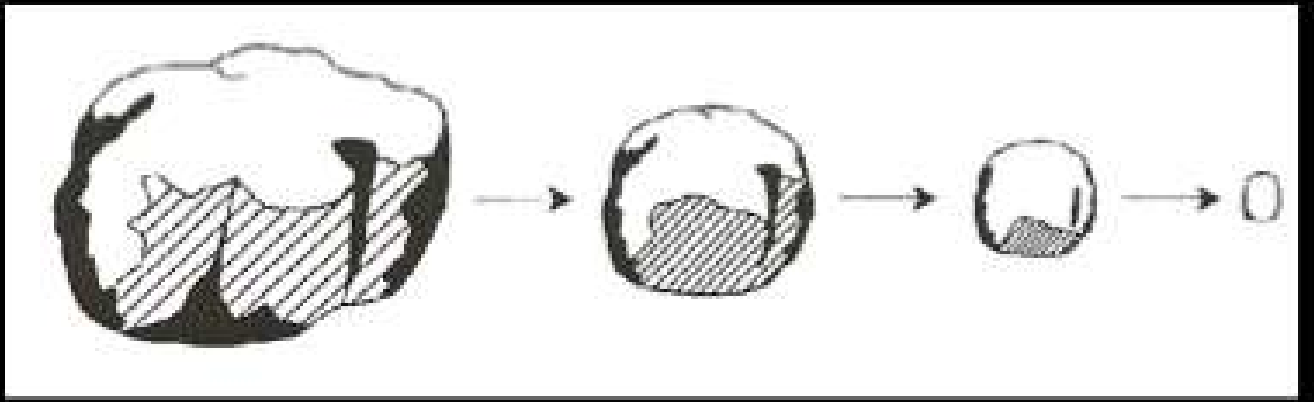
CW 1.3 Weathering Notes
Think about how the following notes related back to the statue CER!

1. **WEATHERING-** **The physical and chemical *breakdown of rock* into smaller particles called sediment.**



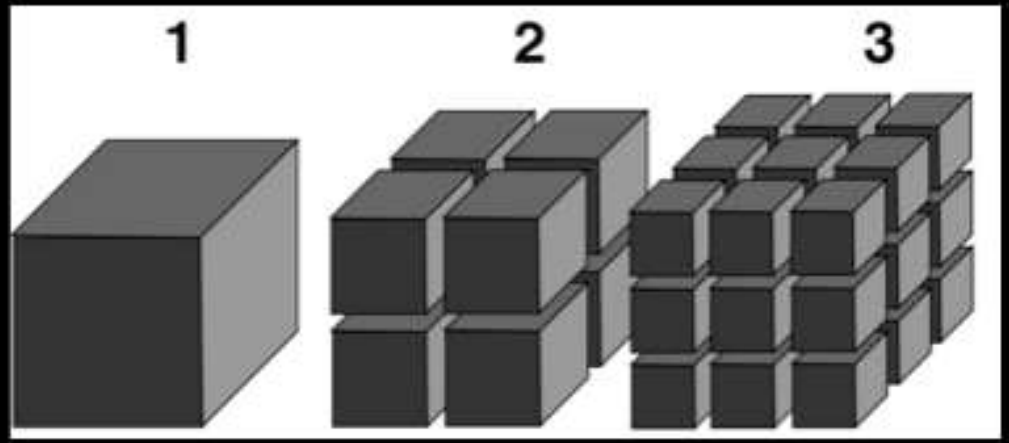
2. EROSION- A process by which weathered sediments are *carried* and *transported.*

Sediment may get transported thousands of miles by one of the world's major rivers, or it may just go from the top of the hill to the bottom during a landslide. During this journey, a lot can happen to the sediment.

SURFACE AREA

Def: A measure of how much exposed area a solid object has.

As a rock breaks into smaller pieces, (see diagram below), what happens to the overall surface area of that rock?



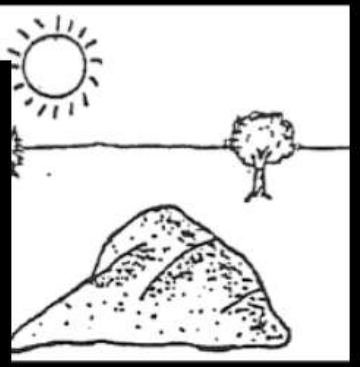
Which beaker will "weather" the alka-seltzer quicker? Why?

BEAKER #1	• BEAKER #2
-1 circular tablet of Alka-Seltzer	-1 crushed up tablet of Alka-seltzer
	

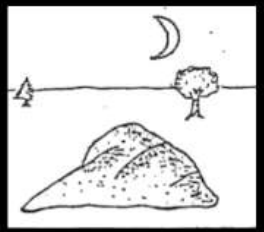
1. **PHYSICAL WEATHERING** → occurs when rock is cracked, split, or broken into smaller pieces of the same material without changing composition.

a. Temperature Change

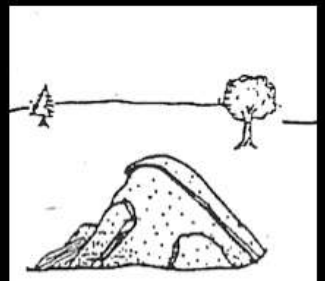
- 1. Rocks are heated by the sun. As the outside of the rock is heated, its surface begins to _____EXPAND_____.

