Rocks and Weathering

How fast can it fizz?

- Make a hypothesis as to which one is going to dissolve faster.

Weathering

- **Weathering** is the process that breaks down rock and other substances on Earth's surface.
  - Heat, cold, water and ice can all contribute
  - Oxygen and carbon dioxide found in the atmosphere
  - Repeat freezing and thawing
  - Rainwater can dissolve minerals that bind rock together
  - Besides mountains, give some examples of weathering

Erosion

- **Erosion** is the removal of rock particles by wind, water, ice or gravity.
- Weathering breaks rocks into smaller pieces and then the forces of erosion _____.
  - A. breaks it down even farther
  - B. makes the rocks disappear
  - C. carry the pieces away
  - D. wear down mountains

Togetherness

- Weathering and erosion work together continuously to wear down and carry away the rocks at Earth's surface.
- Weathering and erosion takes place SLOWLY over long periods of time.
  - Give an example of weathering and erosion in nature.
- What is the difference between weathering and erosion?

Forms of Weathering

- 2 forms of weathering
  - Mechanical
  - Chemical

Mechanical

- What happens when you hit a rock with a hammer?
- The type of weathering in which rock is physically broken into smaller pieces is called **mechanical weathering**
  - Works very *slowly*

Freezing and thawing

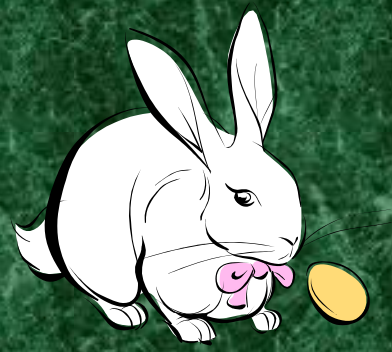
- When water freezes in a crack in a rock, it expands and makes the crack bigger. This is called **ice wedging.**
  - Give an example of ice wedging.

Release of Pressure

- As erosion removes material from the surface of a mass of rock, pressure on the rock is reduced. This release of pressure causes the outside of the rock to crack and flake off like the layers of an onion.

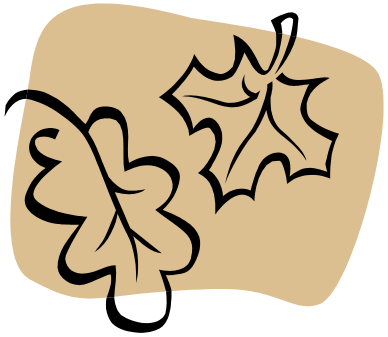
Animal actions

- Animals that burrow in the ground—moles, gophers, prairie dogs, and some insects—loosen and break apart rocks in the soil



Plant Growth

- Roots of trees and other plants enter cracks in rocks. As roots grow, they force the cracks farther apart. Over time, the roots of even small plants can pry apart cracked rock.



Abrasion

- Sand and other rock particles that are carried by wind, water, or ice can wear away exposed rock surfaces like sandpaper on wood. Wind-driven sand can cause weathering on rocks and mountains.

Magazine

- Find some pictures off some forms of mechanical weathering in a magazine. What type of mechanical weathering is it?
- Find 5 pictures. Identify the kind of mechanical weathering and cite the article in the following format:

  Author name (last, first). "Title of article." Name of magazine date published: page number.

  ex:

Miller, William. "Analyzing Erosion." National Geographic May 16, 2010: 14-24.

