

3: Layer by Layer

Based on the Arizona quarter reverse



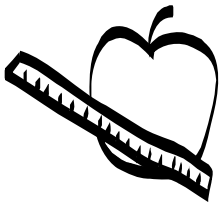
OBJECTIVE

Students will identify the process by which the Grand Canyon was formed and identify the different geological materials that comprise the various layers of the Grand Canyon.



MATERIALS

- 1 overhead projector
- 1 overhead transparency of each of the following:
 - “Arizona Quarter Reverse” page
 - “Erosion Equation” worksheet
 - “Layer by Layer” worksheets (2 pages)
- Copies of the following:
 - “Arizona Quarter Reverse” page
 - “Erosion Equation” worksheet
 - “Layer by Layer” worksheets (2 pages)
 - “Canyon Clues” worksheet
- 1 class map of the United States
- Chart Paper
- Markers
- 1 copy of text that gives information about erosion. For example:
 - *Rock Cycles: Formation, Properties, and Erosion* by Rebecca Harman
 - *Erosion (Early Bird Science)* by Joelle Riley
 - *Erosion (Earth Watch)* by Cherie Winner
- 1 copy of text that gives information about the Grand Canyon. For example:
 - *A Grand Canyon Journey: Tracing Time in Stone* by Peter Anderson
 - *Exploring the Grand Canyon (Grand Canyon Association)* by Lynne Foster
 - *In Search of the Grand Canyon: Down the Colorado with John Wesley Powell* by Mary Ann Fraser
- Computers with Internet Access
- Black permanent marker
- 16 oz. water bottles with labels removed
- Small funnels
- Colored sand (10 different colors)
- Scissors



Layer by Layer



PREPARATIONS

- Make an overhead transparency of each of the following:
 - “Arizona Quarter Reverse” page
 - “Erosion Equation” worksheet
 - “Erosion Equation” worksheet completed
 - “Layer by Layer” worksheets (2 pages)
- Make copies of each of the following:
 - “Arizona Quarter Reverse” page (1 per student)
 - “Erosion Equation” worksheet (1 per student)
 - “Layer by Layer” worksheets (1 of each page per student)
 - “Canyon Clues” worksheet (1 per pair)
- Locate a text that gives information about erosion (see examples under “Materials”) and mark appropriate passages to read in class.
- Locate text that gives information about the Grand Canyon (see examples under “Materials”) and mark appropriate passages to read in class.
- Arrange to use the school computer lab for one class session.
- Bookmark Internet sites that contain information about the Grand Canyon.
- Prepare work stations for Session 5 by setting up the “Layer by Layer—Part 2” worksheet, “Canyon Clues” worksheet, sand, water bottles, scissors, and funnels for each student pair.



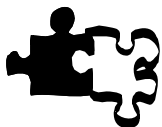
GROUPINGS

- Whole group
- Pairs
- Individual work



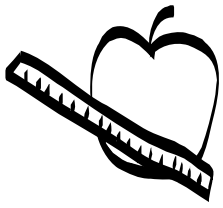
CLASS TIME

Five 45- to 60-minute sessions



CONNECTIONS

- Science
- Language Arts



Layer by Layer



TERMS AND CONCEPTS

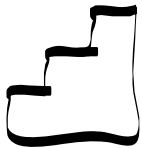
- Reverse (back)
- Obverse (front)
- Primary rock layers
- The Grand Canyon
- Erosion



BACKGROUND KNOWLEDGE

Students should have a basic knowledge of:

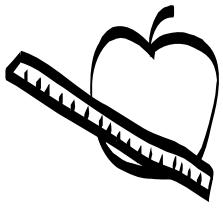
- Rock formations
- Geological timeline
- Geological layer