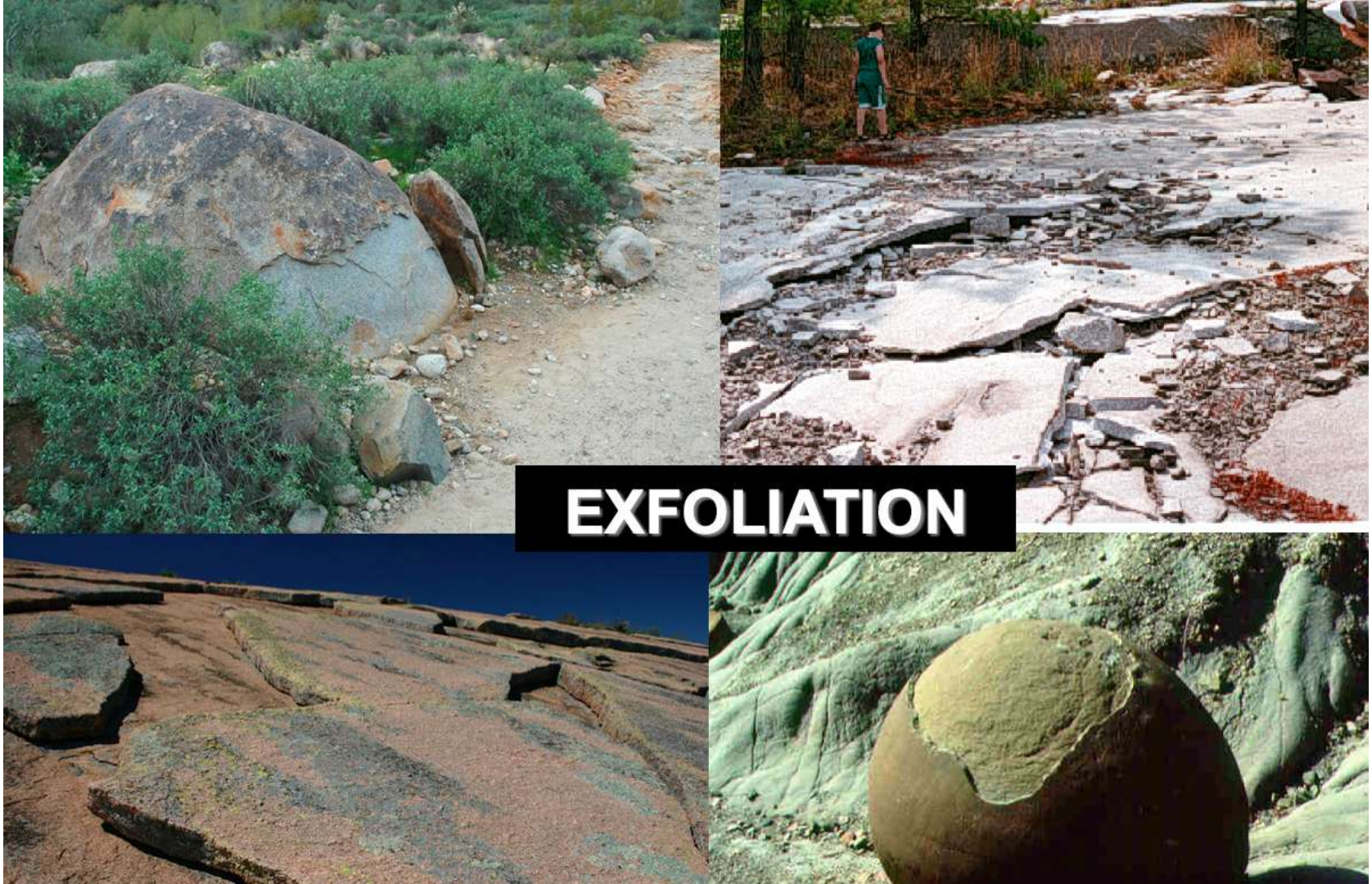


- 2. As temperatures fall at night, the outside of the rock _____CONTRACT_____.

