

# Weathering



# What is Weathering?





***The process by which rocks and minerals at the Earth's surface are physically and chemically broken down.***

# Mechanical Weathering



***Breaks rock into smaller pieces.***

# Types of Weathering



# Mechanical Weathering



***Disintegration of structure. Gravity pulls rock downward***

# Types of Mechanical Weathering

- Loss of Overlying Rock and Soil
  - **Sheet jointing** on a granite outcrop produces cracks in the rock, thereby exposing more of the rock surface to weathering.

# Types of Mechanical Weathering

- Repeated **wetted and drying**
- Especially effective at breaking up rocks that contain clay.
- Clays swell up when wet and shrink when dry.
- Causes rocks that contain clay, such as shale, to fall apart.



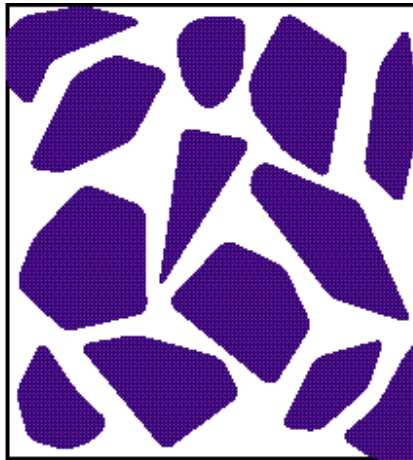
# Abrasion



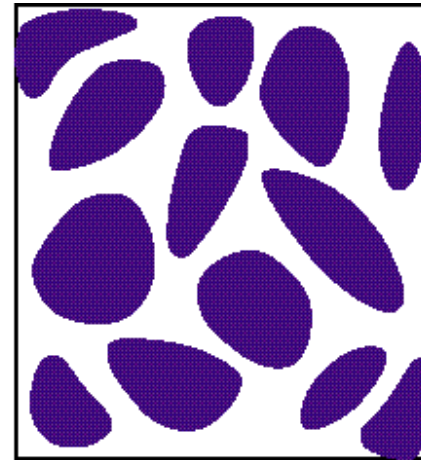
***Physical wearing and grinding of a surface through friction.***



**ANGULAR**

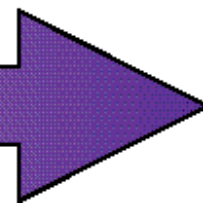


**MEDIUM**



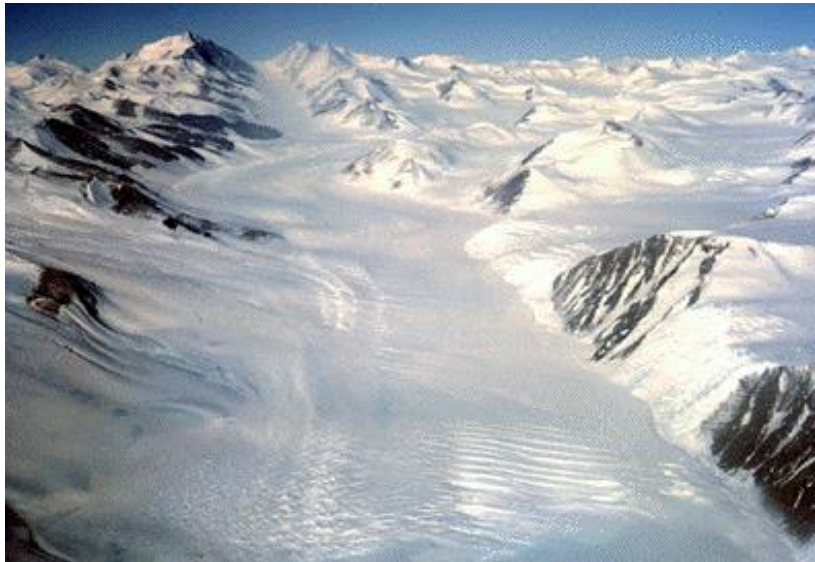
**ROUNDED**

**More Mechanical Weathering**



# Mushroom Park





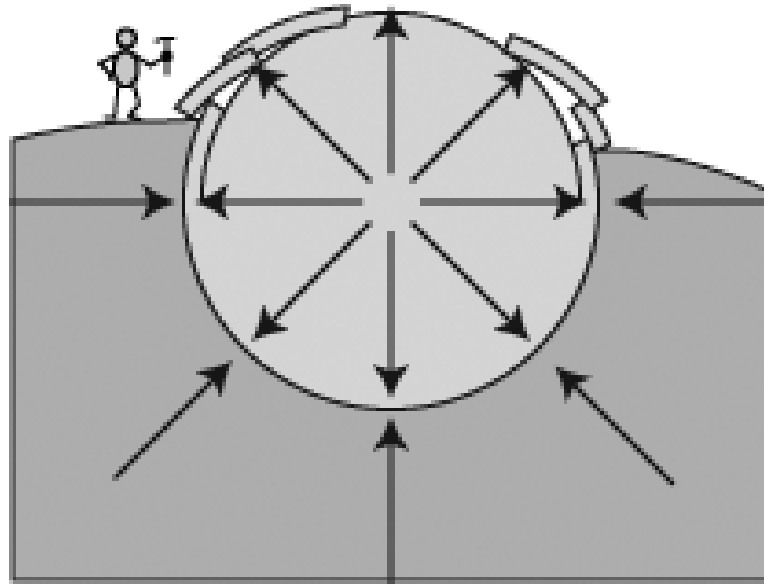
# Animal & Plant(Organic Activity)



***Lichen works very slowly to break down granite boulders.***



# Exfoliation



***The peeling away of large sheets of loosened materials at the surface of a rock.***

# Exfoliation



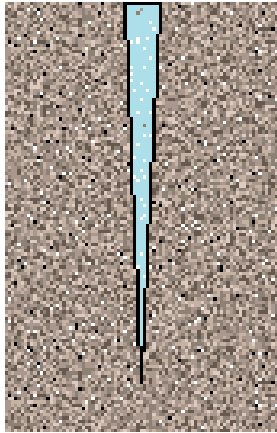


# Types of Mechanical Weathering

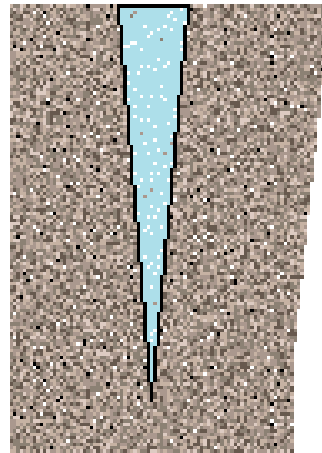
## Granite exfoliation



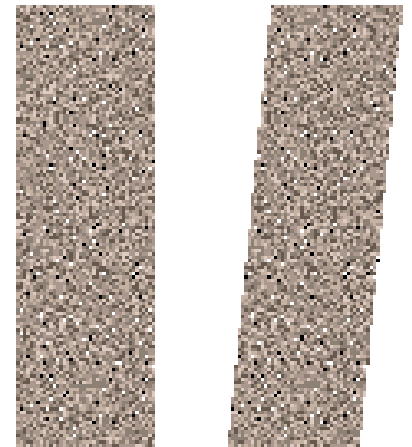
# Frost Wedging



Water-filled  
crack

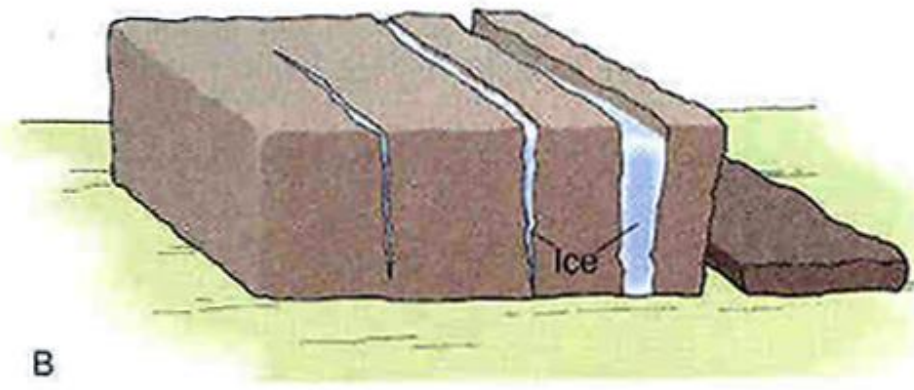
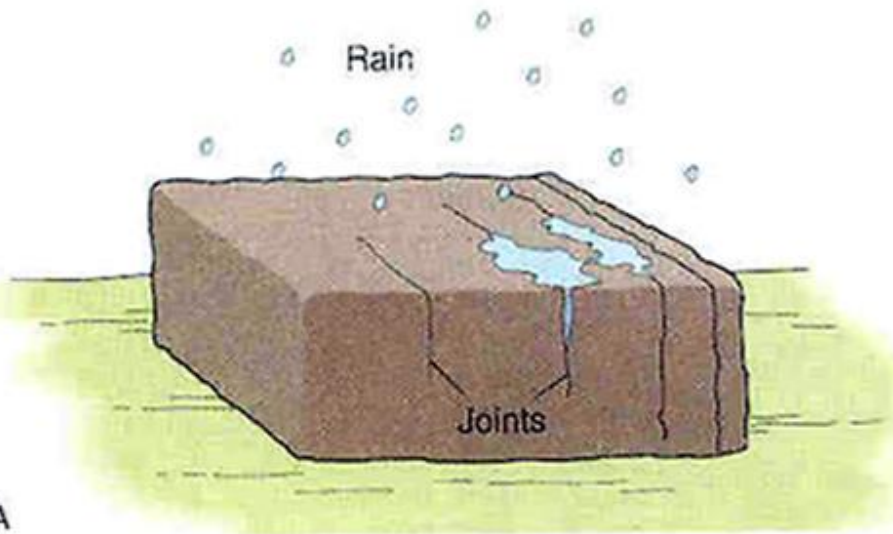


