Sedimentary Rock Formation Models

5.7 A Explore the **processes** that led to the formation of sedimentary rock and fossil fuels.

The Formation Process Explained

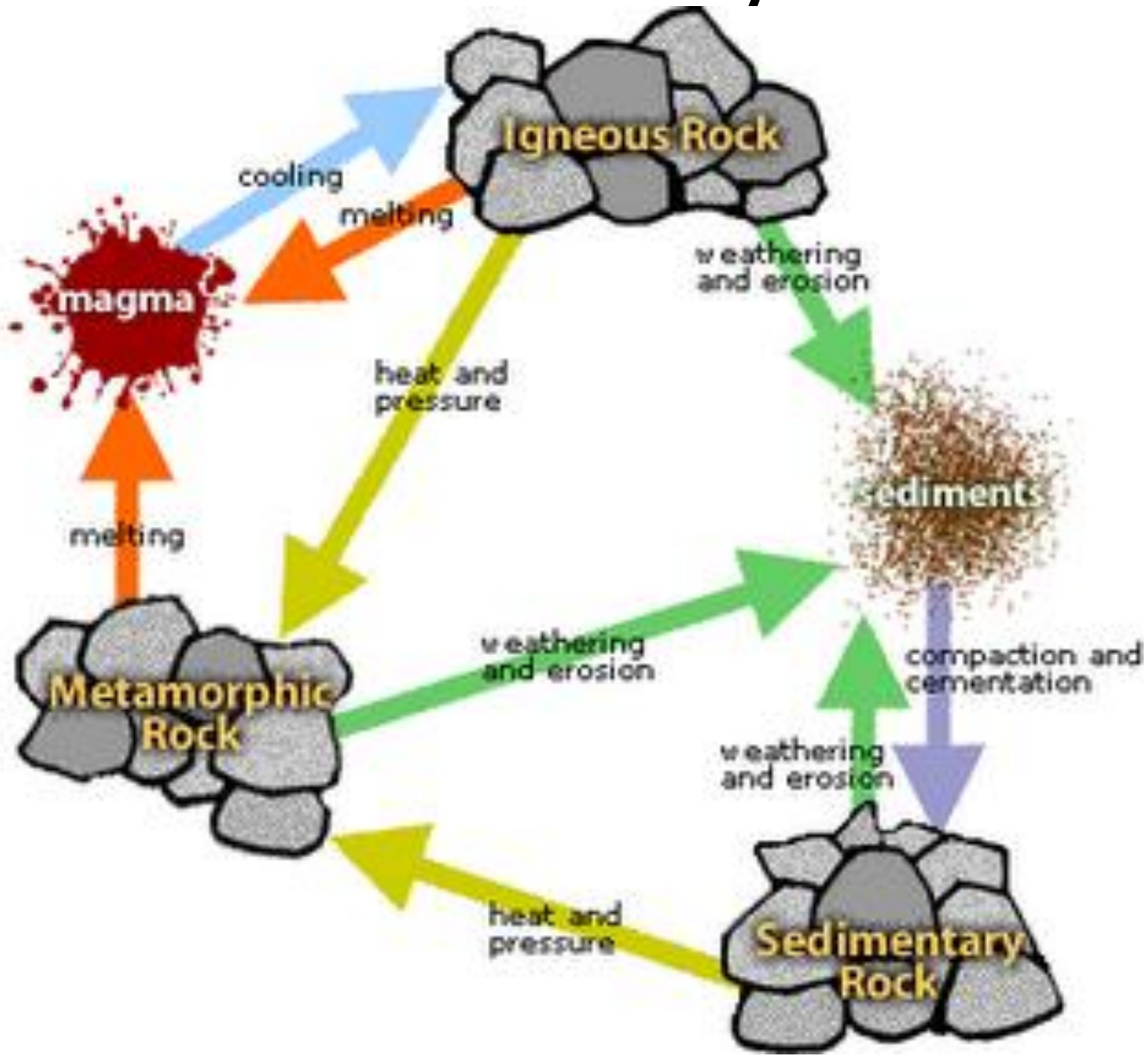
Formation of these rocks is one of the important parts of the rock cycle. For millions of years, the process of deposition and formation of these rocks has been operational in changing the geological structure of earth and enriching it. Let us now see how sedimentary rocks are formed.

