Earth History

Investigation 3: Grand Canyon Rocks

Part 1: Observing Grand Canyon Rock Samples

The Grand Canyon appears to have lines. Write down everything you can about why the lines are there.

During his expedition down the Colorado River, Powell collected rock samples and drew detailed pictures of each location. Every evening that it was possible (and sometimes when it appeared impossible), he would climb up the canyon wall to get a better view of where they had been and where they were headed. It wasn’t until his second expedition that he included a photographer to his crew.

You will be studying two locations in the Grand Canyon that Powell may have visited. You are the first people to investigate these two sites and will be reporting your findings to the expedition funders.

How do you describe your location on the Colorado River?

Transparency: Grand Canyon Map

Lee’s Ferry = Mile 0 on the river

Green books: Nankoweap Canyon and North Canyon – discuss

Transparency: Marble Canyon

LAB SHEET – North Canyon Sketch: page _________
  Nankoweap Canyon Sketch: page _________
LAB SHEET – North Canyon Rock Observations: page _________
  Nankoweap Canyon Rock Observations: page _________
Grand Canyon Rock samples: North Canyon and Nankoweap Canyon

When geologists go into the field, they make a detailed drawing of the rock exposures they study. They collect samples (small, representative pieces) from the rock exposures they observe. They label the rock samples and the drawings to help them remember where they collected the rocks. They then write detailed descriptions of the rock samples in their field journals.
Your task: Observe and describe each rock in each box.

Acid Test – Model

How might you organize your rock observations? Discuss

LAB MATERIALS:

2 sets of rock from the same site (North Canyon or Nankoweap) (1 set per 2 people)
2 hand lenses
1 bottle of acid
paper towel

After completing the Grand Canyon rock observation charts:

What are some of the rock properties you have observed and recorded?

How are the rocks alike?

How are the rocks different?

If you rubbed any of the rocks together, what did you observe?

You have now completed the first steps in trying to read the story written in the Grand Canyon rocks. Now you will divide the rocks into groups.

Nankoweap and North Canyon

What are some examples of a property you might use to sort the rocks into groups?

Sort the Rocks:

#1 Sort the rocks from North Canyon into groups.
#2 Sort the rocks from Nankoweap Canyon into groups.
#3 Make up a descriptive name for each group of rocks.

After sorting and naming the rocks:

Into how many groups did you sort the rocks from North Canyon?
Into how many groups did you sort the rocks from Nankoweap Canyon?

What properties did you use to sort the rocks?

Which of the rocks in both sets fizzed when you placed acid on them?

Did these rocks share any other properties?

The material in the rock that reacted with the acid is calcite. Calcite is a common mineral composed of calcium, carbon, and oxygen.

Calcite’s chemical formula is CaCO₃. This particular combination of carbon and oxygen is called a carbonate. Calcium carbonate is found naturally as calcite and as chalk.

When the acid reacts with calcite, a gas, carbon dioxide (CO₂), is given off. Hence the fizzing.

When geologists place acid on a rock and it fizzes, they can be pretty sure that calcite is one of the minerals in the rock.

Limestone: Rocks that contain calcite. The four rocks that fizzed are all samples of limestone.

Compare rock 6 and rock 8:

What property do these two rock samples share?

Did either of them fizz when you placed acid on them?

What do you observe if you gently rub these two samples together?

Sandstone: Rocks that are made out of sand particles and cemented together.

Rock 7: Shale

**Part 2: Correlating Grand Canyon Rocks**

Quick Write:
Why would a geologist consider a bottle of hydrochloric acid and hand lens two of his or her most important tools in the field?
Green books: North Canyon and Nankoweap Canyon: pages 8 and 9
Discuss
Transparency: Grand Canyon Rocks

LAB SHEET - Grand Canyon Rocks: page __________

Place rock samples on worksheet (columns)
Record the names of rocks on the rectangle on the Grand Canyon Rocks page.

On our Grand Canyon Rocks sheets we have North Canyon and Nankoweap Canyon right next to one another. However, on the river, they are miles apart. I’d like you to cut your tow rock walls apart and move them apart to see if you can get even more information about the rocks in the Grand Canyon.

LAB SHEET – Grand Canyon Rock Lineup sheet: page __________

Some of the rocks are the same at both North and Nankoweap Canyons. Geologists describe these flat deposits of rock as layers. Layers can be thick or thin, but they always extend over a large area.

In what other context have you used the word layer?

You can think of rocks in the Grand Canyon as layers in a cake. Just like you slice through a cake with a knife and expose the layers inside, the Colorado River cut through the rock layers in the Grand Canyon, exposing the edges of the rock layers.

Symbols for the different kinds of rocks:
Limestone:
Shale:
Sandstone:

Share finished lineups

Correlate is a word that means to find a relationship or connection between rock layers from two or more locations. You have just correlated the rocks from two locations at the Grand Canyon.