Chemical Weathering

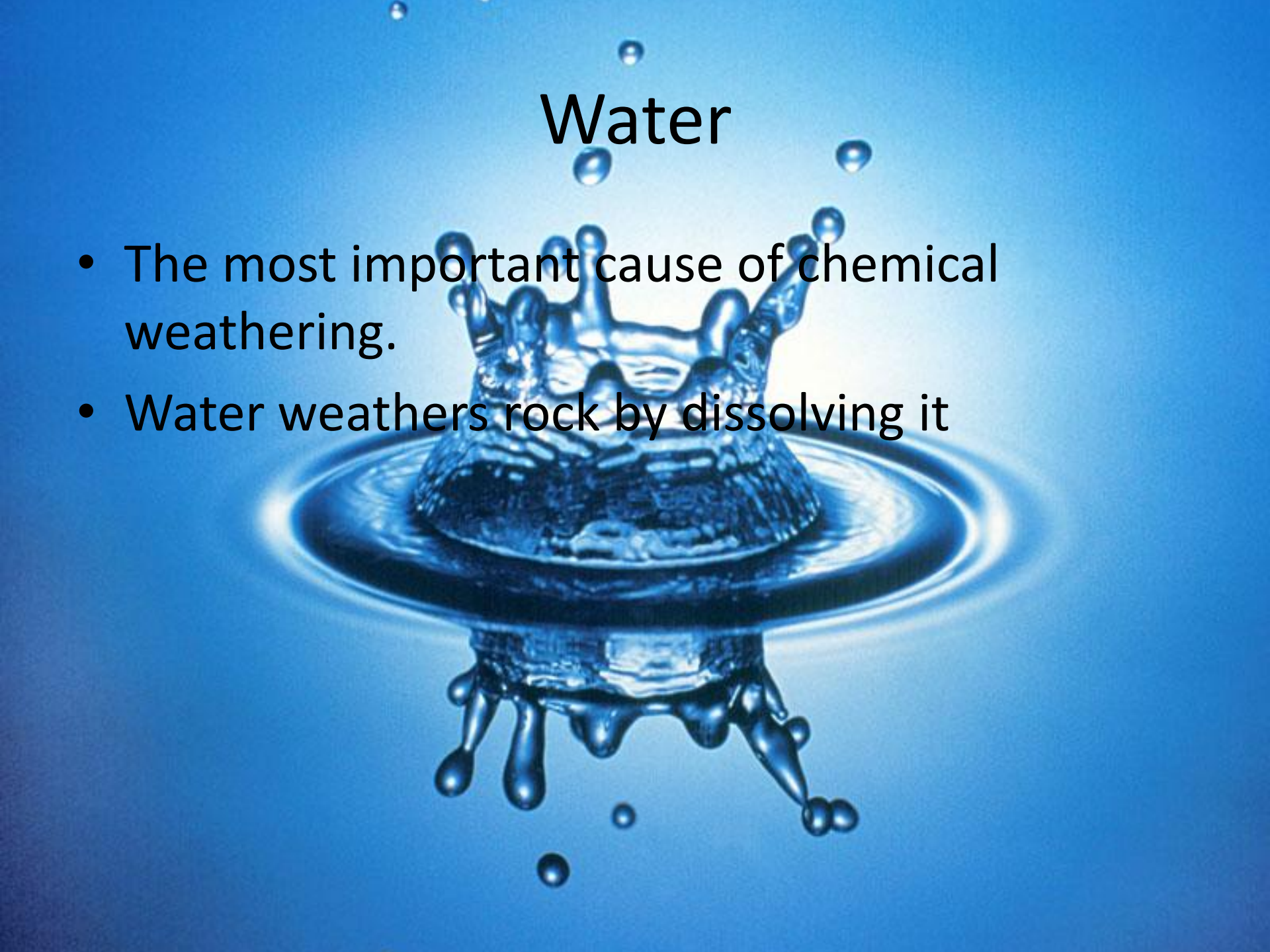
- **Chemical weathering** is the process of that breaks down rock through chemical changes.
- Chemical weathering creates holes or soft spots in rock, so the rock breaks apart more easily.

Togetherness…again

- Chemical weathering and mechanical weathering often work together
- As mechanical weathering breaks rocks into pieces, more surface area becomes exposed to chemical weathering.
  - Think of the Fizz Activity

Water

- The most important cause of chemical weathering.
- Water weathers rock by dissolving it



Oxygen

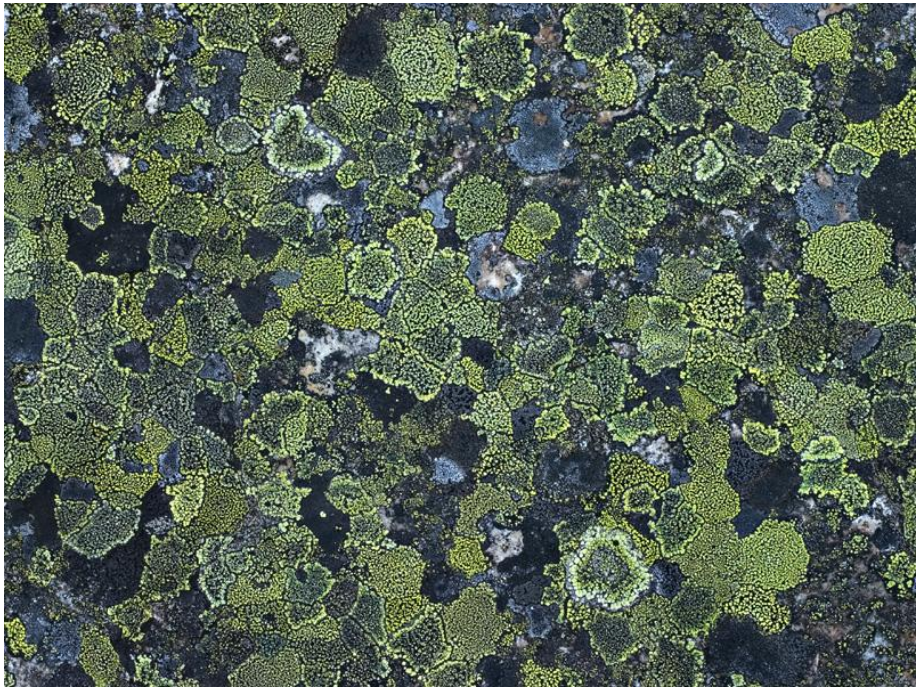
- The oxygen gas in the air will react with different elements
- Rust happens through a process called **oxidation**, when iron combines with oxygen in the presence of water. The product of this reaction is rust.
  - Rust gives rock a red or brown color