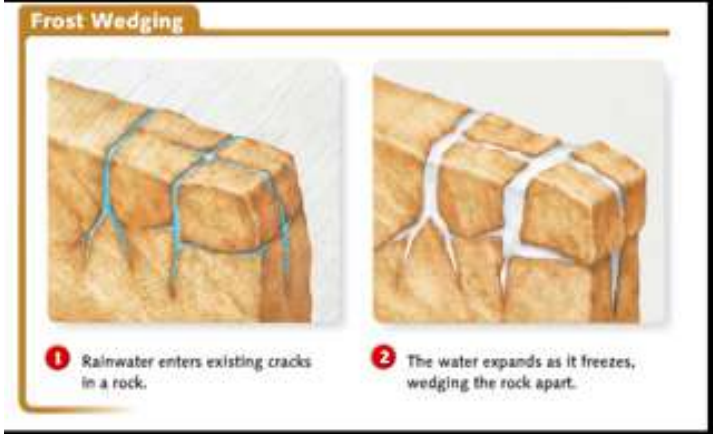


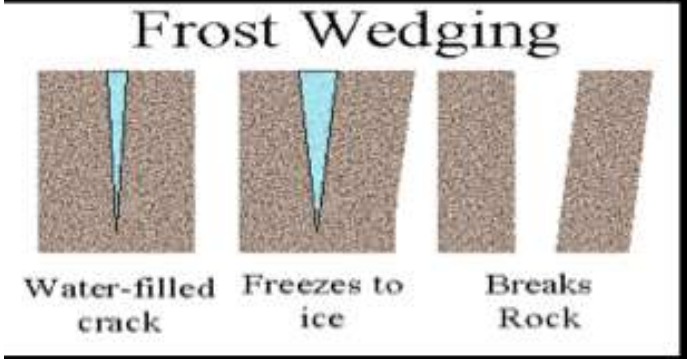
- 3. This cycle of heating and cooling of the rock's surface, causes slabs or layers of rock to break off.
- THIS PROCESS IS CALLED: _____EXFOLIATION_____




EXFOLIATION

b. Frost Action aka (Frost Wedging)





- 1. This process occurs when water seeps into the cracks in a rock.
- 2. When water freezes (into ice), it **expands** by 9%
- 3. This cycle of freezing and melting causes the rock to split or break apart.

b. Frost Action aka (Frost Wedging)

- example from real life

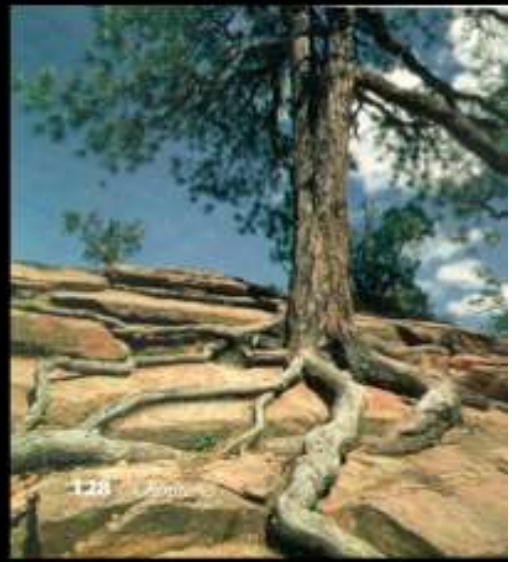
  - filling a water bottle/ garbage pail to the top then freezing it → it may crack or break

- 4. The same process happens to our roads during the winter months and creates **pot holes**.


FROST
WEDGING

c. Organic Activity (Plant/Animal Action)

- 1. The activities of organisms, including plants, burrowing animals, and humans, can also cause mechanical weathering.



