S6E5. Students will investigate the scientific view of how the earth’s surface is formed.
c. Classify rocks by their process of formation.
g. Describe how fossils show evidence of the changing surface and climate of the Earth.

Objectives:

Define Relative Age, Absolute Age

Explain the principles of relative time including uniformitarianism, superposition, and original horizontality

Explain how geologic events can be used to determine relative time including inclusions, cross-cutting relationship, contact metamorphism, and unconformities

Identify various types of fossils

Explain the various theories of how life began on Earth

Explain extinction

Define Index fossils

Explain the differences in each of the major geologic eras

Connect sedimentary rocks to fossils
Directions:

- Read each slide then **fill in** the blank provided, **some** slides are informational only.

- Some slides have the word in **red**, or **underlined** for you to fill in the blank.

- Rock on!
Intro to Sedimentary Rocks

• Produced from *weathering products* (sediment) of *pre-existing* rocks or accumulated *biological matter*

• *Sediment* - loose, solid particles originating from:
  – Weathering and erosion of pre-existing rocks
  – Chemical precipitation from solution, including secretion by organisms in water

• Classified by *particle size*:
  – Boulder - >256 mm
  – Cobble - 64 to 256 mm
  – Pebble - 2 to 64 mm
  – Sand - 1/16 to 2 mm
  – Silt - 1/256 to 1/16 mm
  – Clay - <1/256 mm
Types of Sedimentary Rocks

- **Detrital (clastic) sedimentary rocks**
  - rocks produced from rock fragments
  - Most common sedimentary rock type
  - Form from cemented sediment grains that come from pre-existing rocks

- **Chemical sedimentary rocks**
  - rocks produced by precipitation of dissolved ions in water
  - Have crystalline textures
  - Form by precipitation of minerals from solution

- **Organic sedimentary rocks**
  - rocks produced by accumulation of biological debris, such as in swamps or bogs
  - Accumulate from remains of organisms
Sedimentary Structures

- Sedimentary rock types and *sedimentary structures* within the rocks give clues to *past environments*

- **Sedimentary structures**
  - Features within sedimentary rocks produced during or just after sediment deposition
  - Provide clues to how and where deposition of sediments occurred

- **Bedding**
  - Series of visible layers within a rock
  - Most common sedimentary structure

- **Cross-bedding**
  - Series of thin, inclined layers within a horizontal bed
  - Common in sandstones
  - Indicative of deposition in ripples, bars, dunes, deltas
Sedimentary Structures

- **Ripple marks**
  - Small ridges formed on surface of sediment layer by moving wind or water

- **Graded bedding**
  - Progressive change in grain size from bottom to top of a bed

- **Mud cracks**
  - Polygonal cracks formed in drying mud

- **Fossils**
  - Traces of plants or animals preserved in rock
  - Hard parts (shells, bones) more easily preserved as fossils
Sedimentary Rock Interpretation

- Sedimentary rocks give important clues to the geologic history of an area
- **Fossils** in sedimentary rocks give clues to the history of life
- Important **resources** (coal, oil) are found in sedimentary rocks
- **Source area**
  - Locality that eroded and provided sediment
  - Sediment composition, shape, size and sorting are indicators of source rock type and relative location
- **Depositional environment**
  - Location where sediment came to rest
  - Sediment characteristics and sedimentary structures (including fossils) are indicators
  - Examples: glacial valleys, alluvial fans, river channels and floodplains, lakes, deltas, beaches, dunes, shallow marine, reefs, deep marine
I. Fossils and the Past

A. A fossil is *the remains or the evidence of a living thing.*

B. Formation of Fossils:

1. Most fossils are incomplete because usually only the hard parts of a plant or animal become fossils.
2. The soft flesh of dead organisms was usually eaten by animals or decayed before it could form into a fossil.
3. **The organisms below that are circled would most likely become a fossil.**
2. a. Most fossils form when organisms are buried in sediments.

b. Sediments often harden and change into rock. When this happens, organisms may be trapped in the rock.