LAB SHEET – Grand Canyon Rock Correlations: page __________

Green books - From the Little Colorado to the Foot of the Grand Canyon: page 58
Part 3: Colorado Plateau Introduction

Colorado River slide show

Review: North Canyon Rock Observations and Grand Canyon Rock Lineup

The Kaibab Limestone in the Grand Canyon is located at an elevation of about 8000 feet above sea level. What did you observe in your sample of Kaibab Limestone?

Discuss in groups:

How can you explain fossils of sea creatures at such a high elevation?

What evidence do you have to support your explanation?

The Grand Canyon is part of an even larger landform called the Colorado Plateau.

A plateau is a large, nearly level area of land that has been uplifted or elevated above the surrounding area.

Green books: Colorado Plateau Map: page 32
Transparency: Colorado Plateau Map

Which states are home to part of the Colorado Plateau? (U, A, C, NM)

Geologists have studied the rocks of the Colorado Plateau and produced maps that show which rock layers are exposed at the surface. The Kaibab Limestone is exposed at the surface in several areas.

Transparency: Kaibab Limestone
Transparency: Colorado Plateau Map

Geologists have found Kaibab Limestone at different surface locations within this boundary.

If we drilled a hole into the Kaibab Limestone on the Utah/Arizona border north of the Grand Canyon, what do you think we might find under Kaibab Limestone?

What else could we do to see what is under the Kaibab Limestone? Where might we go to see what is under the Kaibab besides the Grand Canyon?

There are many places on the Colorado Plateau that have been designated national parks because of their scenic beauty and interesting landforms. We’re going to take a virtual tour of several of these national parks and observe the rocks found in them.
Landforms shaped like steps or cliffs and slopes are formed by the process of differential erosion. **Differential erosion** occurs where a mountain or plateau is made out of both soft, weak rocks and harder, more resistant rocks. The weaker rocks wear away faster, leaving behind knobs and cliffs of more resistant rocks. The Colorado Plateau is famous for the variety of landforms that were created because of differential erosion.

Green Books: pages 20 -21
Locate Monument Valley on the Colorado Plateau Map
The northeastern corner of Arizona is where many classic cowboy movies were filmed because of the dramatic western scenery.

CD ROM: Monument Valley – Geology Lab, Earth Processes

Choose three images that are good examples of differential erosion.

#1 Sketch the landforms you see.
#2 Describe the rock layers
#3 Label which rock layers are softer and which are harder. (Inference) (put on back of packet)

Observe Neighborhood Rocks:

What are some of the properties we can observe about our rocks to help us identify them?
Earth History
Mid- Summative Exam 3 Review

Define the following words:
Elevation

Samples

River miles

Layers

Plateau

Sedimentary

Rock Column

Formation

Correlation

How do you identify limestone, sandstone, and shale?

How do you decide if rocks are softer or weaker?
GRAND CANYON ROCKS

Nankoweap Canyon
Mile 52

Rock-Layer name

Rock ID

Colorado River
Elevation of river: 2800 feet

North Canyon
Mile 20

Rock-Layer Name

Rock ID

Colorado River
Elevation of river: 2925 feet
You correlated the rocks from two locations at the Grand Canyon. To correlate means to match rock layers from two or more locations.

You will need your Grand Canyon Rock Lineup sheet and your Earth History Resources book to answer these questions.

1. How far apart are North and Nankoweap Canyons? ____________________________

2. What is the elevation of the river at North Canyon? ____________________________

3. What is the elevation of the river at Nankoweap Canyon? ________________________

4. Which way is the Colorado River flowing, from North Canyon to Nankoweap or vice versa? How do you know? ____________________________________________
   ____________________________________________
   ____________________________________________

5. Which rock layer is at river level in North Canyon? ____________________________

6. Which rock layer is at river level in Nankoweap Canyon? ________________________

7. How can you explain the evidence that different rock layers are exposed at river level at these two sites? ____________________________________________
   ____________________________________________
   ____________________________________________

8. Suppose you could drill a hole into the rock at Mile 20. What kind of rock would you expect to find? Why? ____________________________________________
   ____________________________________________
   ____________________________________________

9. Suppose you stopped at Mile 30 along the Colorado River in the Grand Canyon. Which rock layer would you expect to see at river level? Why? ____________________________________________
   ____________________________________________
CHUAR BUTTE OBSERVATIONS

Turn to the picture of Chuar Butte in the *Earth History Resources* book. Look at the shape of the outline of the butte and the area on both sides of the Colorado River.

1. How would you describe the shape of Chuar Butte’s outline?

2. What kinds of rocks tend to form the cliffs?

3. What kinds of rocks tend to form the slopes?

4. What is it about sandstone, shale, and limestone that might cause the slopes and cliffs to form?

5. What do you think Chuar Butte would look like today if it were made only of shale?