Carbon Dioxide (CO_2)

- Also found in the air
- CO_2 dissolves in rain water and in water that sinks through the air pockets in the soil.
- Produces a carbonic acid

Living organisms

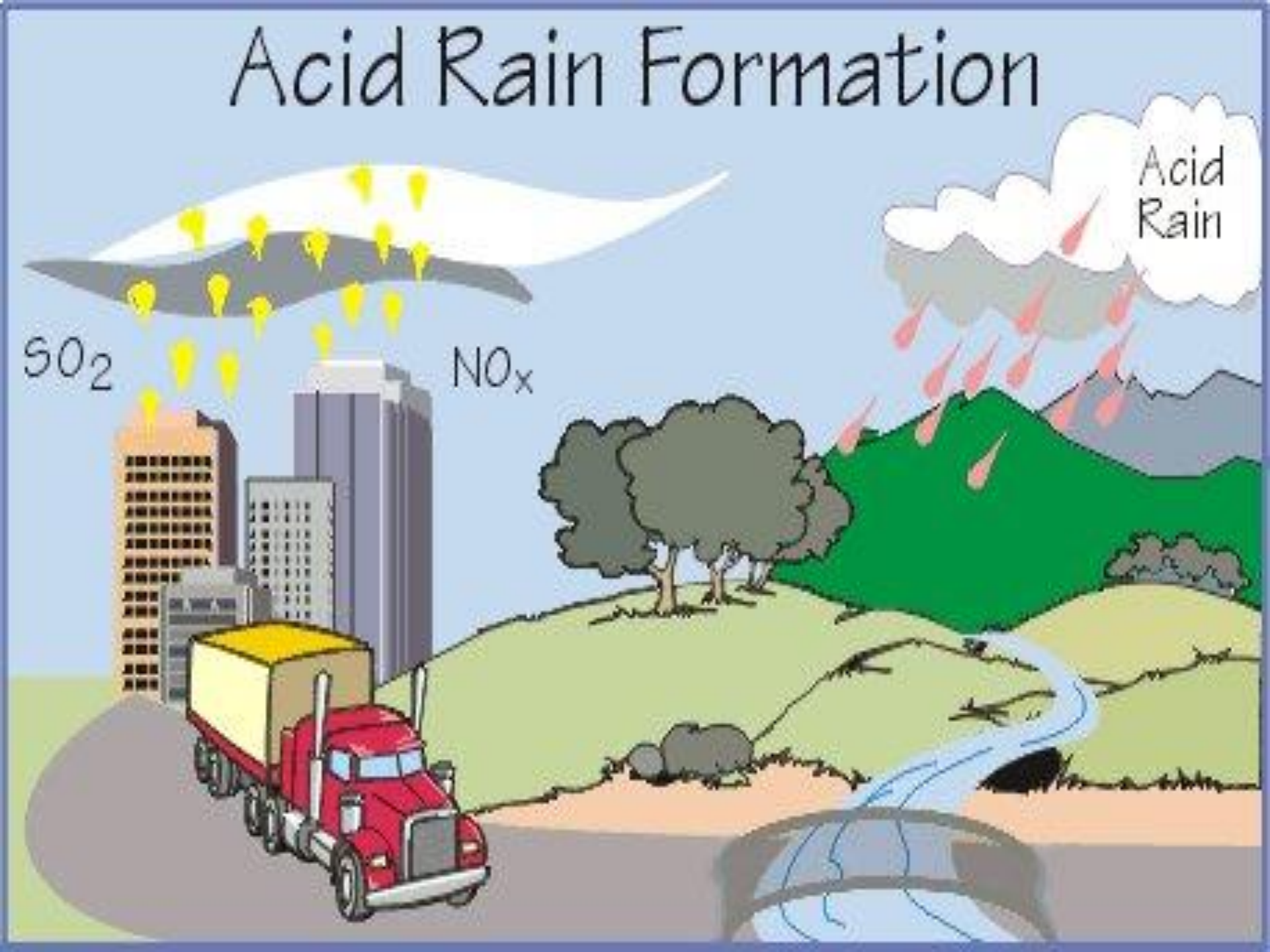
- As plants roots grow, they produce weak acids that slowly dissolve rock
  - Lichen—plantlike organisms grow on rocks also produce this weak acid.