Weathering
The formation process begins with weathering of existent rock exposed to the elements of nature. Wind and water are the chisels and hammers that carve and sculpt the face of the Earth through the process of weathering. The igneous and metamorphic rocks are subjected to constant weathering by wind and water. These two elements of nature wear out rocks over a period of millions of years creating sediments and soil from weathered rocks. Other than this, sedimentation material is generated from the remnants of dying organisms.

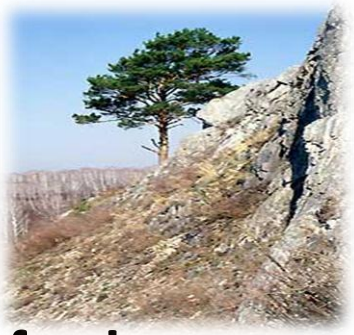
Transport of Sediments and Deposition
These sediments generated through weathering are transported by the wind, rivers, glaciers and seas (in suspended form) to other places in the course of flow. They are finally deposited, layer over layer by these elements in some other place. Gravity, topographical structure and fluid forces decide the resting place of these sediments. Many layers of mineral, organics and chemical deposits accumulate together for years. Layers of different deposits called bedding features are created from them. Crystal formation may also occur in these conditions.

Lithification (Compaction and Cementation)
Over a period of time, as more and more layers are deposited, the process of lithification begins. Two sub-processes that are a part of lithification are compaction and cemenation. Compaction is the compression of the sediments under overlying weight of sediments. Cementation is the process of filling in the gaps in sediments with minerals that gel them together. Crystal formation may occur here too. With these two processes at work, what was a loose layer of deposits, hardens and solidifies to become rock. This is the conclusive stage.

The Rock Cycle



Weathering



Oh no! I'm breaking up...

That's right, it doesn't look good - I'm weathering away fast!

All rocks on the Earth's surface weather - though some weather faster than others. Three different forces work together to break up rocks into smaller pieces.

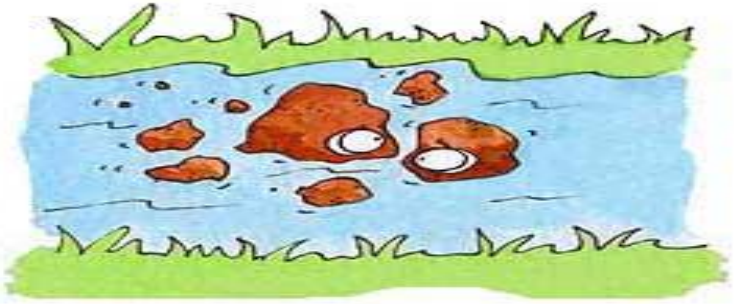
1. Physical weathering - cycles of hot and cold temperatures make rocks expand and contract, and rain may freeze and expand in cracks in the rock. These processes eventually lead to rocks cracking and breaking up.

2. Chemical weathering - different chemicals can dissolve rock, helping to break it up; even water can dissolve some rocks. Polluted 'acid rain' causes chemical weathering.

After hundreds of years I have broken down into a pile of rubble, gravel and sand. What's in store for me next?

http://www.oum.ox.ac.uk/thezone/rocks/cycle/stage1.htm

Erosion



I'm being swept off my feet!
Yep - now that I have weathered into small pieces, it is easy for me to be moved around.

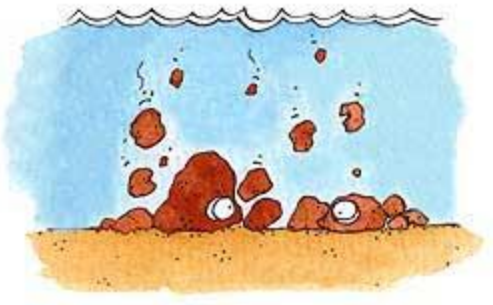
As rocks weather, they are broken up into small, easily transportable pieces or particles.