Freezes to  
ice



Breaks  
Rock

# Frost Wedging



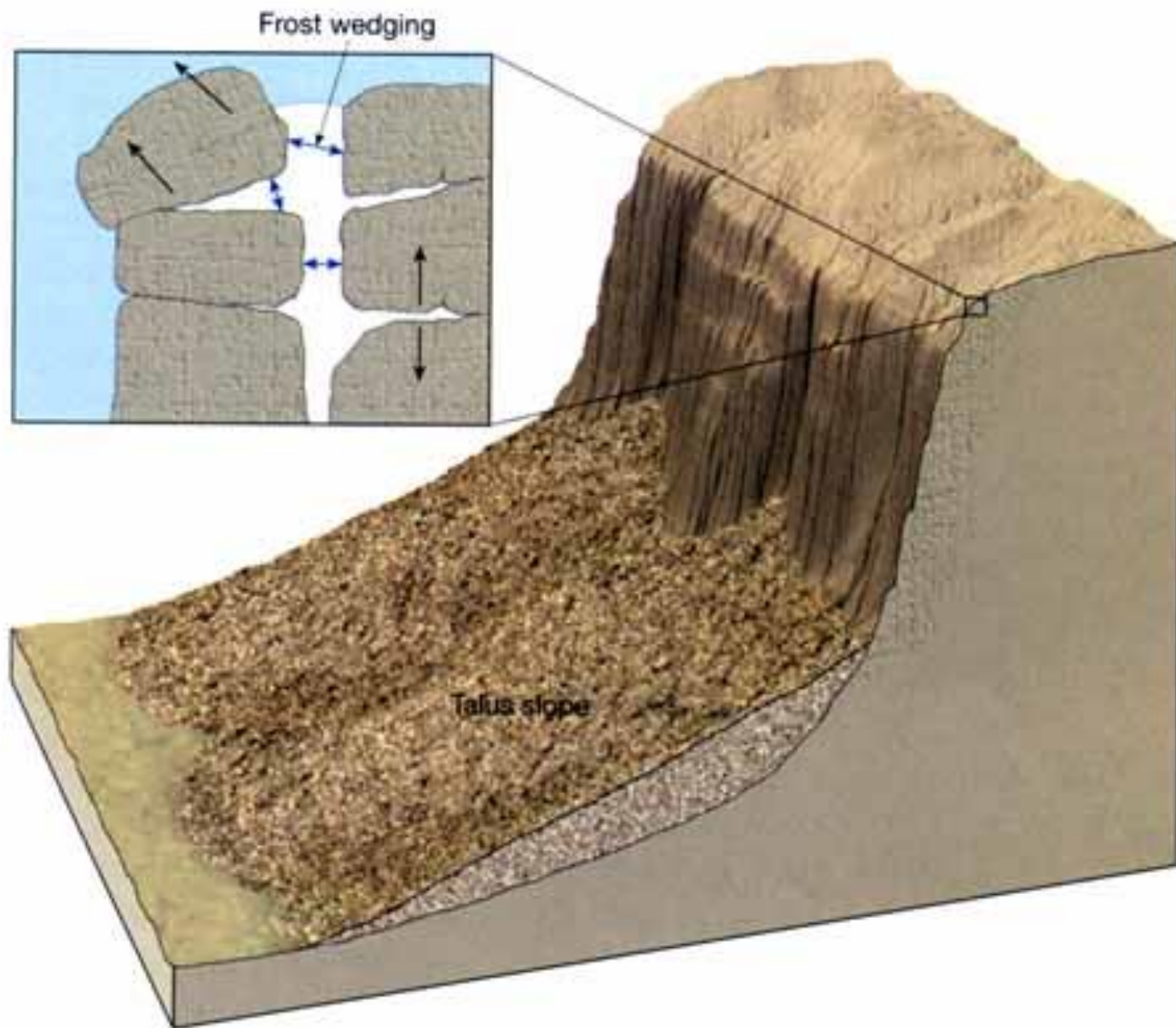
A

B

Frost Wedging

# Frost Wedging







***Mt Brewer in the Sierra Nevada***



***The east ridge of Mt. Brewer***

# Chemical Weathering



***Decomposition***

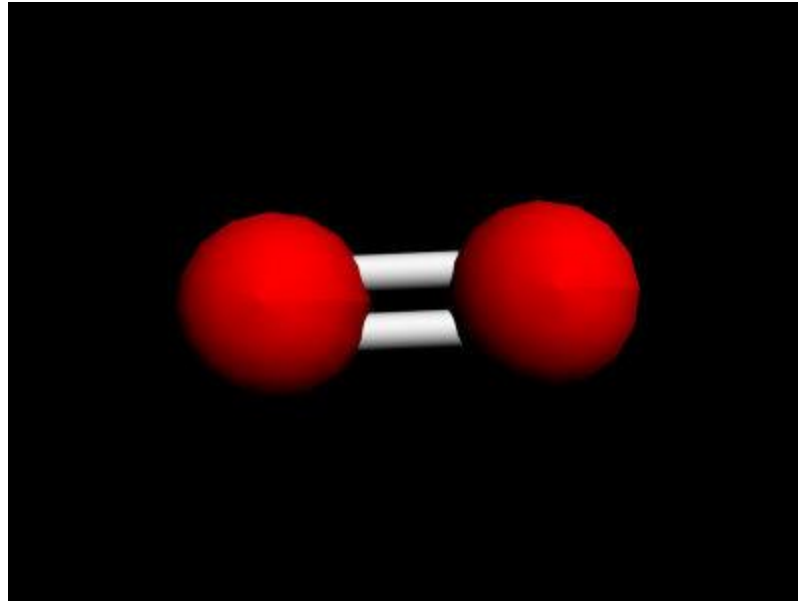


# Chemical Weathering

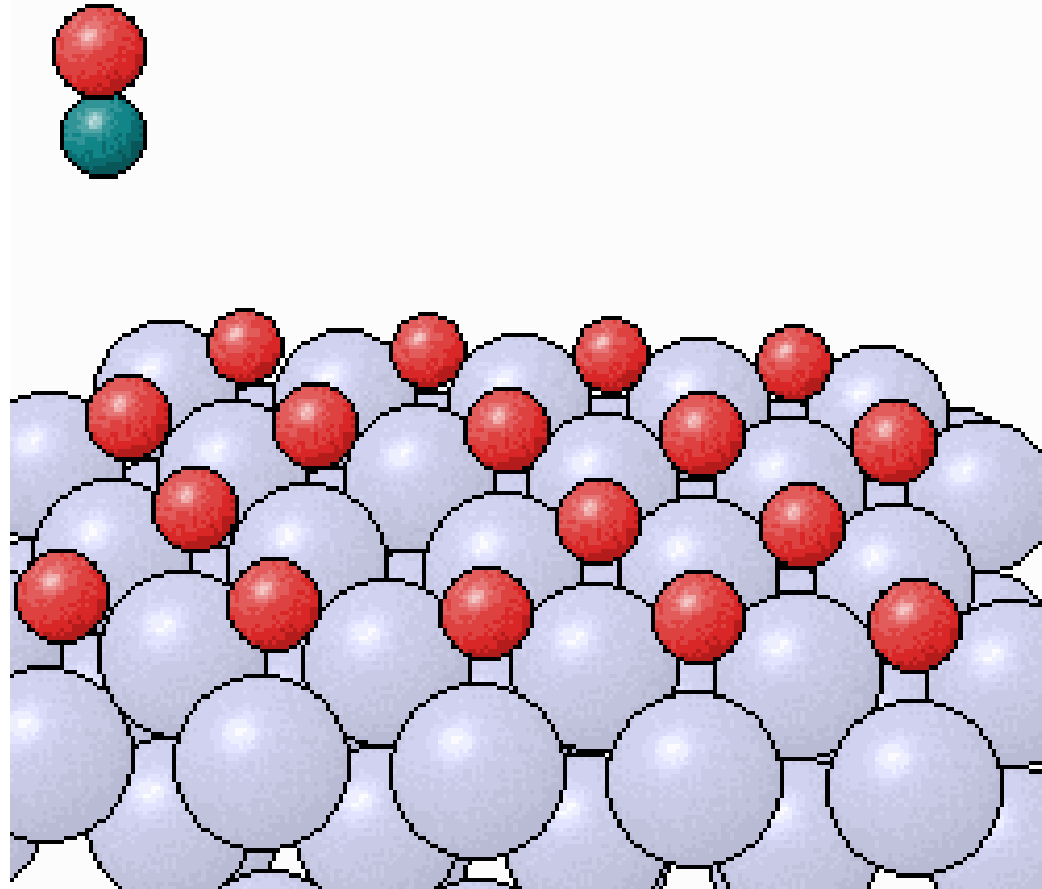


***Rocks are changed into different materials.***

# Oxygen



# Oxidation

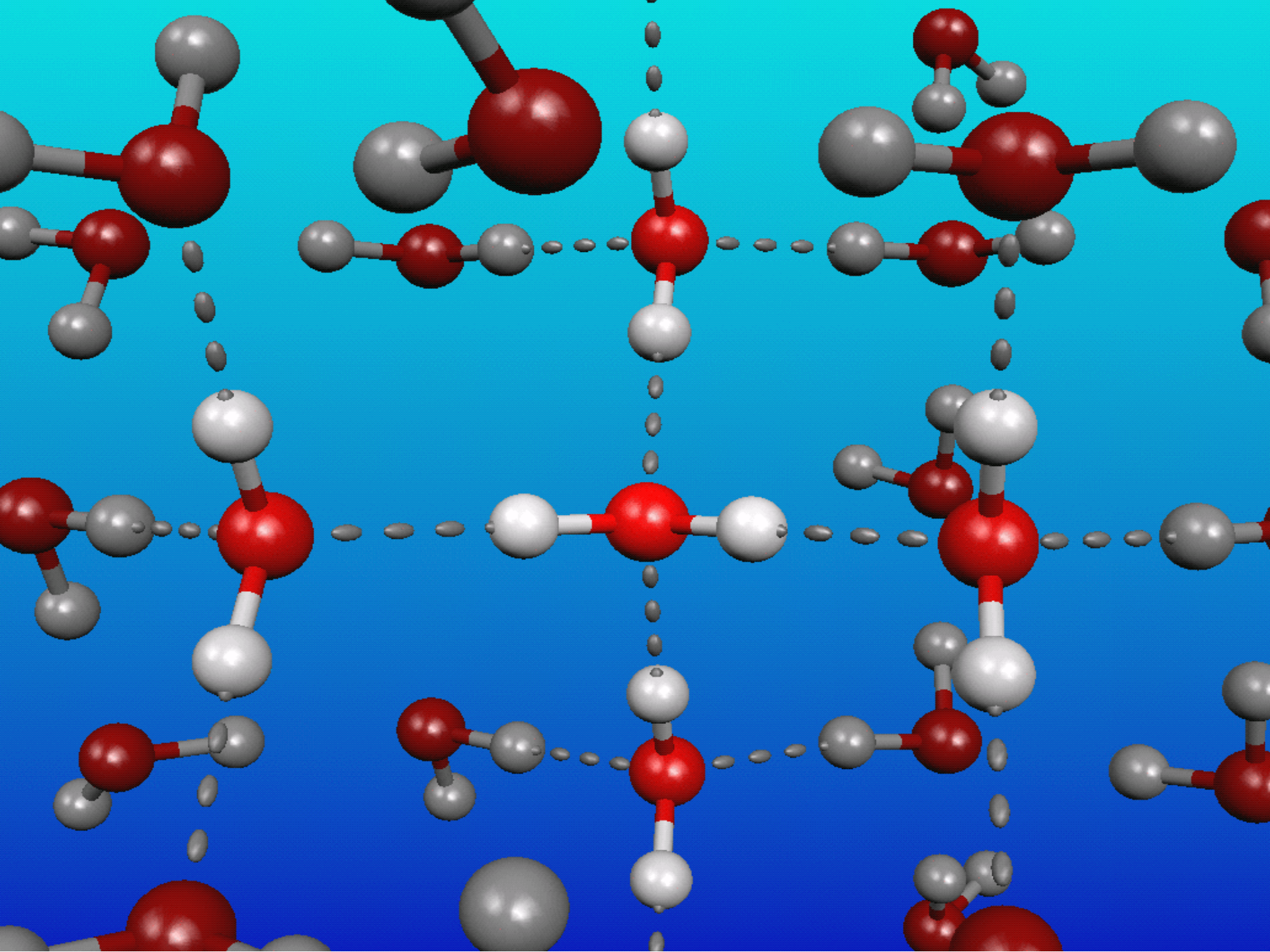


# Agents of Chemical Weathering

- The chemical reaction of oxygen with other substances is called **oxidation**.
  - Iron-bearing minerals are the ones most easily attacked by oxygen.
  - Examples:
    - Magnetite
    - Pyrite