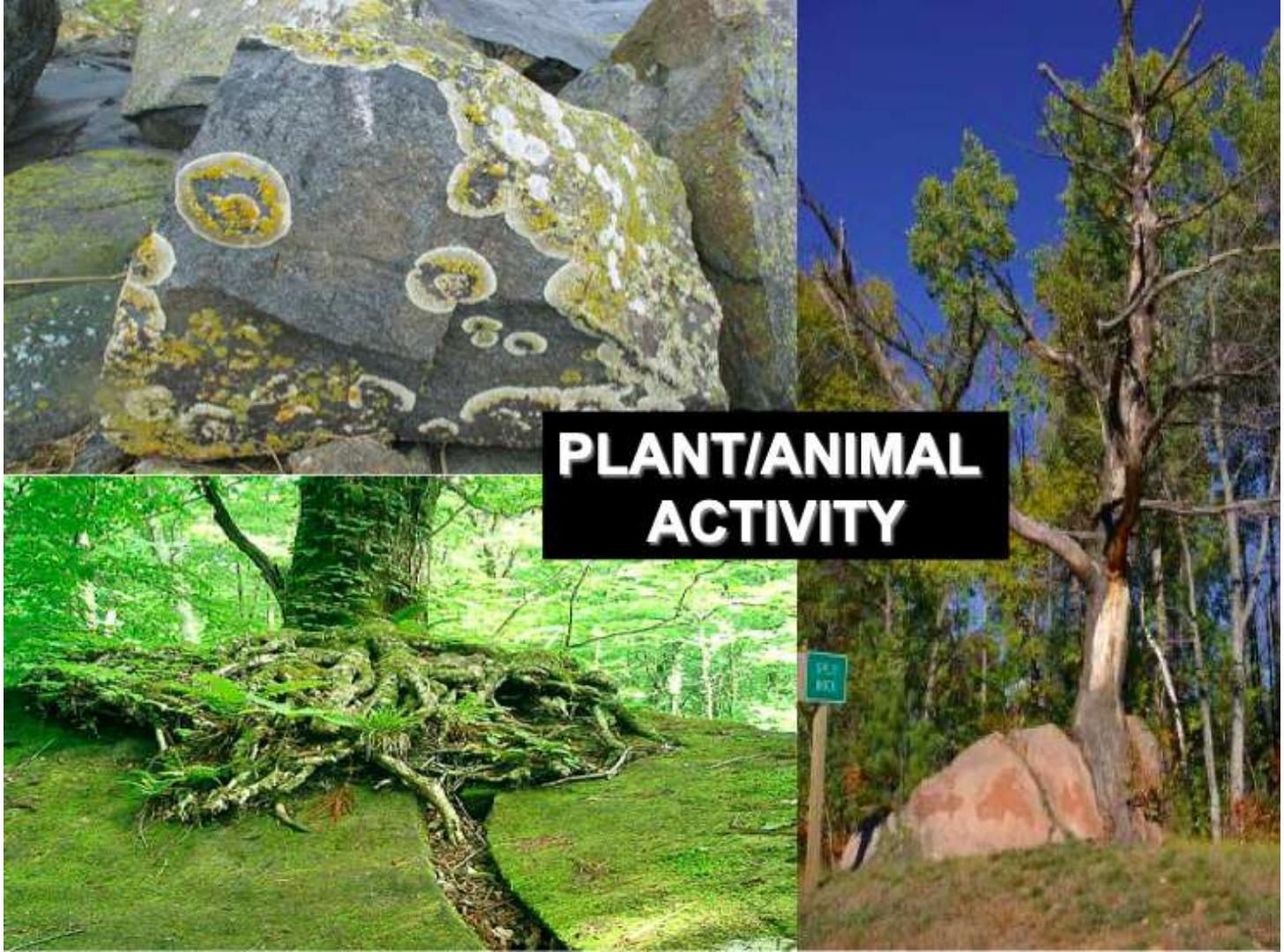
- Trees and shrubs can grow through the cracks in rocks, splitting the rock.

- As they grow, their roots wedge apart the rocks.

c. Organic Activity (Plant/Animal Action)

- Even moss and lichen wedge their tiny hair-like roots between the grains of the rock.

- Burrowing organisms like rodents, earthworms, & ants, bring material to the surface were it can be exposed to the agents of weathering..