STEPS

Sessions 1 and 2

1. Describe the 50 State Quarters® Program for background information, if necessary, using the example of your own state, if available. Then display the transparency or photocopy of the “Arizona Quarter Reverse” page. Locate Arizona on a classroom map. Note its position in relation to your school’s location.
2. With the students, examine the Arizona quarter. Have the students identify the different elements, including the Grand Canyon.
3. Introduce the term “erosion” and write it on a sheet of chart paper. Ask the students to brainstorm the meaning of the word. Record student answers on the chart paper.
4. Distribute the “Erosion Equation” worksheet to the students. Display the transparency of the “Erosions Equation” worksheet. Review the instructions and answer any questions. Ask the students to complete Part I of the worksheet during the reading.
5. Introduce the students to the selected text about erosion. Read the text aloud to the students and attend to any unfamiliar vocabulary and concepts. During the reading, guide their completion of Part I of the “Erosion Equation” worksheet by filling in the transparency of the “Erosion Equation” worksheet while having the students complete their own worksheets.
6. Review Part 1 of the “Erosion Equation” worksheet with the students. Check for student understanding and answer any questions.



Layer by Layer

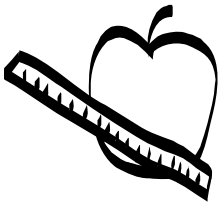
7. Ask the students to re-define the term “erosion” using their “Erosion Equation” worksheet. Record student answers on the chart paper (use a different-colored marker than the first time).
8. Introduce the students to the selected text about the Grand Canyon. Read the text aloud to the students and attend to unfamiliar vocabulary during the reading. Add the terms “Grand Canyon” and “geological layer” and their definitions to the chart paper.
9. Ask the students to identify any relationships they see between the terms “erosion,” “Grand Canyon,” and “geological layer.” Discuss and record student answers on the chart paper.
10. Guide the students through completing Part 2 of the “Erosion Equation” worksheet. Check for student understanding and answer any questions. On chart paper, write the completed erosion equation for the Grand Canyon.
11. Collect the “Erosion Equation” worksheets from the students.

Sessions 3 and 4

1. Review the erosion equation created during the previous session with the students. Ask the students to re-state the relationship they see between the terms “erosion,” “Grand Canyon,” and “geological layers.” Answer any student questions.
2. Distribute the “Layer by Layer” worksheets to the students. Display the transparencies of the “Layer by Layer” worksheets. Review the directions on the “Layer By Layer” worksheets with the students and answer any questions.
3. Explain to the students that they will be researching the Grand Canyon and its characteristics. Explain to the students that they will need to research the geological layers of the Grand Canyon and label the diagram that is at the bottom of the worksheet.
4. Take the students to the computer lab and allow them time to do their research. Also allow the students to access print resources in the classroom or library.
5. Allow the students time in class to complete the “Layer by Layer” worksheets. Review the completed “Layer by Layer” worksheets with the students in class. Allow the students to make corrections to their “Layer by Layer” worksheets and then collect them.

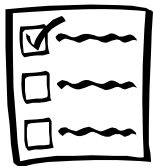
Session 5

1. Redistribute the “Layer by Layer” worksheets to the students and answer any remaining student questions. Divide the students into pairs.



Layer by Layer

2. Have each student pair sit at a workstation that has been set up with one “Canyon Clues” worksheet, one water bottle, one funnel, scissors, and 10 small cups each filled with a different color of sand.
3. Explain to the students that they will be re-creating the geological layers of the Grand Canyon using the colored sand and their “Layer by Layer” worksheets. Explain that they will read the descriptions on the “Canyon Clues” worksheet at their workstations and match each description with the correct geological layer on their “Layer by Layer” worksheets. Each description and layer will have a corresponding color of sand. The students will then use the diagram on their “Layer by Layer” worksheet to correctly layer the sand from the bottom to the top geological layer.
4. Have the students cut out each of the Canyon Clues once they have identified the layers. Have them put the clues in the correct geological order on their desks before using the sand. Visit each workstation to check on student progress.
5. Once the students have completed the “Canyon Clues” worksheet and used sand to recreate the geological layers of the Grand Canyon, have them place the lids on their water bottles. Collect the completed worksheets and water bottles. Have the students clean up their workstations.
6. Display the “Layer by Layer” worksheets and “Grand Canyon” water bottles around the classroom.



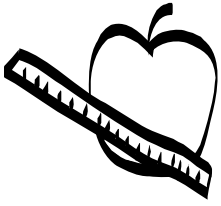
ASSESSMENT

Use the students’ class participation, worksheets, and “Grand Canyon” water bottles to evaluate whether they have met the lesson objectives.