Acid Rain

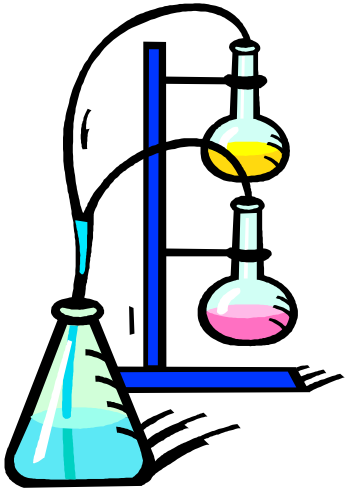
- Air polluted with sulfur, carbon and nitrogen can create a chemical reaction with water, forming acids.
- Acid rain causes very rapid chemical weathering.

Acid Rain Formation



Design your own experiment

- Different effects of weathering
- Materials
  - Film canisters
  - Bouillon cubes
  - Lemon juice
  - Alcohol
  - Dice
  - Rock salt



Must have:

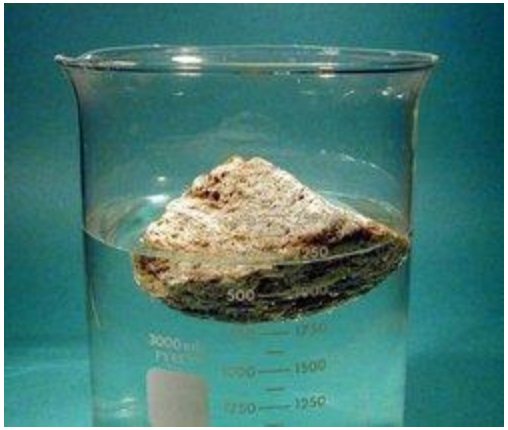
- Fold a paper in thirds like the oobleck paper!
- Steps of the scientific method
  - Ask a question
  - Make an observation (what do you think is going to happen)
  - Hypothesis—if_____ then _____
  - Test and collect data (make a table or chart to collect data)
  - Analyze data (what does your data that you collected mean)
  - Conclusion (I support my hypothesis because….WHY?)
- Two different things…mechanical or chemical or a combination.

Rate of Weathering

- Slate tombstones carved in the 1700s are less weathered and easier to read than marble gravestones from the 1800's. WHY?
- The most important factors that determine the rate at which weathering occurs are:
  - Type of rock
  - Climate

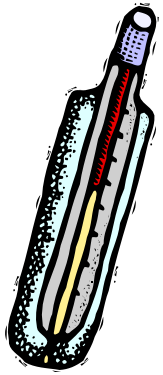
Type of rock

- The minerals that make up a rock determine how fast it weathers.
- Some rocks will dissolve faster because it is **permeable** or full of tiny air spaces that allow water to seep through it