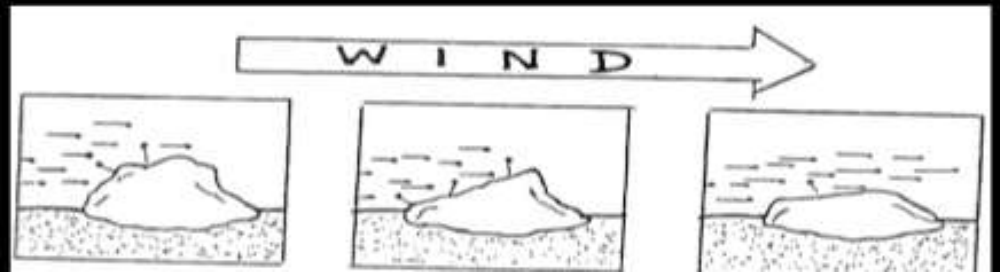

PLANT/ANIMAL
ACTIVITY

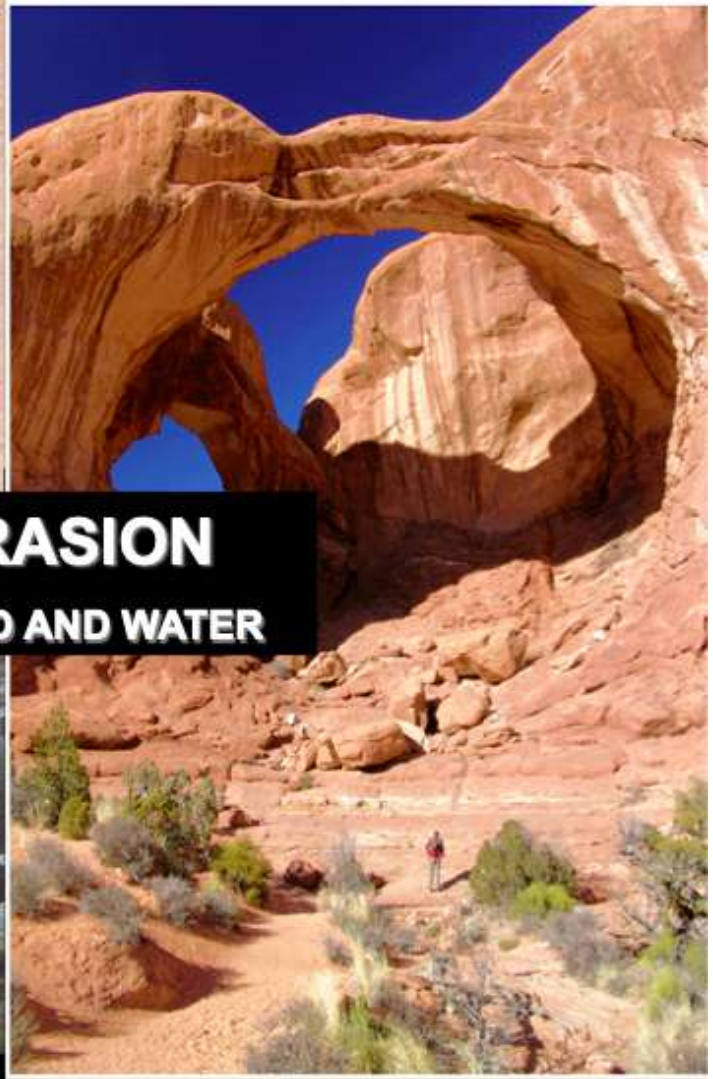
d. Abrasion

- 1. Abrasion is the breakdown of rocks caused by friction.

- As moving sand, pebbles, and larger rocks grind and scrape against one another, these rocks are worn away.
  - *Can you explain how sand is a product of abrasion?*

- This is how rocks often become *rounded*.





ABRASION

OF WIND AND WATER

Boulders rounded by impacts and abrasion

Which method of mechanical weathering is shown below?

Zach Smith, TERC

Liquid water runs into existing cracks in rocks. When it freezes, the water expands and the crack is widened.

Which method of mechanical weathering is shown below?

_____

Zach Smith, TERC

Water in the ground below paved roads freezes and expands, lifting the pavement unevenly and allowing sections to collapse after the ice melts.

Which method of mechanical weathering is shown below?

_____

Zach Smith, TERC

Tree roots grow between cracks in rocks. The cracks are widened as the roots grow thicker.

Which method of mechanical weathering is shown below?

_____

Zach Smith, TERC

Trees can physically break curbs and sidewalks as well as natural rocks.

Which method of mechanical weathering is shown below?