The movement of these particles is called erosion. There are four major ways erosion can occur:

1. **By gravity - broken pieces of rock fall to the ground, and roll or slide down slopes.**
2. **By water - rivers and streams can transport all sizes of particles.**
3. **By wind - small grains of sand can be picked up and moved by the wind in dust storms.**
4. **By ice - ice rivers, called glaciers, can transport very large pieces of stone.**

I'm still being picked up and transported by a river. What happens next?

Deposition

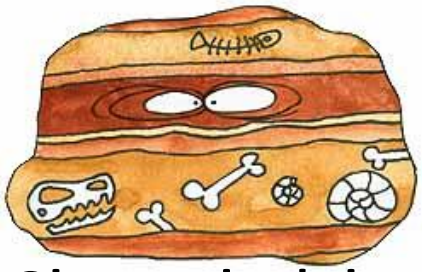


I've got a sinking feeling...
The river that has carried me along has now reached the sea - I think I'm being dumped.

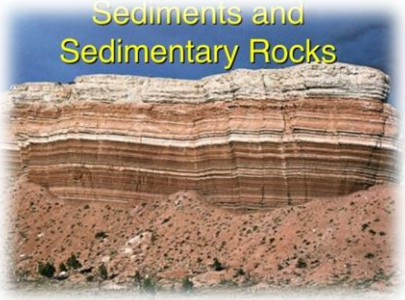
Particles of rock cannot be transported forever. Rivers reach the sea, the wind stops blowing and glaciers melt - they dump the load of particles they were carrying. This process is called deposition.

During deposition particles of rock are laid down in layers. Heavier particles are normally dumped first and then covered by finer material. Layers of sediment build up over time. These layers form a sedimentary sequence.

I have sunk to the bottom of the sea floor - buried by particles falling from above. What's in store for me next?



Sediments make Sedimentary Rock



Oh no, what's happening now?
This might not be so bad after all - I'm feeling whole again.

As the layers of sediment build up, the pressure on the lower layers increases. The layers are squeezed together and any water mixed in with the sediments is forced out. This process is called compaction.

At the same time the particles of sediment begin to stick to each other - they are cemented together by clay, or by minerals like silica or calcite.

After compaction and cementation the sedimentary sequence has changed into a sedimentary rock. Sedimentary rocks like sandstone, shale and limestone differ from other rocks in that they:

1. Are formed from layers of sediment built up over many years.

2. Are grains of sediment cemented together by various minerals.

3. May contain *fossils* - remains of plants and animals that were caught up in the sediment.

4. Sediments formed with dead / decaying plants and animals may turn to *fossil fuels* when HEAT and PRESSURE from the Earth are added

Well I'm feeling much better now that I can call myself a sedimentary rock. What next? There's a choice this time - up or down, you decide!

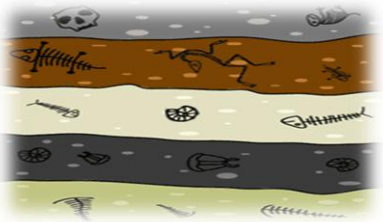
ROCKS AND LAYERS

Most of the rocks exposed at the surface of Earth are ***sedimentary***--formed from particles of older rocks that have been broken apart by water or wind.

These sedimentary particles may bury living and dead animals and plants on the lake or sea bottom.

The sediments at the bottom of the pile become rock.

The animal skeletons and plant pieces can become fossils.