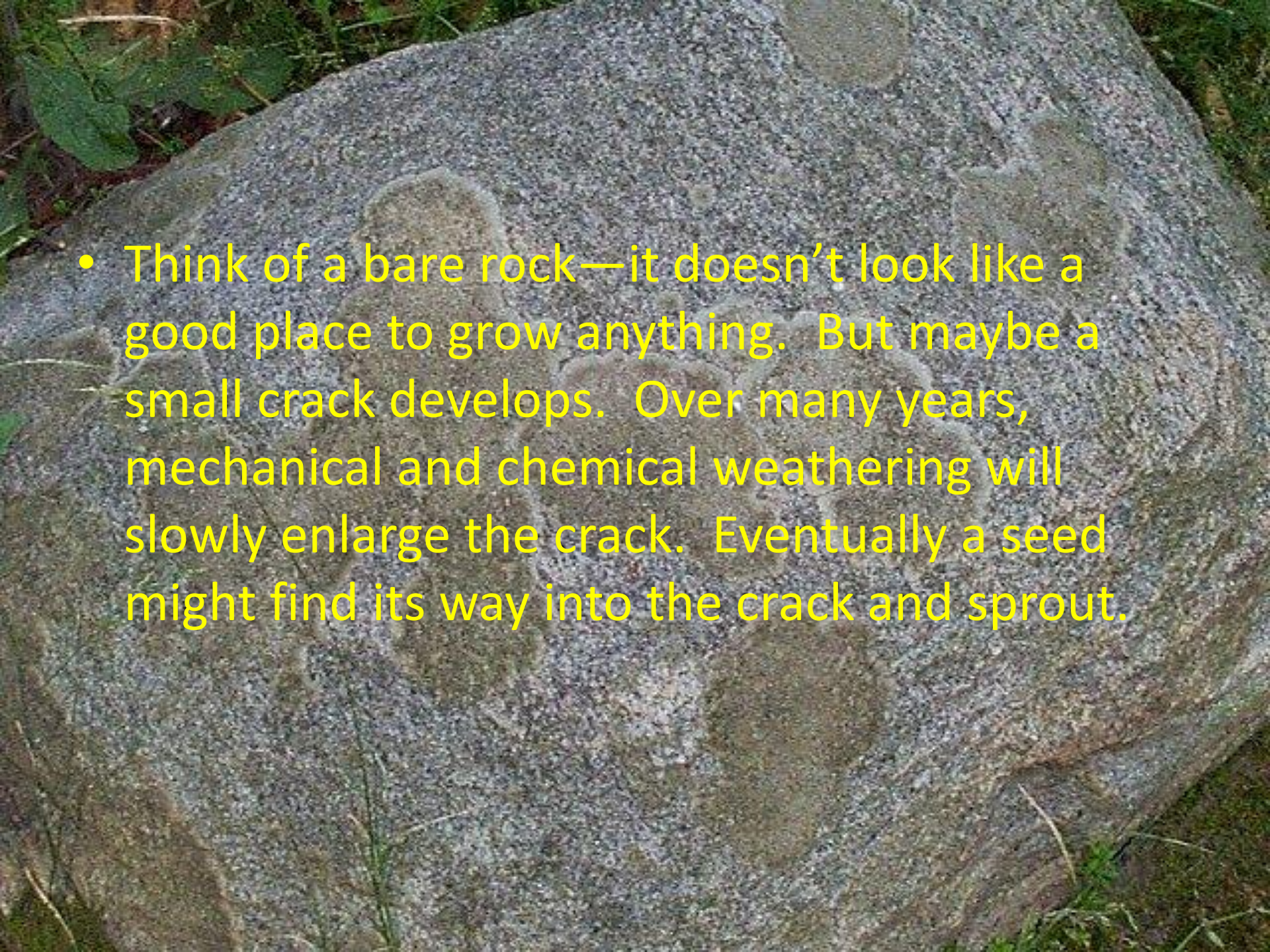
Climate

- Weathering occurs faster in wet climates
- Chemical reactions occur faster at higher temperatures
  - Hot + wet = very fast weathering



How Soil Forms

- Use a toothpick to separate a sample of soil into individual particles. With a hand lens, try to identify the different types of particles in the sample.
- Write a “recipe” for the sample of soil, naming each of the “ingredients” that you think the soil contains. Include what percentage of each ingredient would be needed to make up the soil.



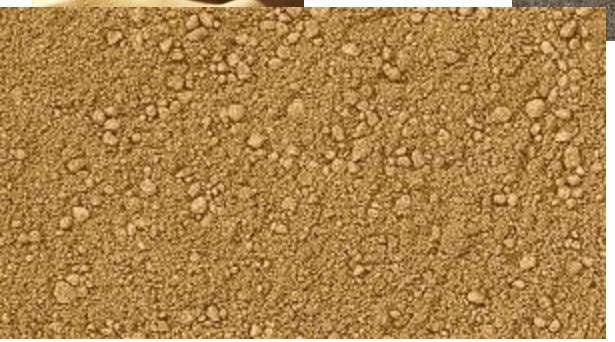
- Think of a bare rock—it doesn't look like a good place to grow anything. But maybe a small crack develops. Over many years, mechanical and chemical weathering will slowly enlarge the crack. Eventually a seed might find its way into the crack and sprout.