_____

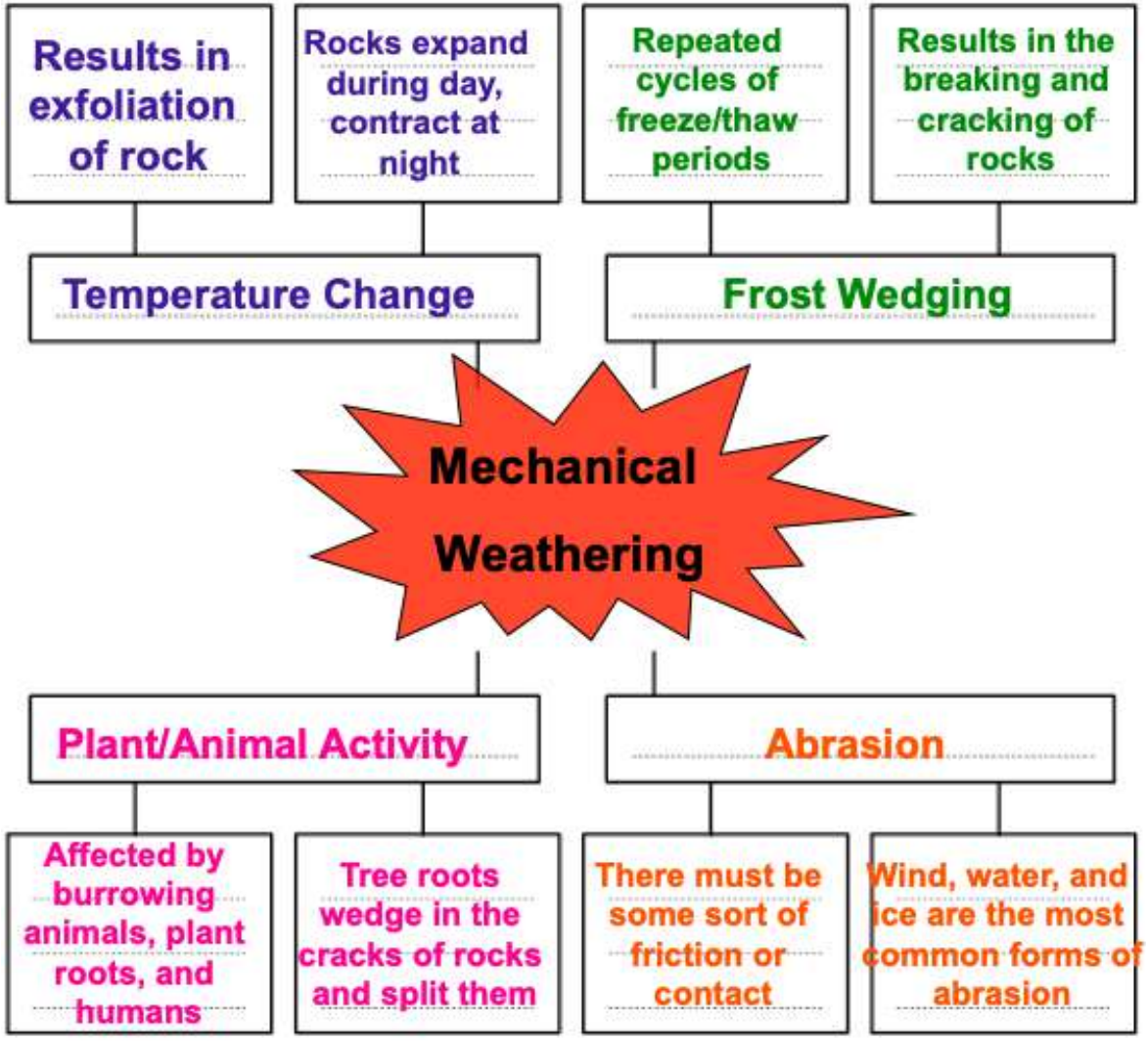
Zach Smith, TERC

Repeated freezing and thawing of water on mountaintops can result in large areas of sharp, shattered rocks.

Which method of mechanical weathering is shown below?

Zach Smith, TERC

Moss roots wedge into pores and crevices on the surfaces of rocks.


Results in exfoliation of rock
Rocks expand during day, contract at night
Repeated cycles of freeze/thaw periods
Results in the breaking and cracking of rocks
Temperature Change
Frost Wedging
Mechanical Weathering
Plant/Animal Activity
Abrasion
Affected by burrowing animals, plant roots, and humans
Tree roots wedge in the cracks of rocks and split them
There must be some sort of friction or contact
Wind, water, and ice are the most common forms of abrasion

II. Types of Weathering

- 1. **CHEMICAL WEATHERING** → the breakdown of rock through a change in mineral or chemical composition.

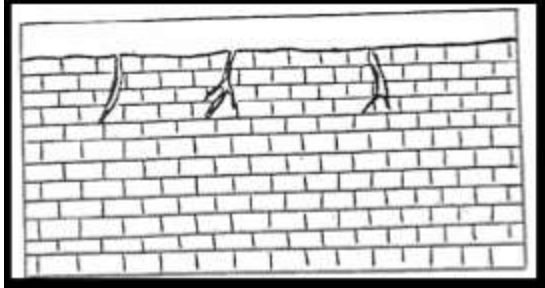
a. Carbonation

- Occurs when carbon dioxide in the atmosphere dissolves in the droplets of water that make up a cloud.

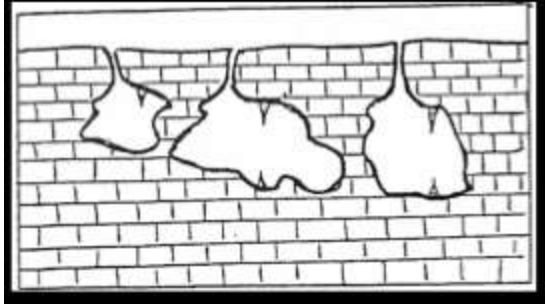
- This mixture forms a weak "carbonic acid" that dissolves certain rocks and minerals, some which include limestone, marble, and chalk.

Carbonation reaction = (carbon dioxide + water)

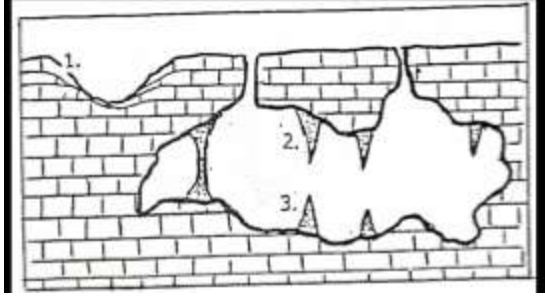
A result of this type of chemical weathering is the formation of caverns or caves!



- Using map symbols in your ESRT, describe what type of bedrock this is. **limestone**



- Carbonic acid rain water seeps into the limestone bedrock through cracks. The carbonic acid dissolves the limestone which is carried away by water.