Fossils and Rock Record

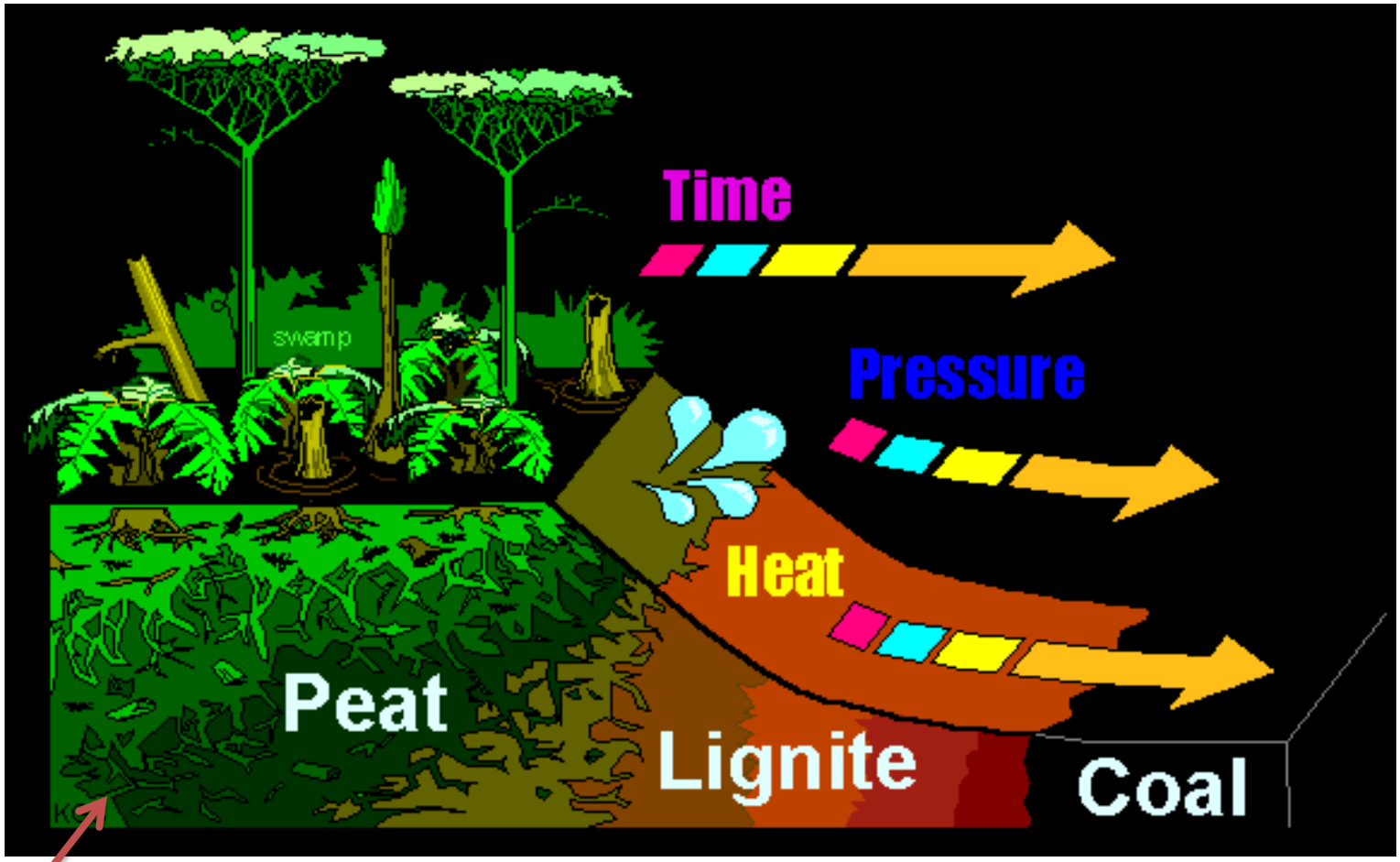
Each layer of sedimentary rock is a record (story) of the past

Some layers have fossils in them.

Scientist can look at the fossils and the rock they were found in, and learn . . .