    - Dark-colored ferromagnesian silicates





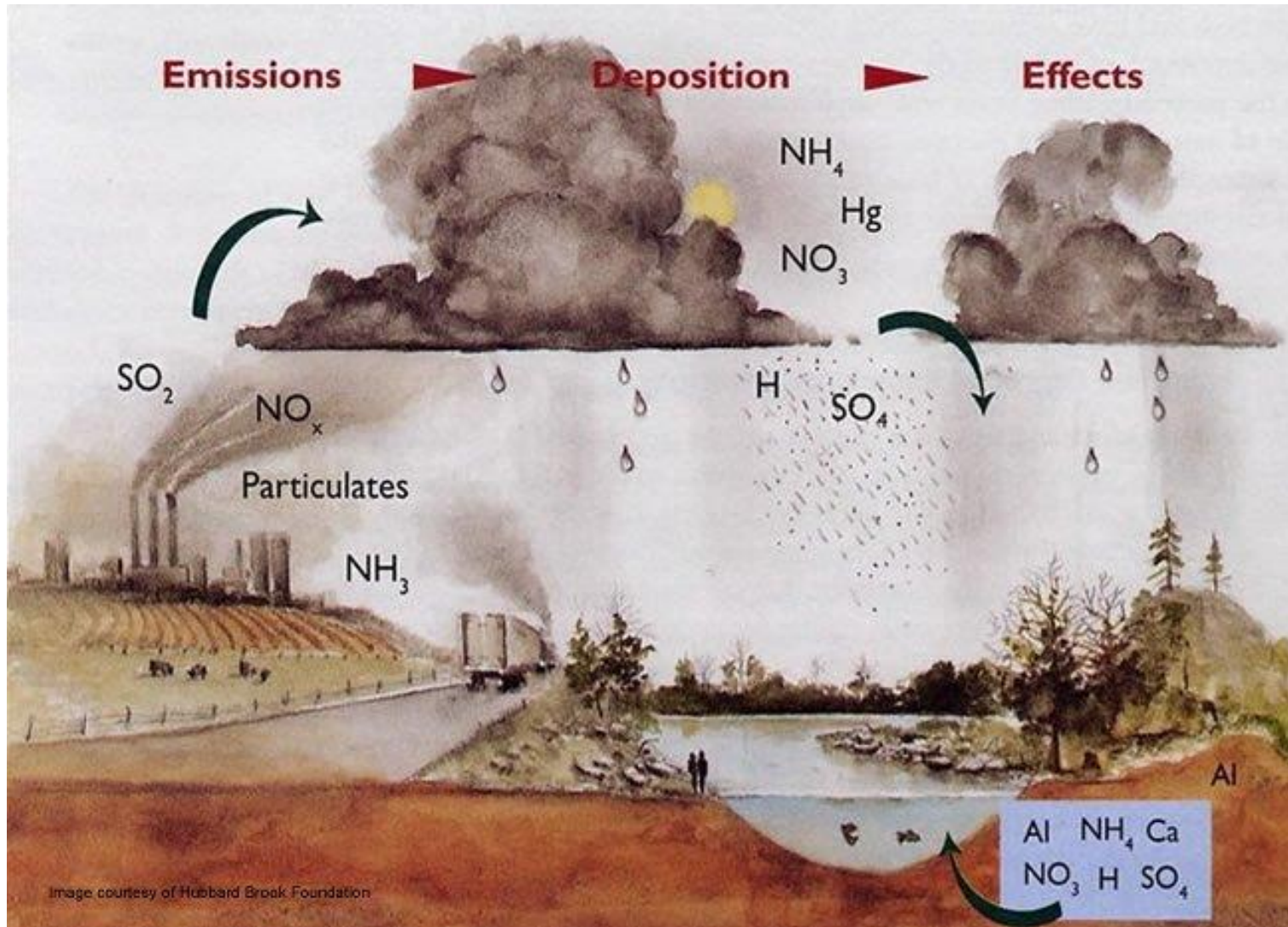


# Acid Rain





# Acid Rain



# Agents of Chemical Weathering

- Carbon dioxide dissolves easily in water.
  - It forms a weak acid called **carbonic acid**
  - This is the same compound that is in carbonated drinks.
  - Attacks many common minerals such as feldspar, hornblende, augite and biotite mica.
  - The original mineral is changed into a clay mineral.
- Sulfur from the atmosphere mixes with water to form a strong acid known as **Sulfuric Acid**

# Water Weathering or Hydrolysis



# Agents of Chemical Weathering

- The chemical reaction of water with other substances is called **hydrolysis**.
- Common materials undergoing hydrolysis:

- Feldspar

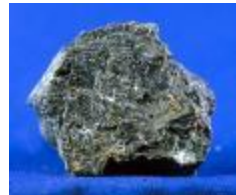


- 

- Hornblende



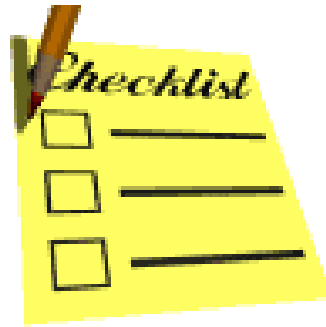
- Augite







# Mechanical vs. Chemical



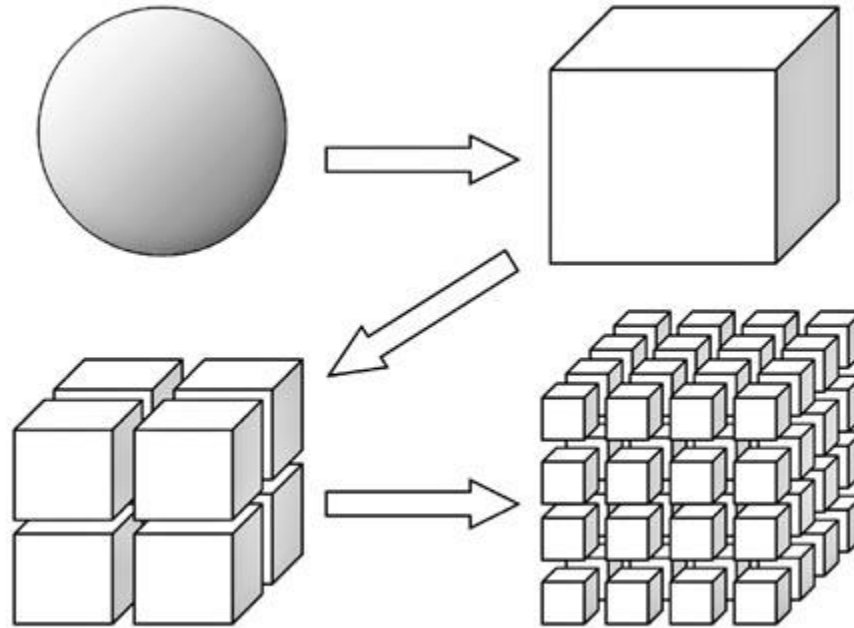
## Mechanical Weathering

*Changes the size of the rock.*

## Chemical Weathering

*Changes the composition of the rock.*

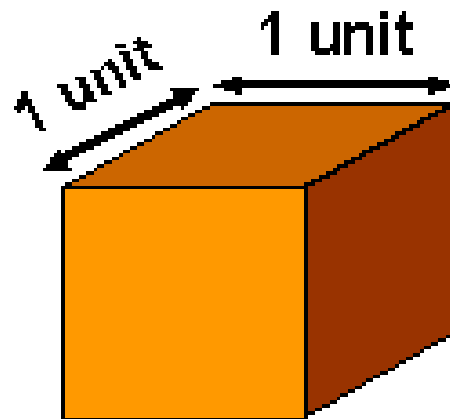
# Factors That Control Weathering



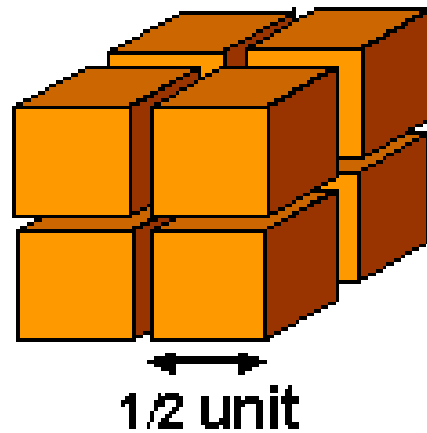
***Surface Area***



# Surface Area

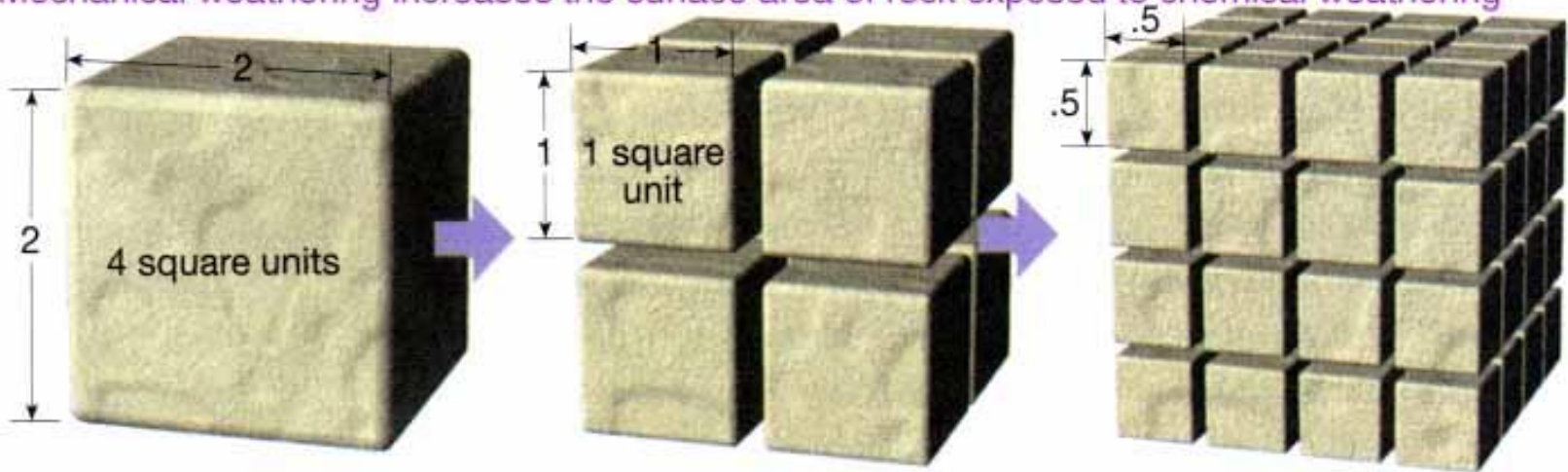


Total surface area of cube:  
**6 square units**



Total surface area following disintegration:  
**12 square units**

Mechanical weathering increases the surface area of rock exposed to chemical weathering



$$\begin{array}{l} 4 \text{ square units} \times \\ 6 \text{ sides} \times \\ 1 \text{ cube} = \\ \hline 24 \text{ square units} \end{array}$$

$$\begin{array}{l} 1 \text{ square unit} \times \\ 6 \text{ sides} \times \\ 8 \text{ cubes} = \\ \hline 48 \text{ square units} \end{array}$$

$$\begin{array}{l} .25 \text{ square unit} \times \\ 6 \text{ sides} \times \\ 64 \text{ cubes} = \\ \hline 96 \text{ square units} \end{array}$$

