

How Do You Stack Up?

You and a group of geologists have collected stratigraphic outcrops from different areas around Arizona. Using the following information you will create a model of part of the geologic column showing the geologic history of the part of Arizona that contains all of the outcrops. Some questions to ask as you complete the different outcrops:

- How do geologists use the law of superposition to determine relative age?
- In what way can fossils be used?

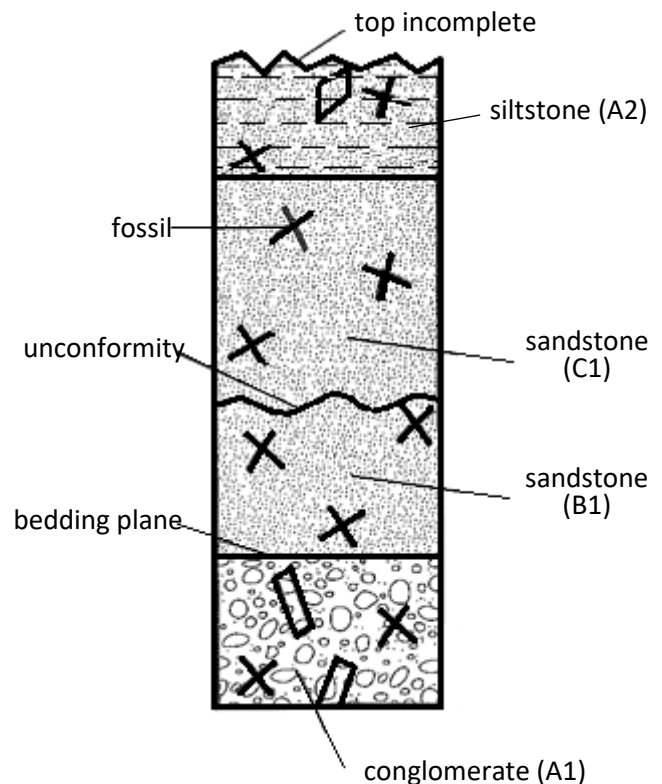
Digging through the Column

Materials:

- outcrop column
- dissection needle
- paper plate
- tray

Procedures:

1. Place outcrop column on the paper plate.
2. What observations can be made about the column? What measurements can you make? Record your observations and measurements on the outcrop mat.
3. Using the dissection needle carefully “dig” through the column.
4. Place fossils that are found on the outcrop mat. What observations can be made about where the fossils are found in the column? Which fossils were found in all layers? Which were found in only 1 or 2 of the layers? Record your observations, numbers of fossils and types on your outcrop mat.
5. Observe all of your classmate’s outcrop mats. What similarities and differences are there between each group’s outcrop columns? Discuss your observations with your group. What conclusions can you make about outcrop columns? Use evidence from your “dig” to support your statements.





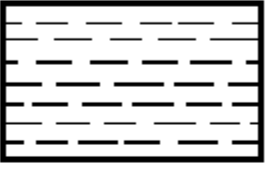
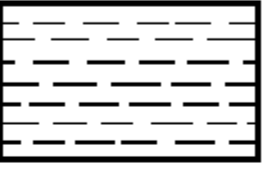
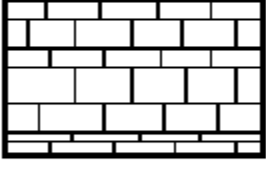









Organizing the Layers

According to the *law of superposition*, in undisturbed sequences of sedimentary rock, the oldest layers are on the bottom. Geologists use this principle to determine the relative age of the rocks in a small area. Geologists can also use fossils in the rocks to date the rocks.

A group of geologists have sent you the tables for 6 different outcrops that they collected from around the state. You will be using this information to model what geologists do by drawing stratigraphic sections for different rock outcrops. Using the stratigraphic drawings and matching up similar rock sequences and fossils you will create a part of the geologic column. This will then be used by geologists to improve and expand our picture of the rock record for our state.


Rock and Fossil Key:

	A	B	C
1		color yellow 	color red 
2		color blue 	color green 
3			
4			
5	<i>e</i>		

Types of upper contact:

- Bedding plane – use a straight line to draw a bedding plane
- Unconformity – use a wavy line to draw an unconformity
- Incomplete – use a jagged line to draw an incomplete

Data Table 1:

Outcrop 1				
Layer	Rock type	Fossil	Thickness	Upper contact
Top	siltstone (A1)	B3, C4	1 cm	incomplete
	sandstone (C1)	B3	3 cm	bedding plane
	sandstone (B1)	B3	2 cm	unconformity
Bottom	conglomerate (A1)	B3, C3	2 cm	bedding plane

Materials:


- Metric ruler
- Pencil
- Colored pencils
- White paper strips
- Scissors


Procedures:


Drawing outcrop 1:


1. Using one strip of white paper follow the instructions in steps 2 thru 6.
2. Starting at the bottom of the paper strip, measure up 2 cm. Using the Rock and Fossil Key sketch a layer of conglomerate (A1) in the box.
3. Use a black crayon or pencil to add B3 and C3 fossils to the conglomerate layer. The top of this layer is a bedding plane, so it should be a straight line.
4. Draw a 2 cm layer of sandstone (B1) with B3 fossils above the conglomerate layer. The top of the layer is an unconformity, so use a wavy line to represent the break in rock-layer sequence.
5. Add a 3 cm layer of another sandstone (C1) with B3 fossils. The top of this layer is another bedding plane.
6. Add a 1 cm layer of siltstone (A2) containing B3 and C4 fossils. The top of this layer is incomplete, so draw a jagged edge at the top. The total length of outcrop 1 should be 9 cm, on the back write outcrop 1.
7. Compare the section you drew with the table for outcrop 1. Be sure you understand how the section and chart for outcrop 1 are related before you continue.
8. Using the information from the following data tables, draw the remaining 5 outcrops. Remember to label each outcrop on the back of the strip of paper.


Data Tables 2-6:

Outcrop 2				
Layer	Rock type	Fossil	Thickness	Upper contact
Top	conglomerate (A1)	A4, B4, B5	4 cm	incomplete
	sandstone (B1)	A4	2 cm	bedding plane
	sandstone (C1)	A4	2 cm	bedding plane
Bottom	limestone (A3)	A4, A5	3 cm	bedding plane

Outcrop 3				
Layer	Rock type	Fossil	Thickness	Upper contact
Top	shale (B2)	C5	4 cm	incomplete
	conglomerate (A1)	A4, B4, B5	6 cm	unconformity
	Bottom	sandstone (B1)	A4	2 cm

Outcrop 4				
Layer	Rock type	Fossil	Thickness	Upper contact
Top	conglomerate (A1)	A4, B4, B5	1 cm	incomplete
	sandstone (B1)	A4	1 cm	bedding plane
	limestone (A3)	A4, A5	1 cm	unconformity
	shale (C2)	A4	6 cm	bedding plane
	shale (B2)	A4, C4	4 cm	bedding plane
Bottom	siltstone (A2)	B3, C4	4 cm	bedding plane

Outcrop 5				
Layer	Rock type	Fossil	Thickness	Upper contact
Top	limestone (A3)	A4, B5	1 cm	incomplete
	shale (C2)	A4	4 cm	bedding plane
	siltstone (A2)	B3, C4	3 cm	unconformity
	sandstone (C1)	B3	4 cm	bedding plane
	sandstone (B1)	B3	2 cm	bedding plane
Bottom	conglomerate (A1)	B3, C3	2 cm	bedding plane

Outcrop 6				
Layer	Rock type	Fossil	Thickness	Upper contact
Top	shale (B2)	C5	1 cm	incomplete
	siltstone (A2)	B5, C5	4 cm	bedding plane
	conglomerate (A1)	A4, B4, B5	3 cm	bedding plane
	sandstone (B1)	A4	2 cm	bedding plane
Bottom	limestone (A3)	A4, A5	2 cm	unconformity

Assembling the Geological Column:

1. In each outcrop, look for layers that have the same rocks and contain the same fossils. Line up the outcrops next to each other by matching similar layers. Don't be surprised if layers don't look exactly the same. This happens in the real world, too.
2. Upper contacts that are unconformities appear because there are rock layers missing. Examine other outcrops to find out what fits between the layers above and below the unconformities. To leave space for these layers, cut the sections along the unconformities.
3. When you find layers that match, you should be able to do one of three things with the other outcrops:
 - a. add rock layers to the bottom of your matched sections
 - b. add rock layers to the top of your matched sections
 - c. slip missing rock layers between unconformities

4. Once you have matched all the layers in the different outcrops, lay the sections on top of each other, being careful to line-up the bedding planes. After several tries, you should be able to create the part of the geologic column that corresponds to the area containing these six outcrops.

Analysis:

1. How many layers are found in this part of the geologic column?
2. Which is the oldest layer in your column? Which rock layer is the youngest? Describe these layers in terms of rock type and the fossils they contain.
3. Which (if any) fossils can be used as index fossils for a single layer? Which layer or layers contain each of these fossils? Why are these fossils considered index fossils?
4. Fossils may also be used to distinguish similar layers from one another. Name two layers in your column that are distinguished only by the fossils they contain. Which fossil(s) identifies each layer?
5. List the fossils in your column from oldest to youngest; label the oldest and youngest fossils.
6. Look at the unconformities in the sections for Outcrops 3 and 4. Which rock layers are partially or completely missing from each section? Explain how you know this.