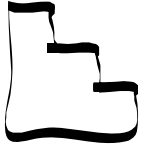


ENRICHMENT/EXTENSIONS

- Have students research current events articles related to erosion and the impact on such things as farming, land development, and wildlife. Have students share their findings with the class.
- Have students research other geological formations that were shaped by erosion. Compare and contrast these geological formations with the Grand Canyon. Have students create a poster which includes pictures and data with their findings.
- Have students look at other quarter designs and locate geological formations that are pictured on these quarters.

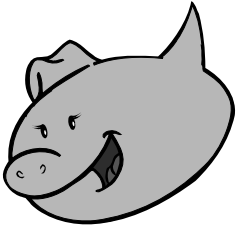


Layer by Layer



DIFFERENTIATED LEARNING OPTIONS

- Allow students to research one layer of the Grand Canyon. Allow students to work in groups to complete the “Canyon Clues” worksheet.
- Reduce the number of clues from 10 to 5. Have five of the clues already completed and allow students to fill in the remaining five layers.
- Have information about the Grand Canyon and erosion already assembled into level-appropriate material and available as research packets.



CONNECTION TO WWW.USMINT.GOV/KIDS

- Have students learn more about the nation’s natural beauty and resources by visiting the 2005 California quarter page <link to <http://www.usmint.gov/kids/coinNews/50sq/2005/ca.cfm>>. This quarter features John Muir and an image of the Yosemite Valley.
- Have students learn more about the nation’s flora and fauna through the Lewis and Clark Adventure <link to <http://www.usmint.gov/kids/games/LewisClarkAdventure/>>.
- Have students learn more about different geographic regions in the United States by using the 2008 Oklahoma quarter lesson plan <link to 2008 OK grades 4-6 lesson plan>



Name _____

Canyon Clues

Directions: Create a model of the Grand Canyon's primary layers.

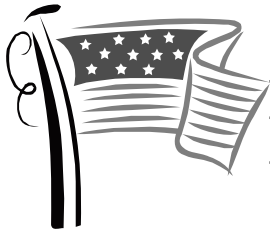
1. Fill in the names of the layers according to the clues below.
2. Match the layers with the colors on your "Layer by Layer" worksheet.
3. Fill out your group's labels and cut out the labels.
4. Arrange the labels in geological order as a guide.
5. Layer the colored sand in your bottle, oldest layer first, and attach the bottom label.

<p>Layer: Kaibab Limestone This 250-million-year-old layer resembles a bathtub ring. Fossils are embedded in its sandy limestone, shale, and sandstone.</p>	<p>Layer: _____ Ripple marks from a prehistoric ocean distinguish this 545-million-year-old layer. The brown sandstone holds marine fossils.</p>
<p>Layer: _____ At 260 million years old, this white or creamy quartz sand contains no skeletal fossils, but many invertebrate tracks.</p>	<p>Layer: _____ The most prominent rock laer is 335 million years old. It contains marine limestone and dolimites with many fossils and caves.</p>
<p>Layer: _____ This layer is 255 million years old. Like the Kaibab Limestone, it marine fossils in sandy limestone, shale, and sandstone.</p>	<p>Layer: _____ The layer that dates back about 530 million years is multicolored mudstone shale, containing some marine fossils.</p>
<p>Layer: _____ At 285 million years old, this layer contains shale and limestone, topped by sandstone, with many fossils.</p>	<p>Layer: _____ This layer is 515 million years old. Its grey limestone contains almost no fossils.</p>
<p>Layer: _____ This layer, 265 million years old, is a deep rust color. It contains layers of soft shale with fossils of plants and animal tracks.</p>	<p>Layer: Vishnu schist At the grand old age of 1,700 to 2,000 million years, this layer contains dark grey or black micha schist.</p>

The Grand Canyon's Primary Layers

By _____

Date _____



Name _____

Layer by Layer

Date _____

PART 1: IDENTIFY THE LAYERS

Directions: Using the Internet and text, write the age, color, and composition of each of the primary layers of the Grand Canyon below. Use the colors listed beside the names to make your sand model.