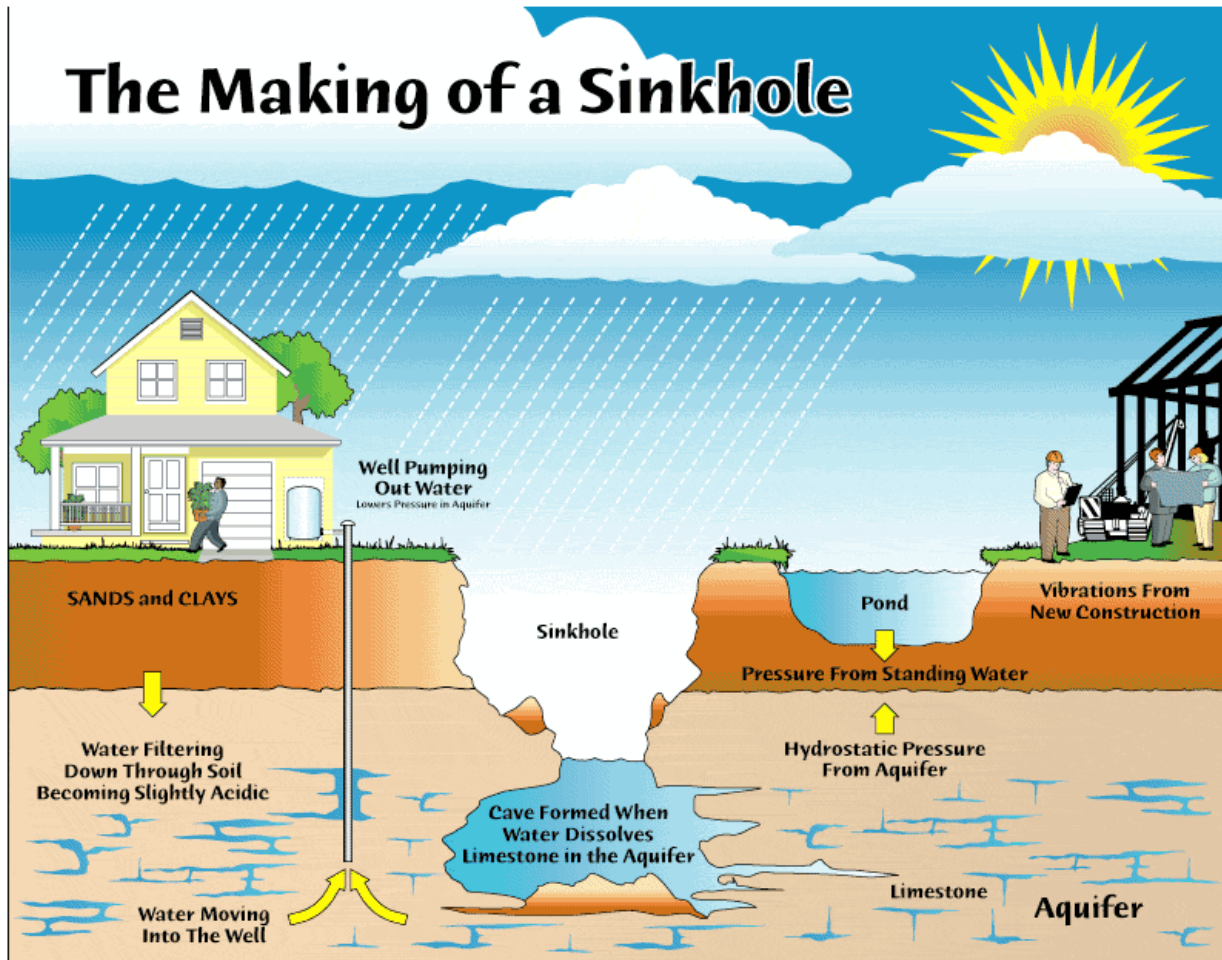
# Factors That Control Weathering

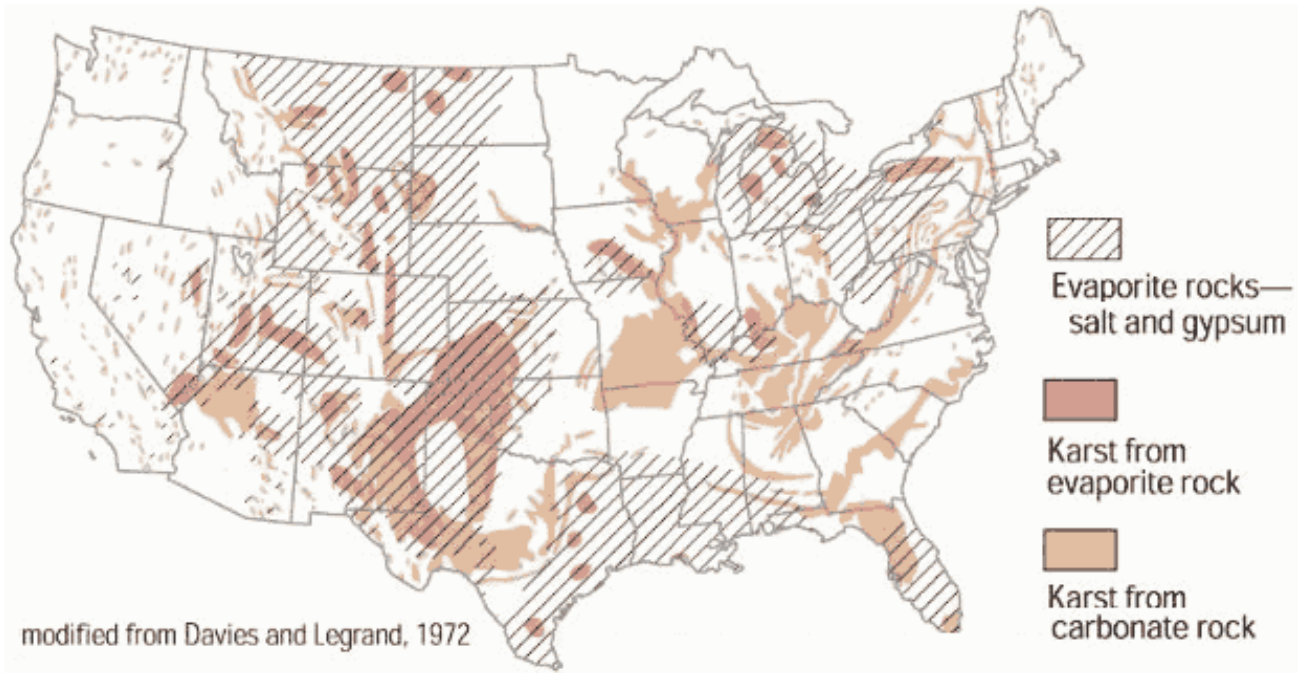


***Composition of Rock***

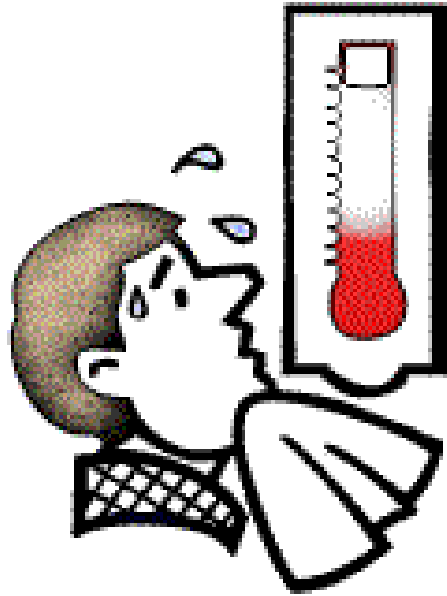


# The Making of a Sinkhole



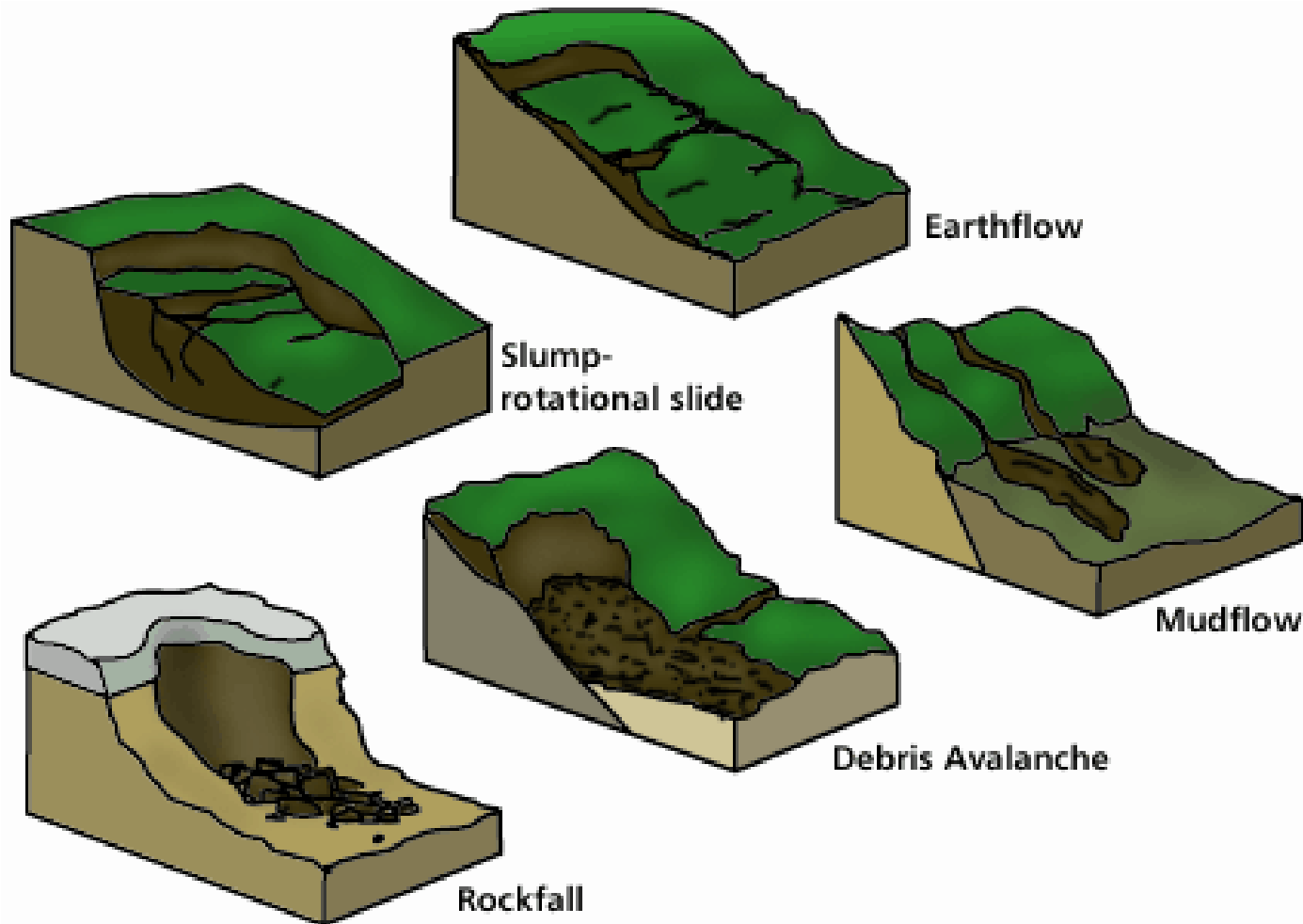


# Factors That Control Weathering



***Climate The wetter the climate the faster and the more weathering occurs***

# Erosion & Mass Movements



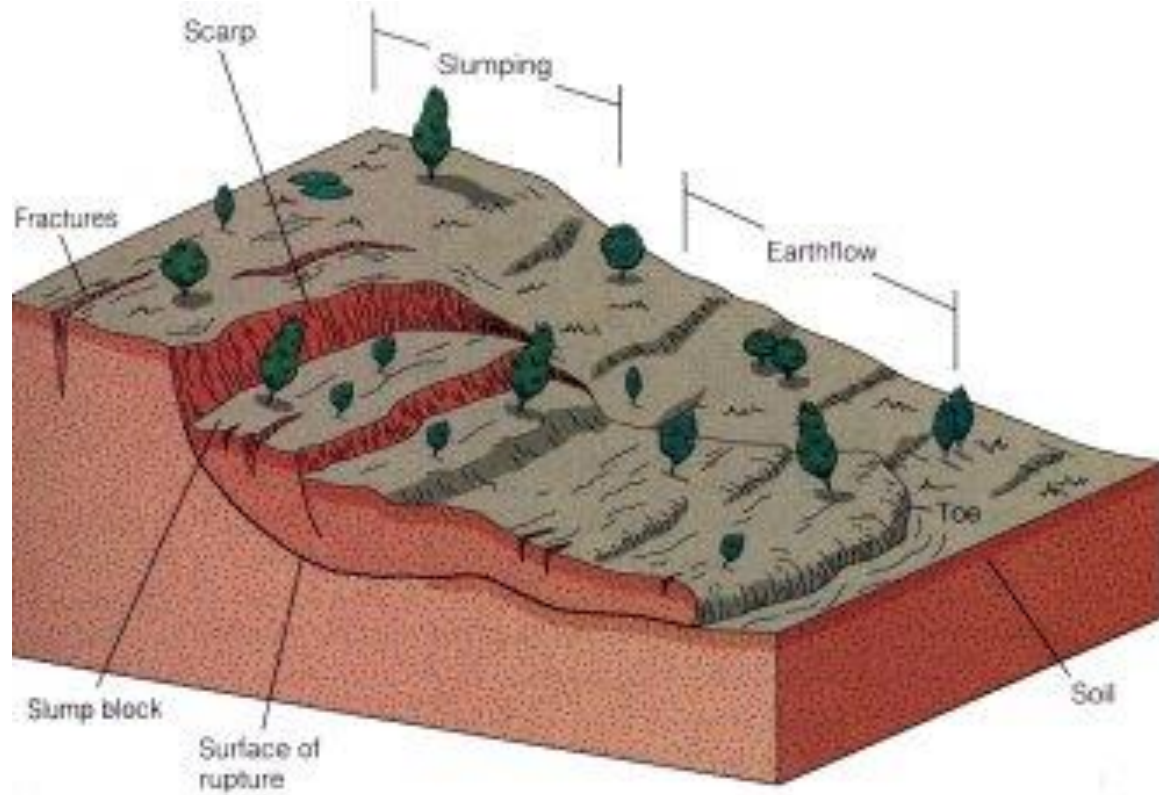


# Erosion

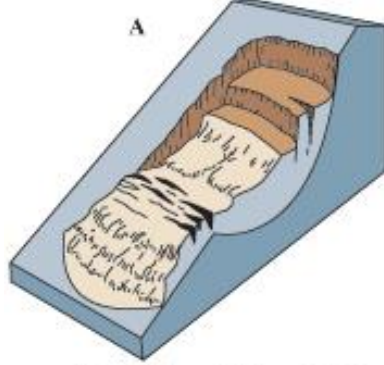


***Removal and transport of materials by wind & running water.***

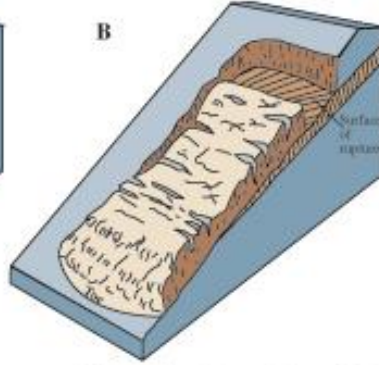
# Mass Movement



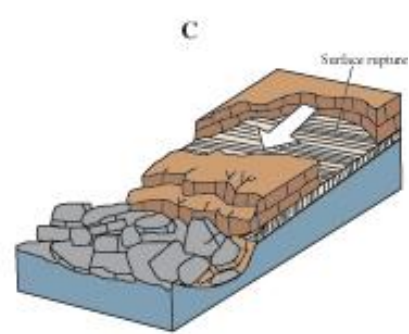
***Downward transportation of weathered materials by gravity.***



