sharp tools.



Shale

This sedimentary rock is made up of fine particles of silt and clay. This rock is made up of many thin layers. When crushed, it can be mixed with water to form clay and can break down to produce oil or natural gas.



Limestone

This light-colored, sedimentary rock is composed of mostly of calcium carbonate. It forms when coral, shells and plant matter accumulate at the sea floor. It is mostly used in construction.