Kaibab Limestone	WHITE	Redwall Limestone	RED
Age:		Age:	
Color:		Color:	
Composition:		Composition:	

Toroweap Formation	YELLOW	Muav Limestone	GREY
Age:		Age:	
Color:		Color:	
Composition:		Composition:	

Coconino Sandstone	BLUE	Bright Angel Shale	GREEN
Age:		Age:	
Color:		Color:	
Composition:		Composition:	

Hermit Shale	ORANGE	Tapeats Sandstone	BROWN
Age:		Age:	
Color:		Color:	
Composition:		Composition:	

Supai Formation	PINK	Vishnu Schist	BLACK
Age:		Age:	
Color:		Color:	
Composition:		Composition:	

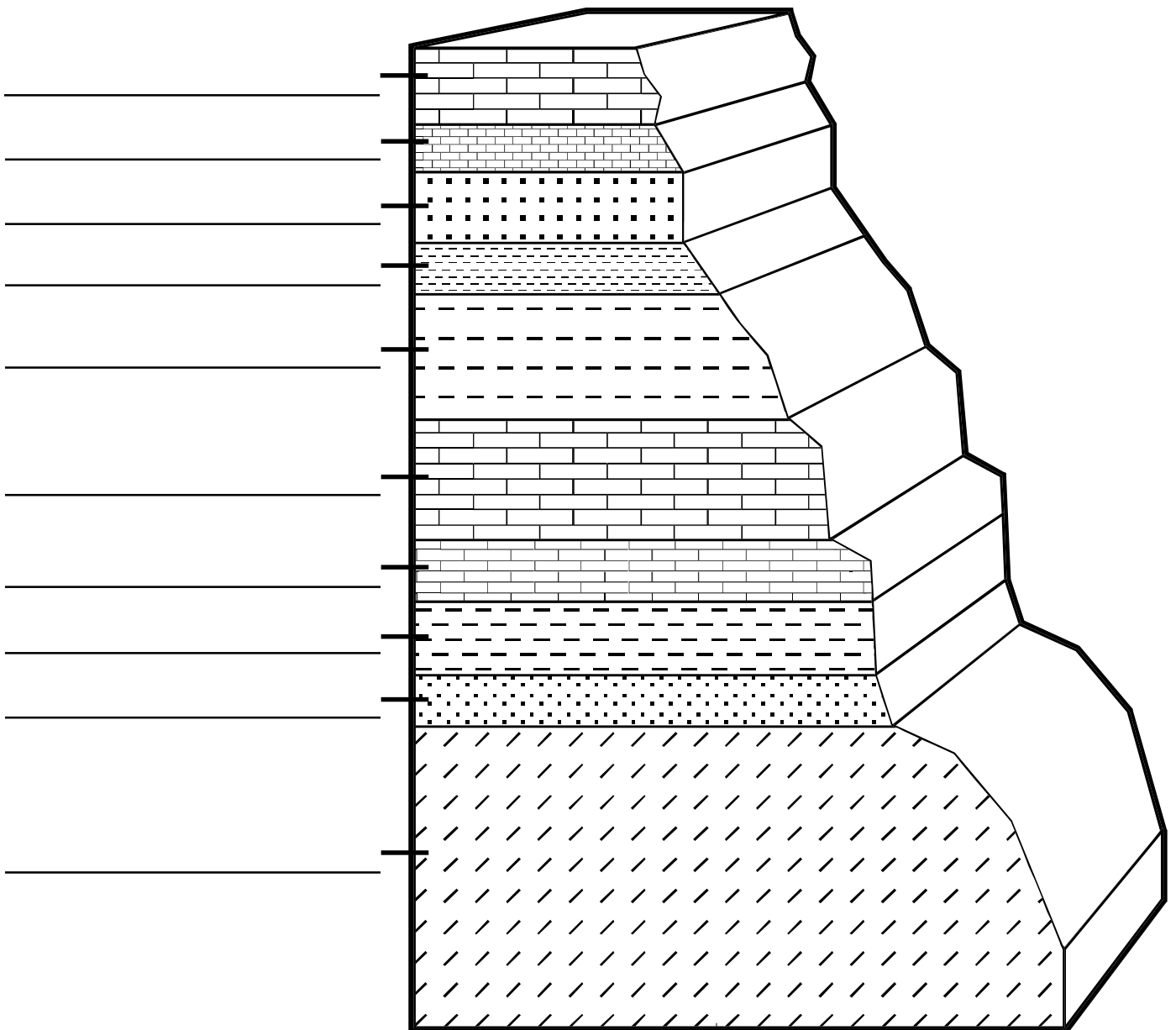


Name _____

Layer by Layer

Date _____

PART 2: LABEL THE LAYERS





Name _____

Layer by Layer

Key

PART 1: IDENTIFY THE LAYERS

Date _____

Directions: Using the Internet and text, write the age, color, and composition of each of the primary layers of the Grand Canyon below. Use the colors listed beside the names to make your sand model.

Kaibab Limestone

Age: 250 million years old

Color: Greyish-white and resembles a bathtub ring

Composition: Sandy limestone, shale, and sandstone containing many marine fossils

Toroweap Formation

Age: 255 million years old

Color: Dark yellow to grey and looks very similar to the Kaibab Limestone