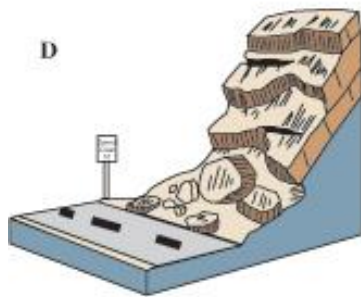
**Rotational landslide**



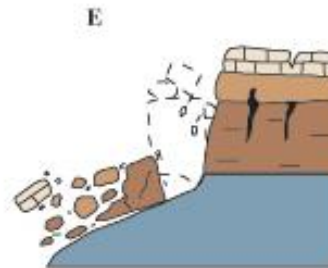
**Translational landslide**



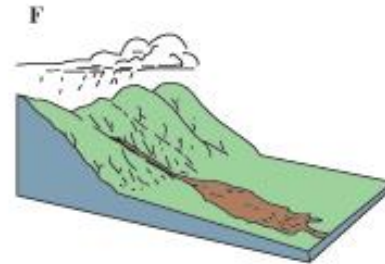
**Block slide**



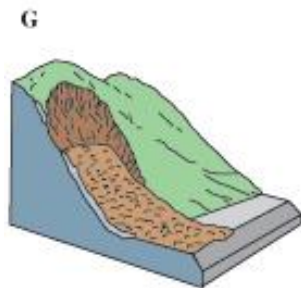
**Rockfall**



**Topple**



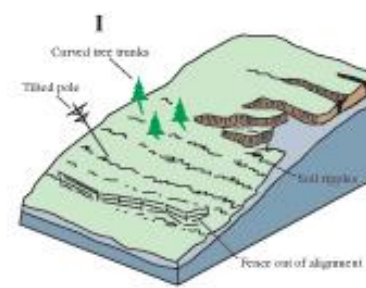
**Debris flow**



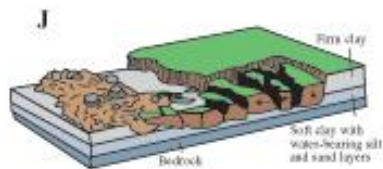
**Debris avalanche**



**Earthflow**



**Creep**



**Lateral spread**

# STOP WITH NOTES SHOW WHAT YOU KNOW

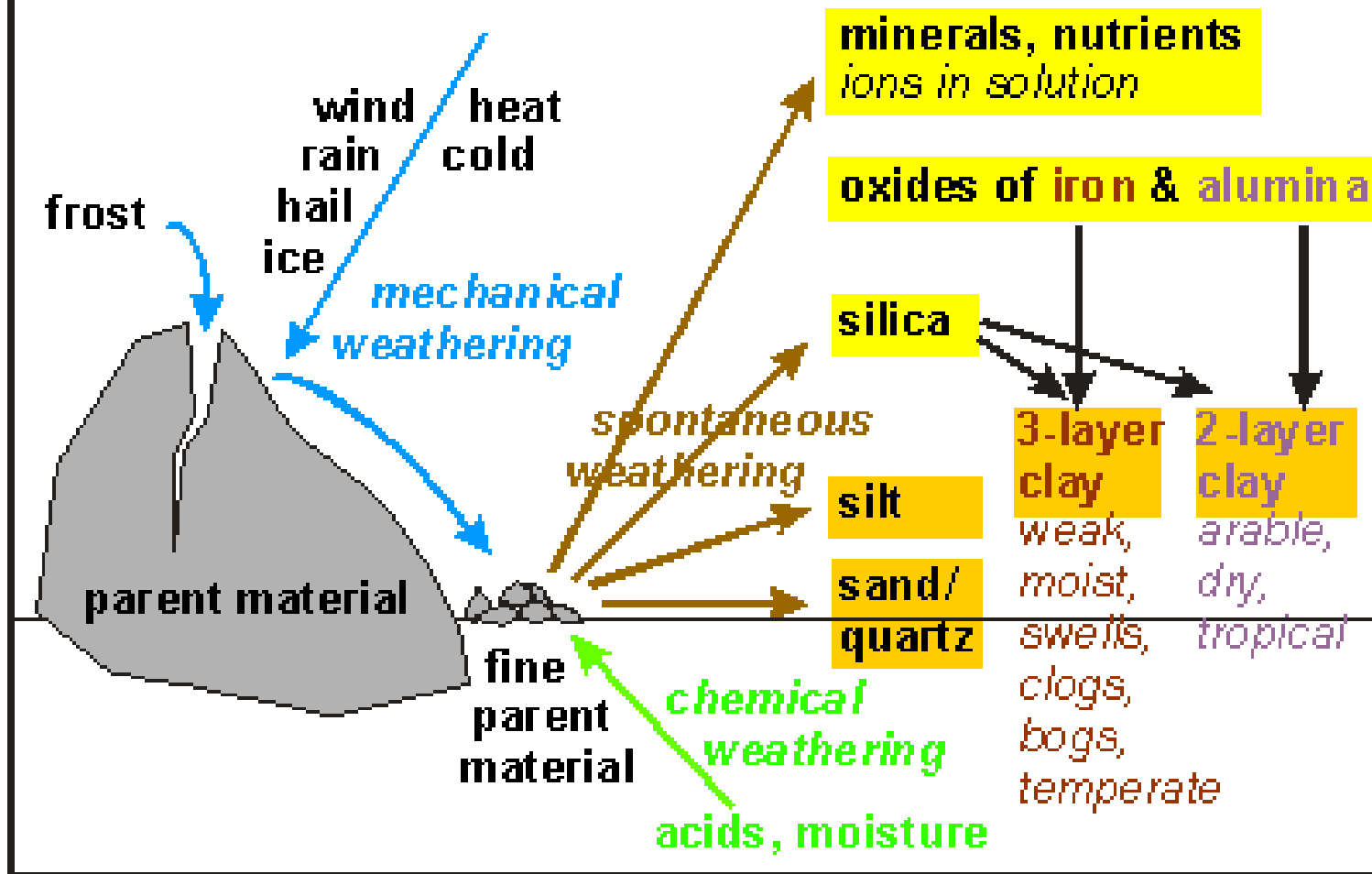
- USE YOUR NOTES TO COMPLETE  
ASSIGNMENT #1 Notes Review
  
- USE YOUR NOTES AND REVIEW:  
COMPLETE ASSIGNMENT #2  
Physical Vs Chemical Weathering