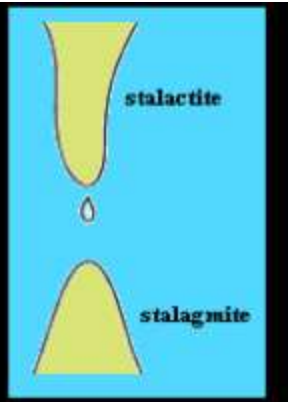
- A cave (cavern) forms by this process. Cavern features include:
  1. Sink Holes
  2. Stalactites (c= ceiling)
  3. Stalagmites (g=ground)

Sink Holes

Are common where the rock below the land surface is limestone, carbonate rock, salt beds, or rocks that can naturally be dissolved by ground water circulating through them.

The most damage from sinkholes tends to occur in Florida, Texas, Alabama, Missouri, Kentucky, Tennessee, and Pennsylvania.

Stalactites vs. Stalagmites



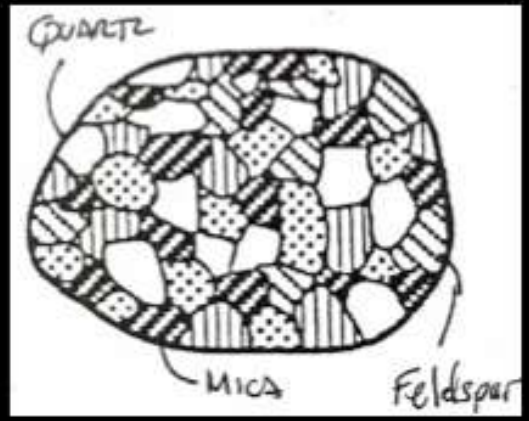
Stalactites- an icicle shaped mass of calcite attached to the ceiling of a limestone cavern.

Stalagmite-a cone of calcite rising from the ground of a cavern .

Usually come in vertical pairs called columns.

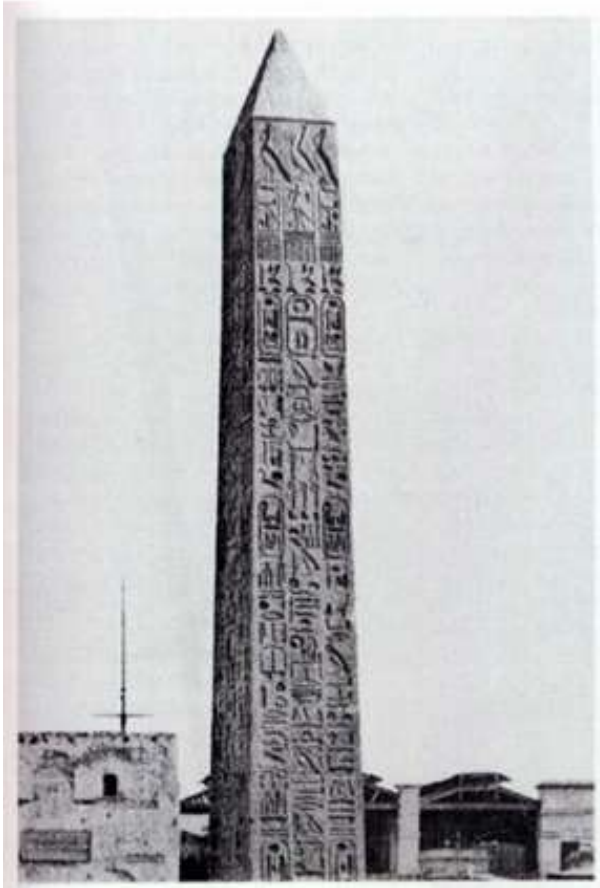
b. Hydrolysis

- The chemical weathering by reaction of ___water___ with other substances.
- very slow process
- Ex: the rock granite is stable in dry climates, but in moist/wet climates, rainfall dissolves the mineral feldspar in granite.
- Feldspar becomes a clay mineral (kaolinite) and weakens the bond between the other minerals.