Composition: Sandy limestone, shale, and sandstone containing some marine fossils

Coconino Sandstone

Age: 260 million years old

Color: White or creamy pure quartz sand

Composition: No skeletal fossils but many invertebrate tracks.

Hermit Shale

Age: 265 million years old

Color: Deep-rust color

Composition: Layers of soft shale that easily erode. Contains fossils of plants and tracks of reptiles and amphibians.

Supai Formation

Age: 285 million years old

Color: Red to tan

Composition: Shale and limestone, topped by sandstone, with many fossils of reptiles, amphibians, and plants.

Redwall Limestone

Age: 335 million years old

Color: Red to dark brown

Composition: Marine limestone and dolomites with many fossils and caves. Most prominent rock layer.

Muav Limestone

Age: 515 million years old

Color: Grey

Composition: Limestone. Almost no fossils.

Bright Angel Shale

Age: 530 million years old

Color: Green with some grey, brown, and tan

Composition: Mudstone shale with some marine fossils.

Tapeats Sandstone

Age: 545 million years old

Color: Dark brown

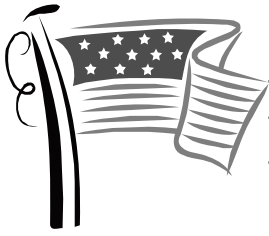
Composition: Medium and coarse-grained sandstone with some marine fossils. Contains ripple marks caused by prehistoric ocean