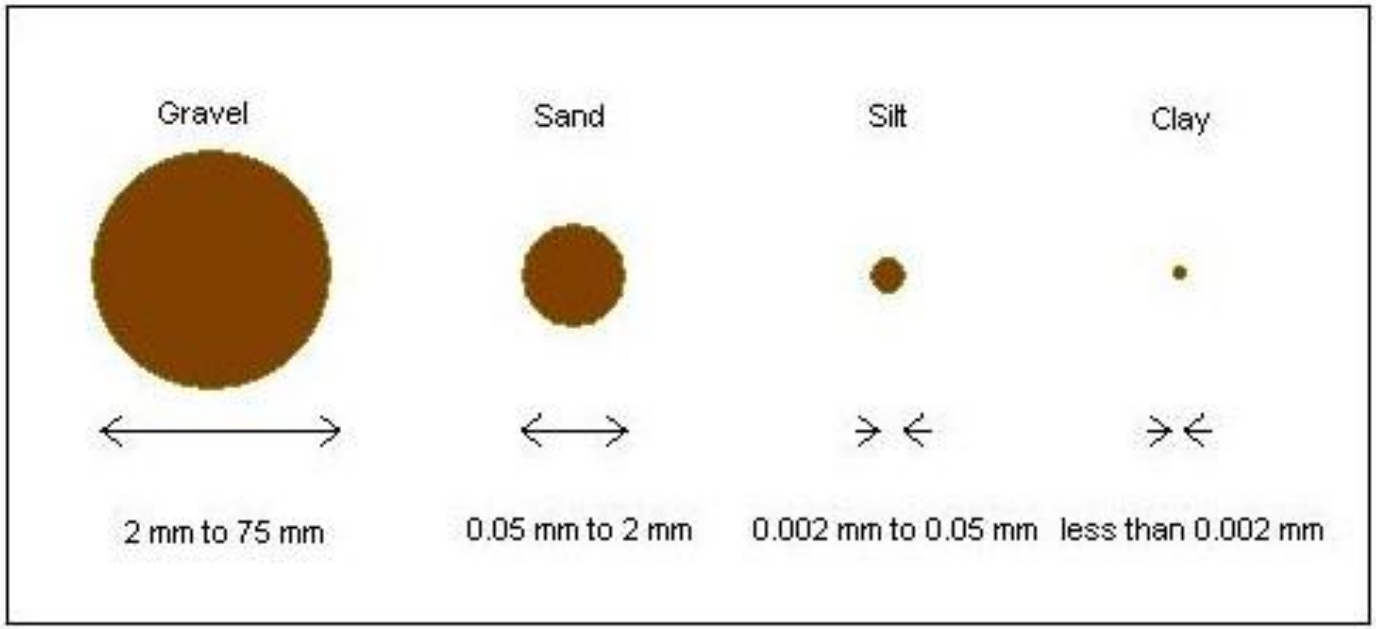
What is Soil?

- **Soil** is loose, weathered material on Earth's surface in which plants grow
- One of the main ingredients of soil is **bedrock**, the solid layer of rock beneath the soil.
  - Once exposed at the surface, bedrock gradually weathers into smaller and smaller particles that are the basic material of soil