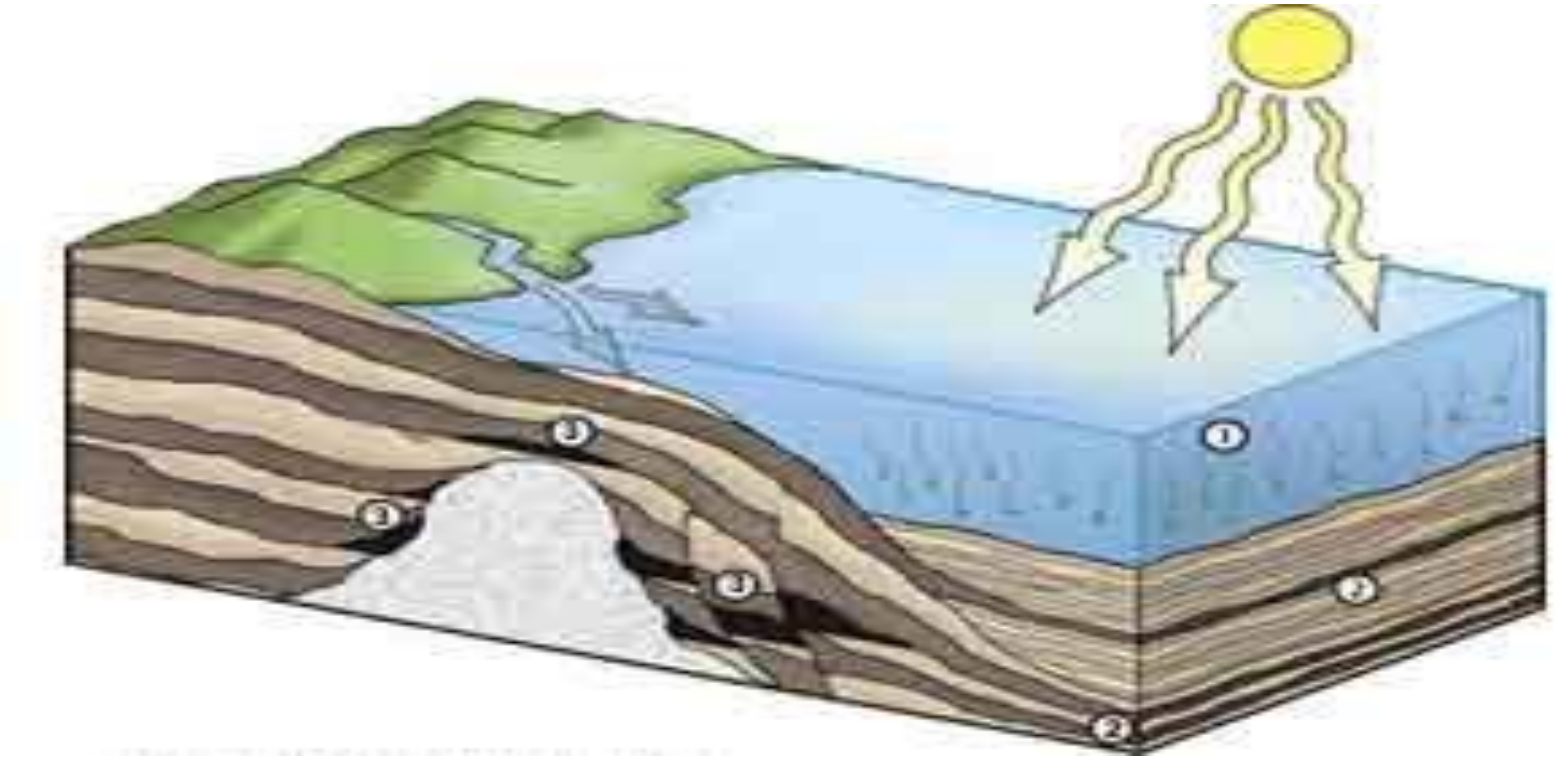
- How old is that fossil?
- What kinds of lived in this place long ago?
- Was there a lake, river, or ocean here?

Fossil Fuels / Coal



Dead plants and animals in a swamp form layers of sediment.

Fossil Fuels



Tiny plants and animals died and fell to the sea floor
(1). Here they were buried under sediment and other rock
(2). The rock squeezed the plants and animals and the energy in their bodies could not escape.
(3). The carbon eventually turned into oil under great pressure and heat.
(4). As the earth changed and moved and folded, pockets where oil and natural gas can be found were formed

Explain how sedimentary rock is formed. Include these words:

river, deposit, deposition, pressure, time, cemented together, formation, fossils, processes

Sequence the events that show the most logical order for a sedimentary rock called sandstone to form. Then write the steps in order in the flow map.
First to happen ----------Last to happen

<u>Events</u>

new layer of sandstone is formed by the earth

sediments are deposited in a new location

old rock is weathered into sediments

sediments are pressed and sealed together

lego relay race that reinforces the weathering process!