Vishnu Schist

Age: 1,700-2,000 million years old

Color: Dark grey or black

Composition: Micro schist



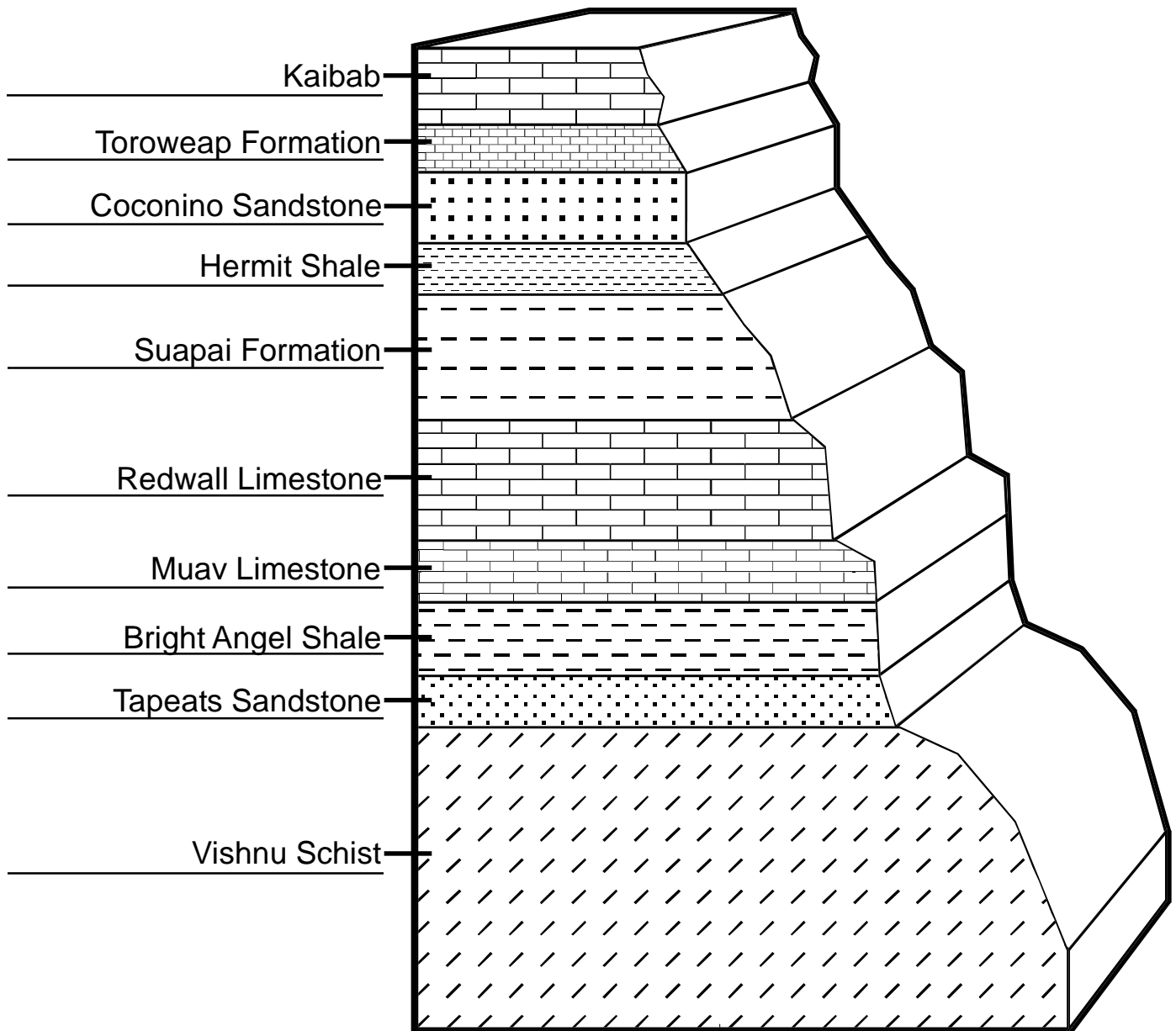
Name _____

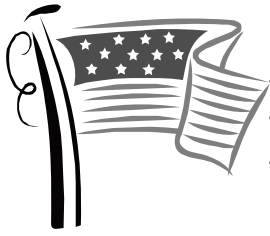
Layer by Layer

Key

Date _____

PART 2: LABEL THE LAYERS





Name _____

Erosion Equation

Date _____

Part 1: Using Internet resources and classroom texts, identify and define the five different types of erosion. In the boxes, draw examples of where that type of erosion may occur.

Erosion is _____

Type: _____	Type: _____	Type: _____
Type: _____	Type: _____	

Part 2: Using the information from Part 1, fill in the erosion equation below to identify the type of erosion that carved the Grand Canyon.

_____ + _____ = _____
Type of erosion Other factor Name of geological feature on Arizona quarter



Name _____

Erosion Equation

Key

Date _____

Part 1: Using Internet resources and classroom texts, identify and define the five different types of erosion. In the boxes, draw examples of where that type of erosion may occur.

Erosion is the gradual wearing away of land surface materials, especially rocks and soils, by the action of water, wind, or a glacier.

Type: <u>Water</u>	Type: <u>Wind</u>	Type: <u>Glacier</u>
Type: <u>Sea</u>	Type: <u>Soil</u>	

Part 2: Using the information from Part 1, fill in the erosion equation below to identify the type of erosion that carved the Grand Canyon.

Water and wind + Time = Grand Canyon

Type of erosion Other factor Name of geological feature on Arizona quarter



Arizona Quarter Reverse