# Soil

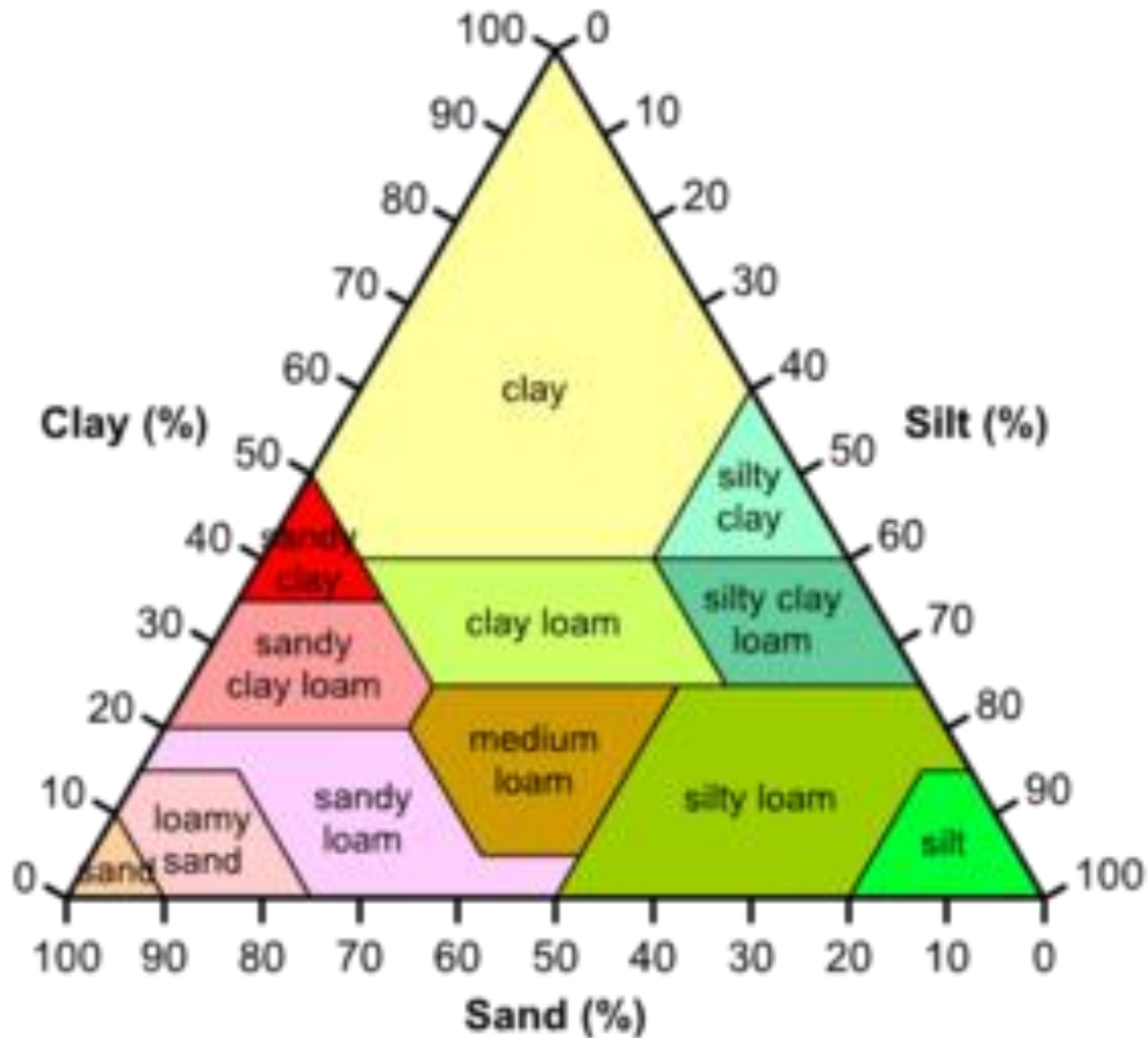


***Earth's Life Supporting Material.***

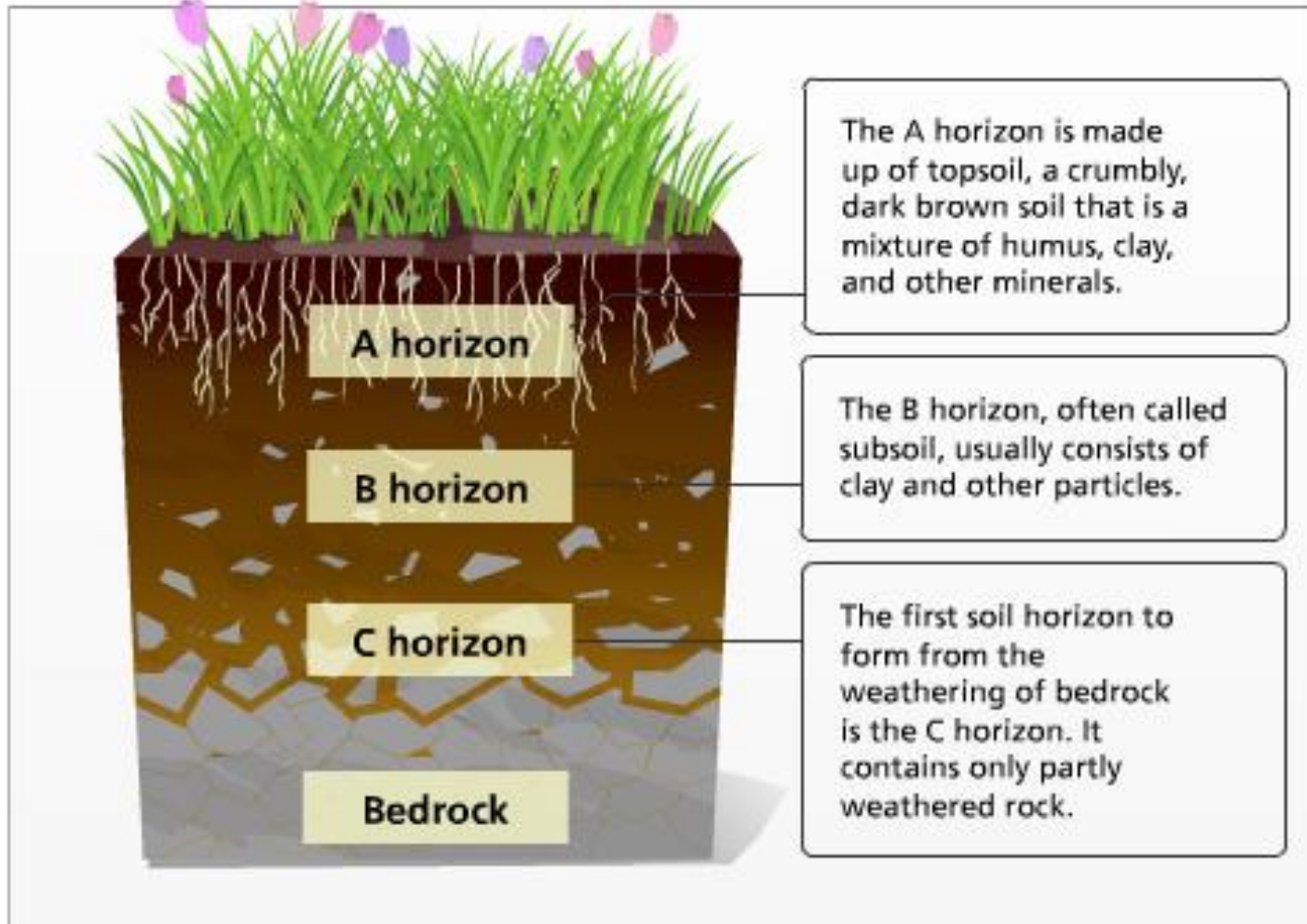
# How is soil made? - weathering



# Soil Composition

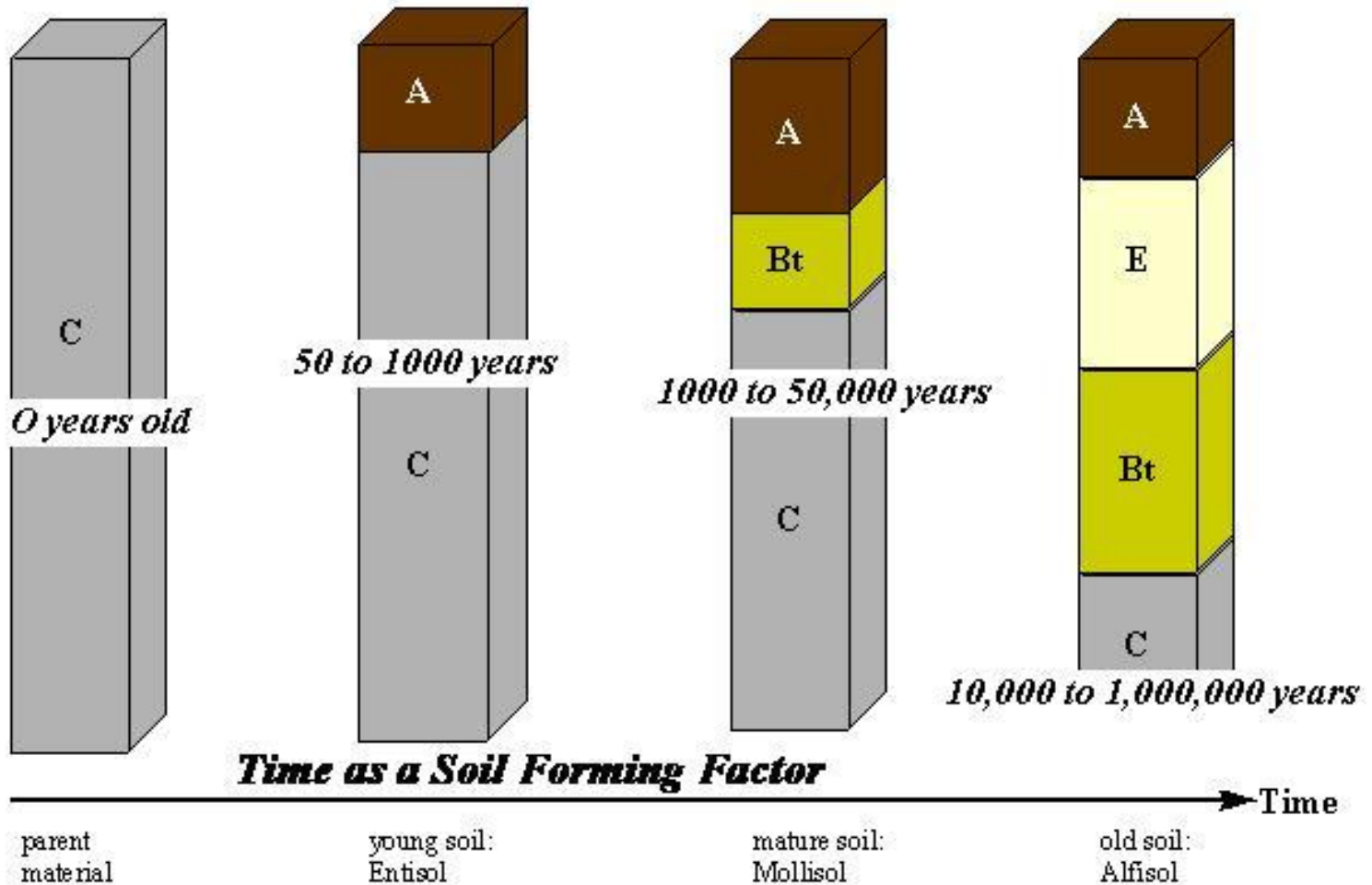


# Soil Profile

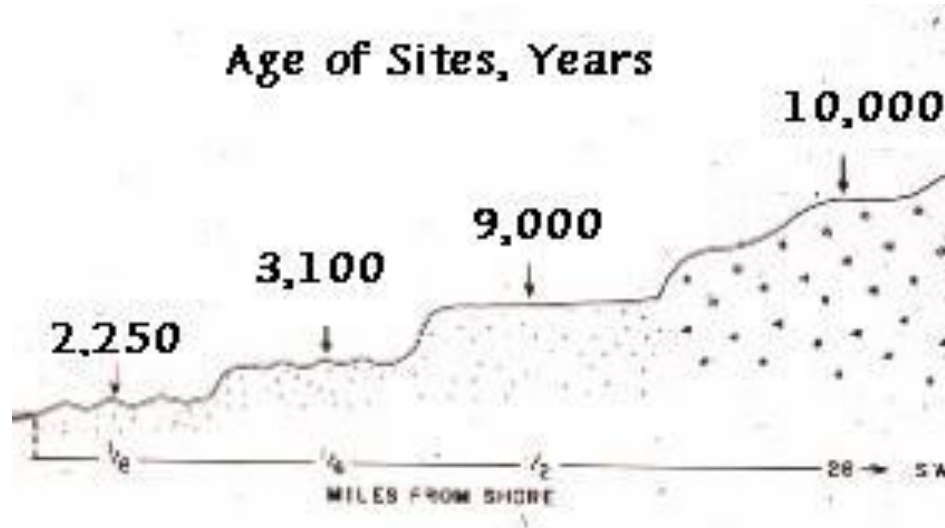




# Soil Profile vs. Time



# Soil Age



Soil 2,250 Age



Soil 3,100 Age



Soil 9,000 Age



10,000 years



# Soil Erosion

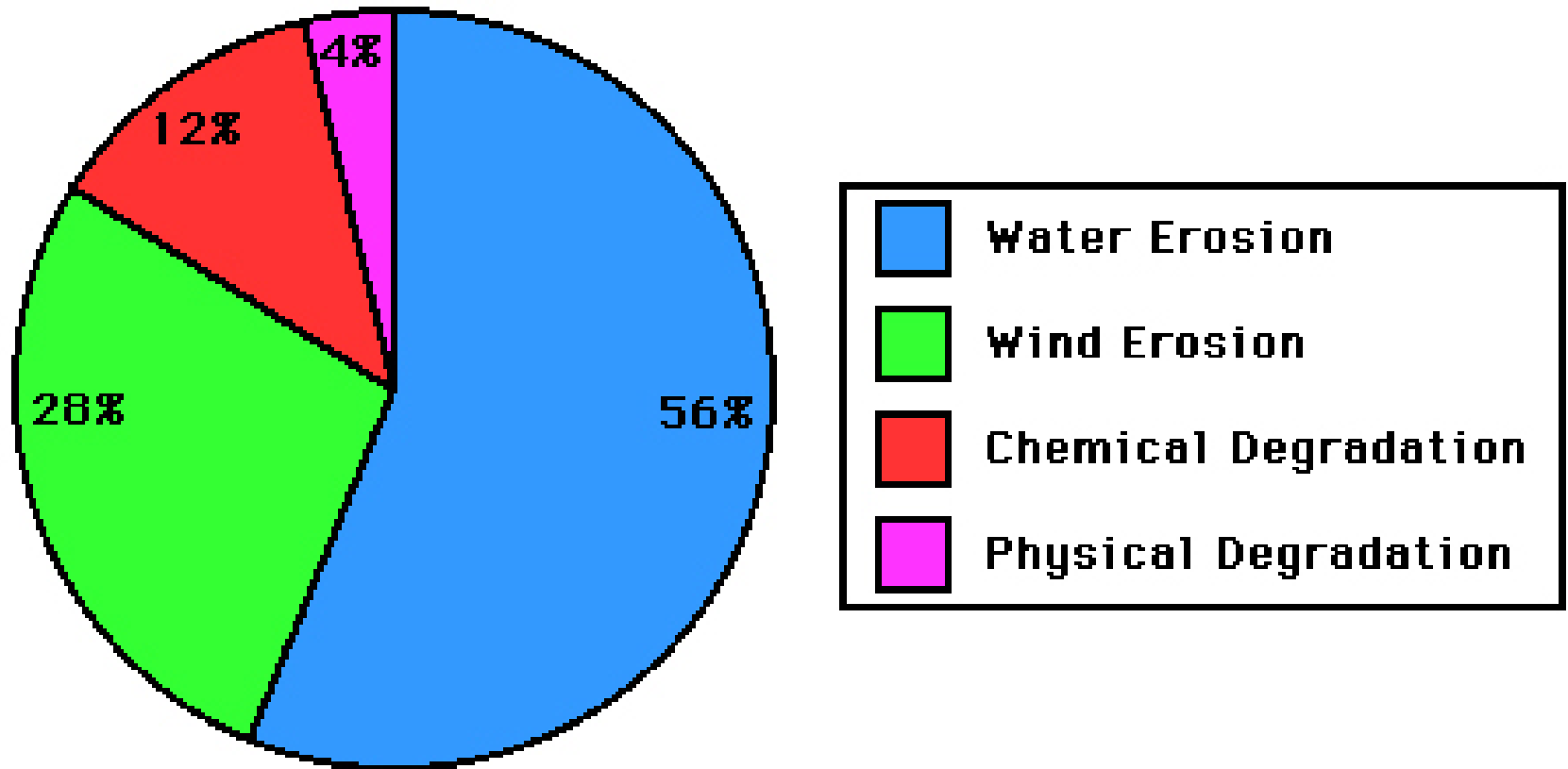


# The Dust Bowl



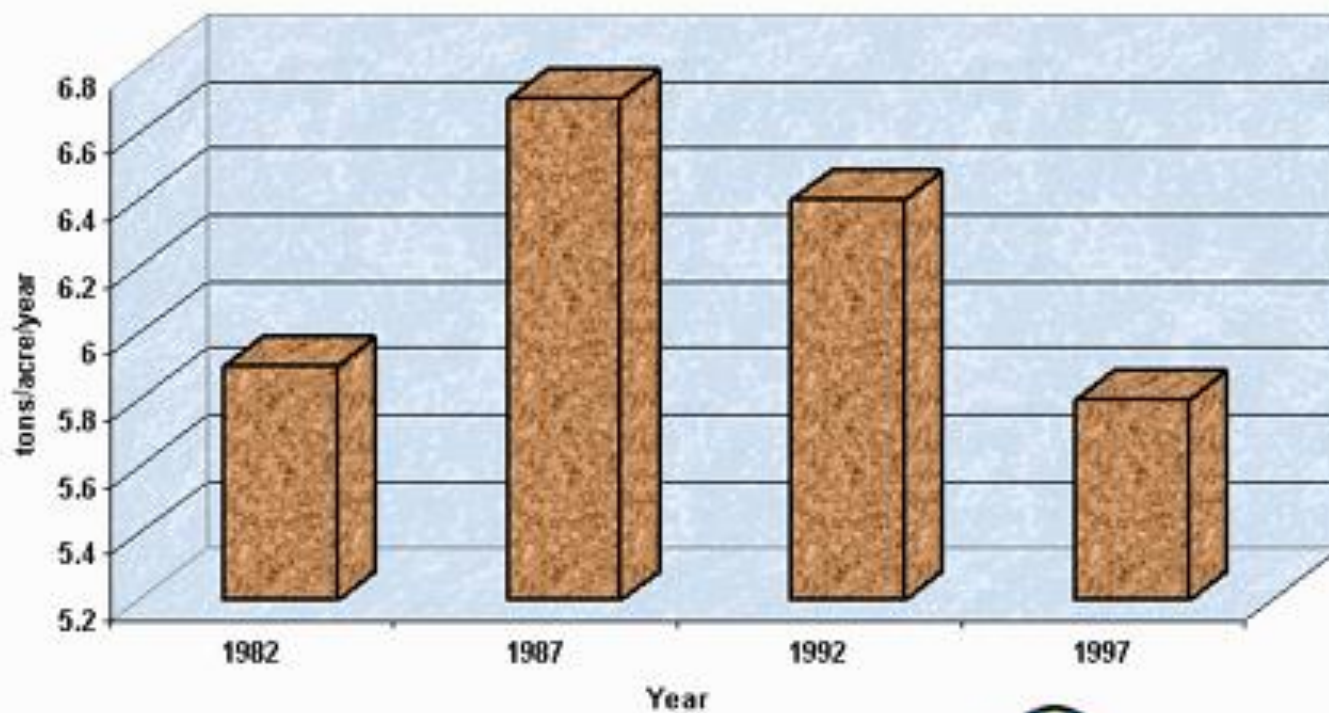