- 1. First, 2 teams build a lego landform
  2. Next, a member from each team pulls a piece off of the landform (weathering) and brings it to the other side (erosion) to start building a new landform (deposition)!
  3. Kids continue taking turns transporting pieces from one side of the room to the other until their original landform is completely weathered away!

Ronnie Rock's Homemade Sedimentary Rock

Rockhttps://www.quirkles.com/e-newsletter/000092011/Ronnie-Rocks-Homemade-Sedimentary-Rock-Science-Activity/index.htm

- ***Materials:***
  - **Clear glass jar with lid (quart jar works best)**
  - **Small pebbles**
  - **Sand**
  - **Twigs**
  - **Leaves**
  - **Epsom salt**
  - **Measuring cup**
  - **Water**
- ***Procedure:***
  - **Fill the jar with equal amounts of pebbles, sand, broken twigs, and crushed leaves. Pour one-fourth cup Epsom salt over the mixture. Add water until there is approximately two inches of space at the top of the jar. Put the jar lid on tight and shake vigorously. Once the ingredients are completely mixed (sediments should be floating in the water), place the jar on a flat surface. Check the jar every hour. After the layers have settled, pour all the water out of the jar and let it dry completely.**
- ***Conclusion:***
  - **You have made a sedimentary rock! You have layers as a result of different types of sediment settling at different times. Epsom salt is made from the dissolved minerals of magnesium and sulfur. This is the "glue" that holds the homemade rock together.**

Sedimentary Rock Model Graham Cracker Crust!

- First, We weathered Graham crackers in tiny crumbs!
- We then added other types of sediment (Sugar!) and Fossil fuels (butter)! We pressed our sediments in the pie pan and put them into the toaster oven to bake.
- Our rocks came out hard and tasty!

Fossil Bread

5.7A Explore the processes that led to the formation of fossil fuels.

- **- Why do you think oil and natural gas are called "Fossil Fuels?"**
  - How long do you think it takes for fossil fuels to form?

SET UP MATERIALS
You will need three slices of different kinds of bread, gummy animals (Ex: Gummy worms or fish), paper towels, a stack of heavy books and a science buddy.

STEPS
1. On a paper towel layer three pieces of bread on top of each other like a pancake stack. The bread layers will represent sediment layers that form over millions of years.

2. Next, insert a **few gummy animals** in a middle layer. (The gummy animals represent animals that died, became trapped in sediments and later fossilized.)

3. Wrap the entire bread fossil in a paper towel.

4. Then stack a layer of heavy books on top of the bread fossil. For best results, apply more pressure.
Let it sit overnight. Do not disturb or peek!

5. On the following day: Predict how you think the bread fossil will look. Uncover the bread fossil and observe very closely.

- **THINK ABOUT IT**
  How has the bread fossil changed? What eventually happened to the animal material when it was trapped in the porous bread layers? Try to pull the layers apart. What do you see in the pores of the bread?

EXPERIMENT AGAIN?
Look for a fossil in your own backyard. Check out one of these books in your school library to help you learn more about fossils. "Aliki's Digging up Dinosaurs" and "The Magic School Bus: Journey to the Center of the Earth."
-Adapted from *Fossils to Fuel*