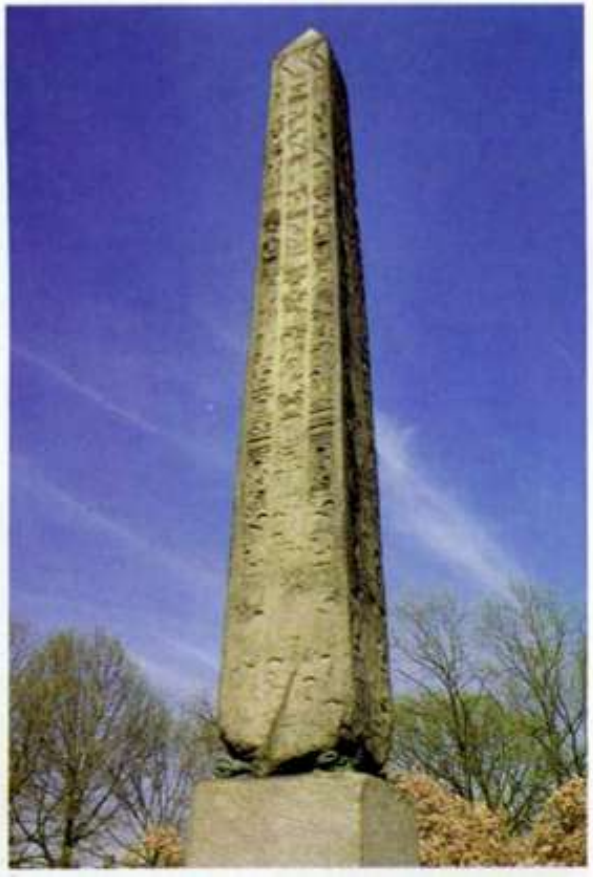


“Cleopatra’s Needle” → Granite Rock Statue

Egypt, 1880



NYC, present



c. Oxidation

- A chemical reaction when **oxygen** from the atmosphere combines with certain minerals in a rock.
- Ex: When oxygen combines with iron, iron oxide or 'rust" forms.
  - (Iron + oxygen) = iron-oxide (rust)
- This chemical change weakens the rock, and the rock begins to crumble.
- Oxidation in the presence of water takes on a reddish- yellow brown color.

d. Plant acids

- Acids from decaying organic matter mix with groundwater and aid in dissolving rocks.

- Plant acids are produced by both plants and animals.

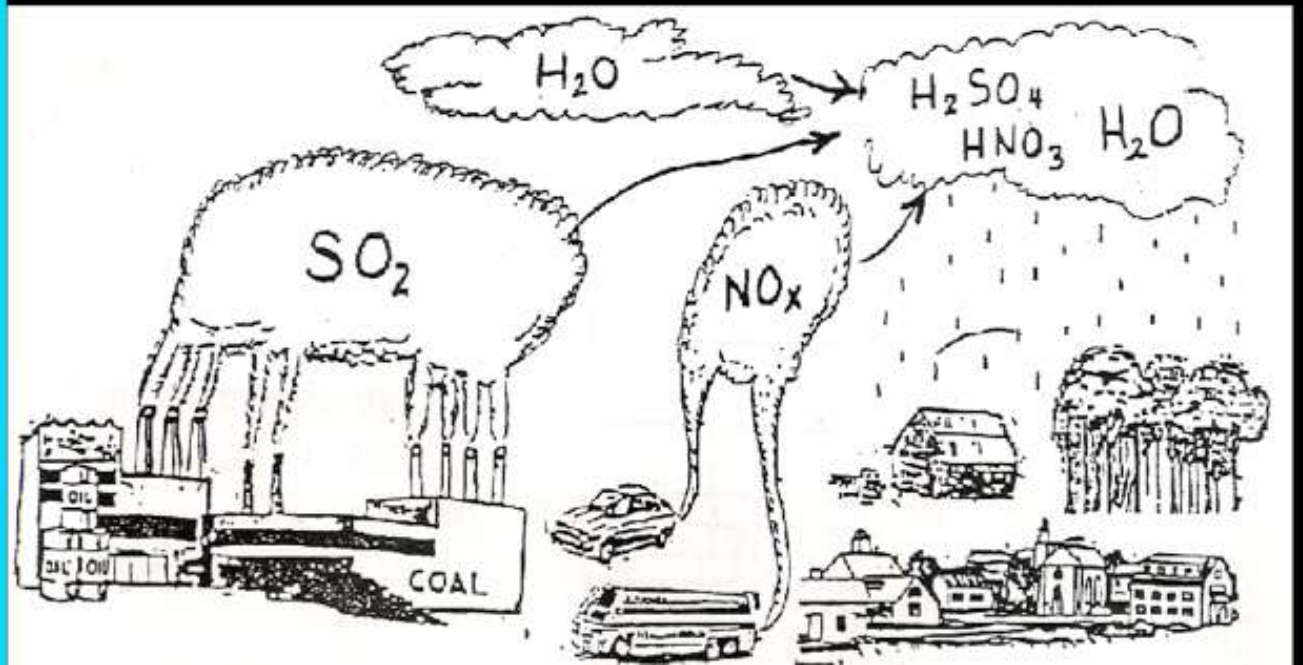
e. Man-Made Acids

- Forms when man-made gases (sulfur dioxide and nitrogen oxides) produced by burning fossil fuels dissolve in the droplets of water that make up clouds.
- This causes the rainwater to become

- Sulfuric acid _____ (H_2SO_4)
- Nitric acid _____ (HNO_3)

Types of acid rain

Acid rain is a serious environmental problem that affects large parts of the United States and Canada. Acid rain is particularly damaging to lakes, streams, and forests and the plants and animals that live in these ecosystems. In addition, acid rain accelerates the decay of building materials and paints, including irreplaceable buildings, statues, and sculptures that are part of our nation's cultural heritage. USEPA



Summary Questions

1. Explain the difference between mechanical and chemical weathering.

2. List the 5 methods of chemical weathering.

3. Describe the type of environment that hydrolysis is effected most by.

4. Describe how humans contribute to the process of chemical weathering.