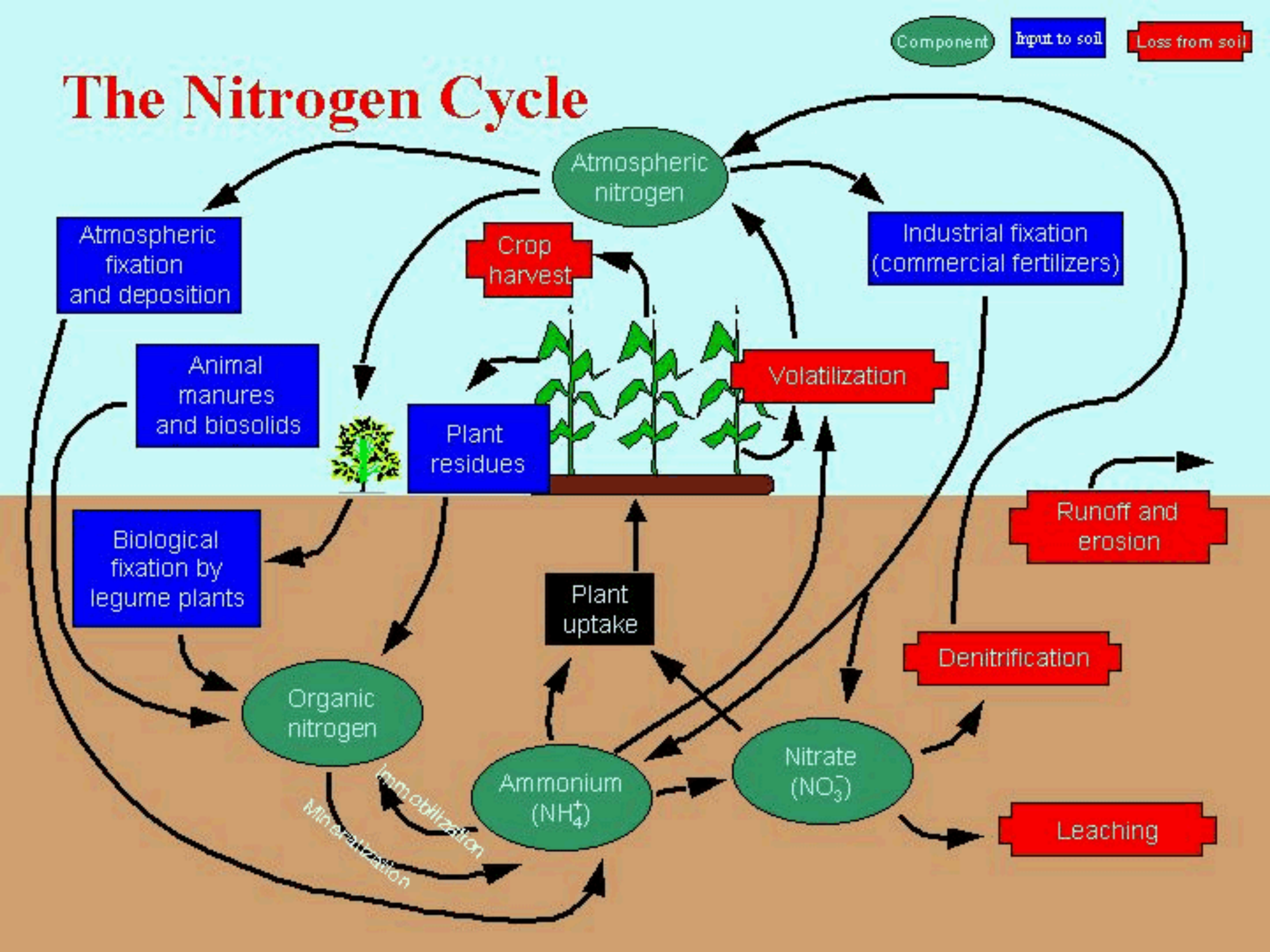
Soil Composition

- Soil is a mixture of rock, particles, minerals, decayed organic material, water and air.
  - Together, sand, silt and clay make up the portion of soil that comes from weathered rock




Gravel
Sand
Silt
Clay
2 mm to 75 mm
0.05 mm to 2 mm
0.002 mm to 0.05 mm
less than 0.002 mm

- **Humus**—decayed organic material—a dark colored substance that forms as plant and animal remains decay.
  - Helps to create spaces in soil for air and water that plants must have
  - Contains nutrients—nitrogen, sulfur, phosphorus, and potassium

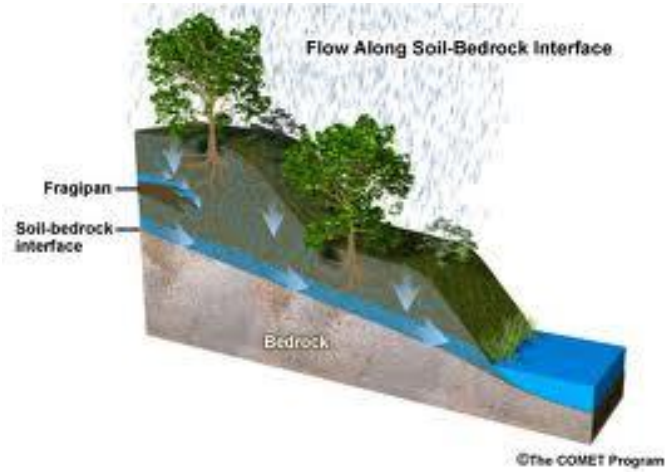

The Nitrogen Cycle
Component
Input to soil
Loss from soil
Atmospheric nitrogen
Atmospheric fixation and deposition
Industrial fixation (commercial fertilizers)
Crop harvest
Volatilization
Animal manures and biosolids
Plant residues
Biological fixation by legume plants
Runoff and erosion
Plant uptake
Denitrification
Organic nitrogen
Ammonium (NH_4^+)
Nitrate (NO_3^-)
Immobilization
Mineralization
Leaching

- The **fertility** of soil is measured by how well the soil supports plant growth
  - Rich in humus—high fertility
  - Rich in sand—low fertility

- Soil that is made up of equal parts of clay, sand and silt is called **loam**.
  - Best for growing most type of plants.