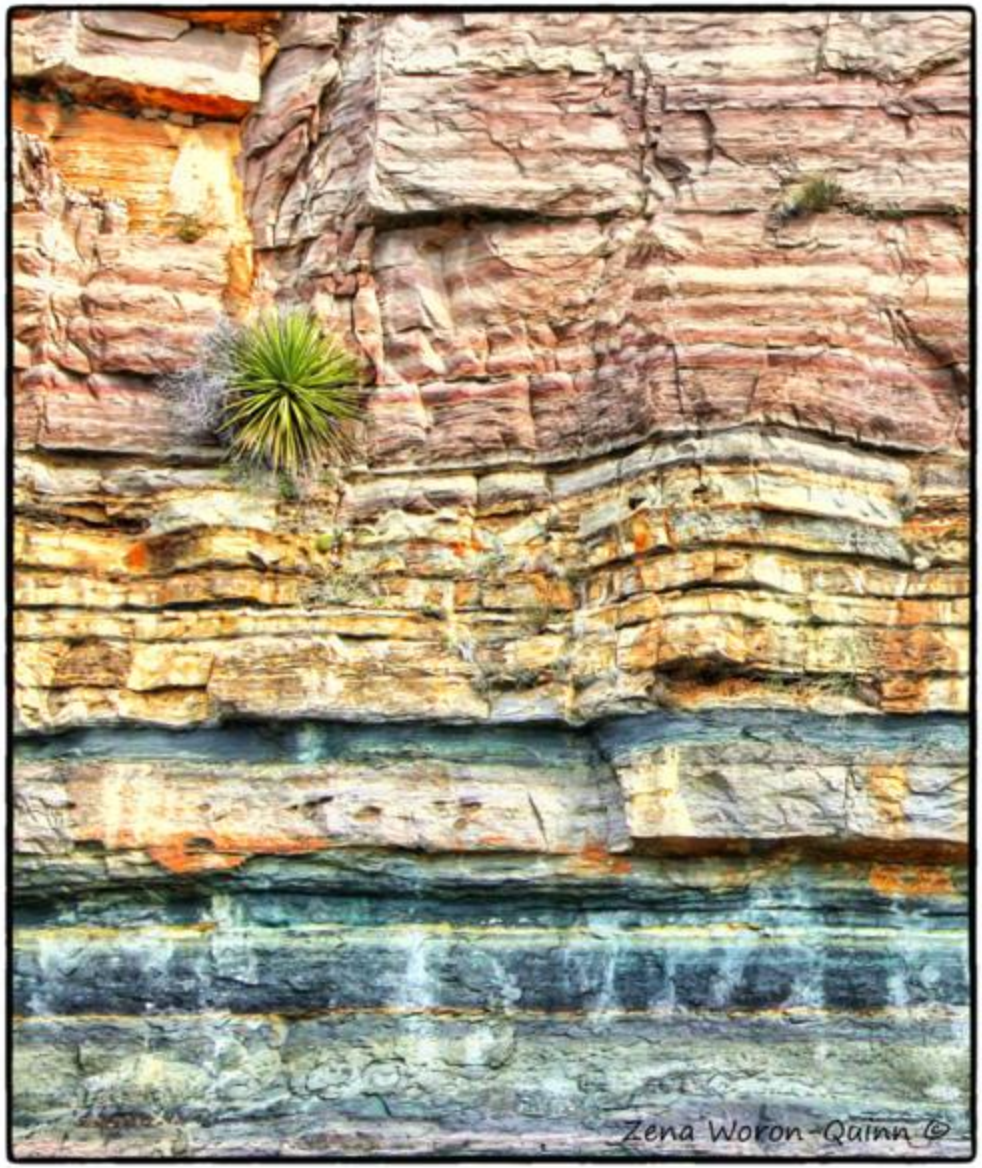
Fossil fuel process

- **Sequence the following sentences so that they describe the formation of the fossil fuel, coal. Write numbers 1-5 in the correct blank to show the correct order of the formation.**
-
- **_____over time, pressure inside the Earth changes the plant material**
- **into a fossil fuel called coal**
-
- **_____ the coal is burned and the energy stored inside the prehistoric**
- **Plant material is released**
-
- **_____ the plants die and are buried under deep deposits of sediment**
-
- **_____ humans mine the coal by digging it out of the Earth**
-
- **_____ plants growing in prehistoric swamps and forests store energy**
- **received from the sun**

Starburst Model

1. Unwrap the three candies and stack them one on top of the other.
2. Describe the model you built using your scientific observations. (stay away from color and smell).
3. We will record your adjectives on the board.
4. This is a model of SEDIMENTARY
5. Explain how sedimentary rock is formed. Include these words:
   river, deposition, pressure, time, cemented together


Along The Way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