# World-Wide Soil Degradation Mechanisms for all Land-Use Types



# Minnesota

## WEQ Estimated Average Annual Erosion Rates on Cultivated Cropland 1982-1997



Source: USDA - Natural Resources  
Conservation Service  
1997 National Resources Inventory  
(Revised)

# METHODS TO CONTROL EROSION



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# Contour Farming



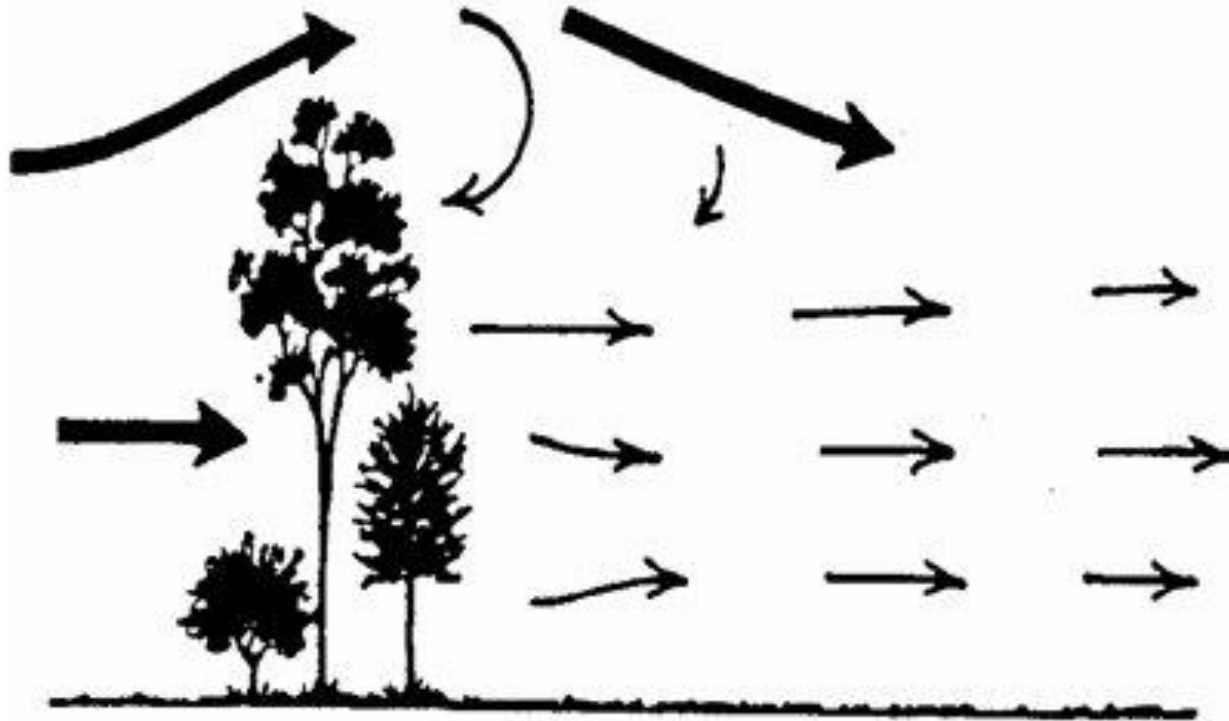
# Strip-Cropping



# Windbreaks



# Windbreaks



# Terraces