Most fossils are found in Sedimentary rocks.
c. Fossils are almost never found in **Igneous** rocks because magma is found deep within Earth where no living things exist, and lava at the surface burns organisms before fossils can form.

d. Fossils are rarely found in **Metamorphic** rocks because heat, pressure, and/or chemical activity that causes a rock to change, also destroys or damages the fossils.
C. Types of Fossils

1. **Casts** and **Molds**

   a. **Cast**
      
      an empty space in the shape of the organism. This occurs when the hard parts of an organism decay and/or the hard parts are dissolved by chemicals.

   b. **Mold**
      
      occurs when minerals fill a mold and harden into the shape of the original organism.
2. **Imprints (Impressions)**

occurs when leaves and feathers leave an impression in soft sediment (mud) that later hardens into rock.

3. **Amber**

occurs when insects are trapped and become embedded in resin (tree sap) that hardens.
4. **Ice** - occurs when an organism is preserved in ice.

5. **Tar** - occurs when animals are trapped in tar pits as in the LaBrea Tar Pits of California.
"In order for a body to be completely mummified as in this case, the body must first dry completely then covered in ice and snow." The mummy was an male adult remarkably well preserved. The condition of his equipment and organic material were also preserved in good condition. The age of the body is about 3,300 BC or late Stone Age.
6. **Petrified** - occurs minerals dissolved in ground water gradually replace the original tissues of plants and animals.

7. **Carbonaceous film** - occurs the carbon in the tissues of organisms leave a residue/thin film of carbon on sediment which then hardens into rock.
D. Interpreting Fossils

1. Fossils indicate that many different kinds of life forms existed at different times in Earth’s history.

2. When fossils are arranged according to age, they show that certain living things have changed or evolved over time.
3. Fossils indicate how the Earth’s surface has changed. For example, fossils of marine organisms can be found in rocks that are presently high above sea level.
4. Fossils give clues to Earth’s past climate.
5. Fossils tell about the appearance and activities of past life.

For example, fossil teeth give clues about the kind of food the animal ate.
II. Relative Dating

A. Relative Age- the age of something compared to something else.

B. The Geologic Column- an ideal sequence of rock layers created by combining data from all known rock sequences at various locations.
C. Principle of Superposition-

In an undisturbed set of sedimentary rock layers, the oldest rock is at the bottom and the youngest is on the top.
D. Disturbed Rock Layers and Relative Dating

“Principle of Cross-Cutting Relationships”

A fault is **YOUNGER** than the rock layers it cuts across.

An igneous intrusion is **YOUNGER** than the rock layers it penetrates.

= Contact metamorphism
The folding and tilting of rock layers are events that are **YOUNGER** than the rock layers they effect.

**“Principle of Original Horizontality”**

Layers of sediment are deposited in flat-lying layers.
The photograph represents a mountainous area in the Pacific Northwest. Scientists believe that sedimentary rocks like these represent evidence of crustal change because these rocks were
1. formed by igneous intrusion
2. faulted during deposition
3. originally deposited in horizontal layers
4. changed from metamorphic rocks
E. Unconformity - A buried erosional surface separating two rock layers of different ages that show that sediment deposition was not continuous.

Formation of an Unconformity:

1. Deposition - formation of horizontal rock layers

2. Uplifting/folding

3. Erosion of surface layers

4. Subsidence - sinking down of earth’s layers followed by deposition of new sedimentary layers
The unconformities shown in the cross section represent:

1. buried erosional surfaces
2. locations of index fossils
3. volcanic ash deposits
4. boundaries between oceanic and continental crust

The unconformities shown in the cross section represent:

1. Letter X
2. Letter E
3. Letter Q
4. Letter Y
F. Index Fossils- a fossil that is used to date the rock layers in which it is found.

1. An organism that lived during a relatively short, well-defined time span.

2. Organism lived in a wide geographic area.
Summary: Clues

A. An animal dies and sinks into shallow water.

B. Sediment covers the animal.

C. The sediment becomes rock, preserving parts of the animal.

D. Mountain building, weathering, and erosion eventually expose the fossil at the surface.
A catastrophic world-wide flood and its receding waters could account for all the layers both marine and land-dwelling. It also accounts for the mixing of animals and dinosaurs into the various geologic layers.

In contrast, marine fossils in every layer mixed with mammals and dinosaurs does not make sense with the uniformitarian view. How can slow and gradual change account for marine fossils mixed with mammals and dinosaurs in every layer?
Finished

THANK YOU!