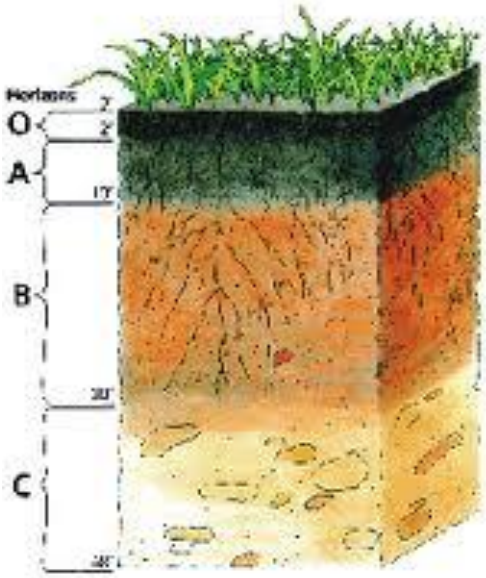
The Process of Soil Formation

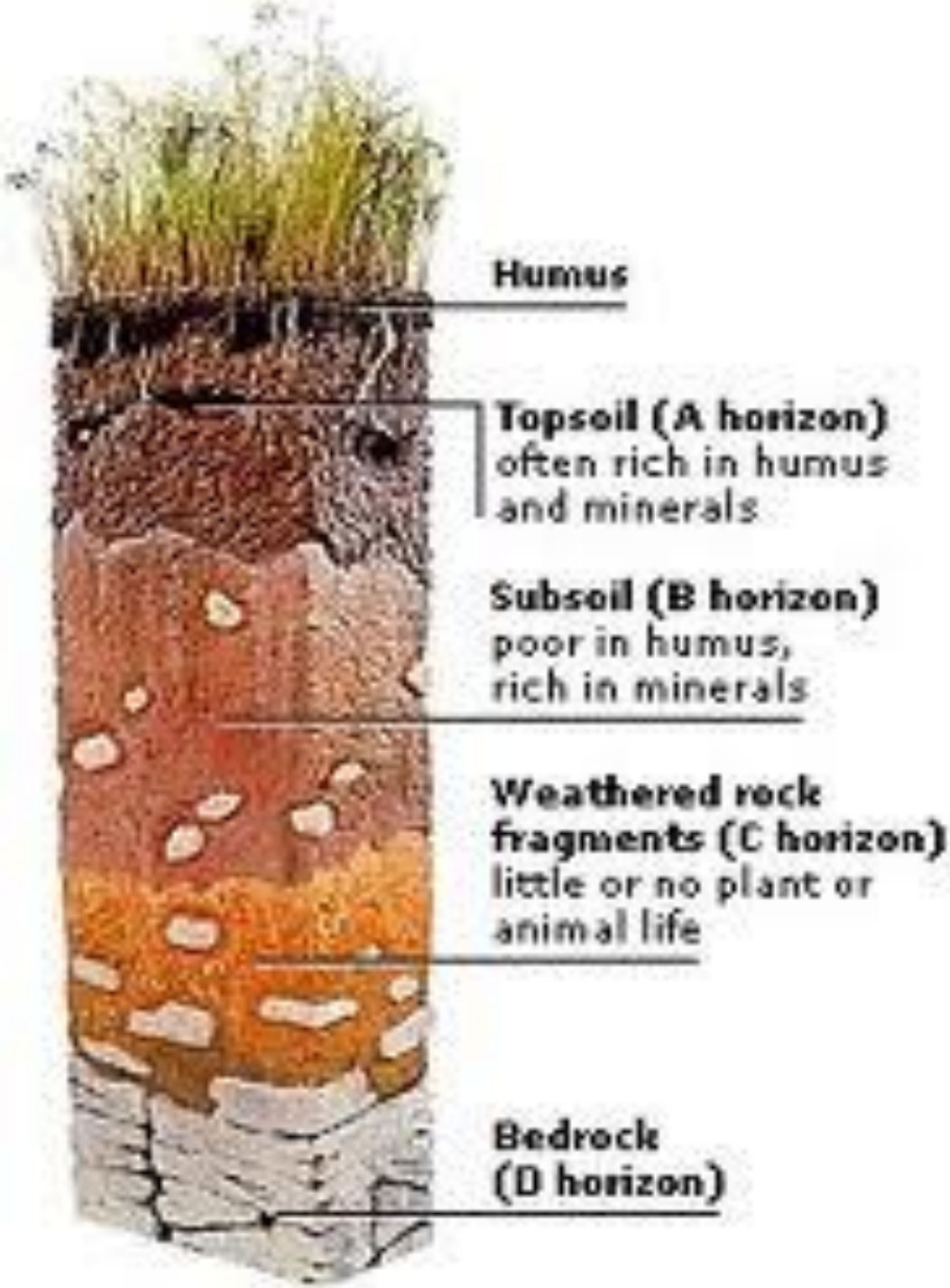
- **Soil forms as rock is broken down by weathering and mixes with other materials on the surface. Soil is constantly being formed whenever bedrock is exposed.**
  - Soil formation occurs continues over a long period of time.



Soil Horizons

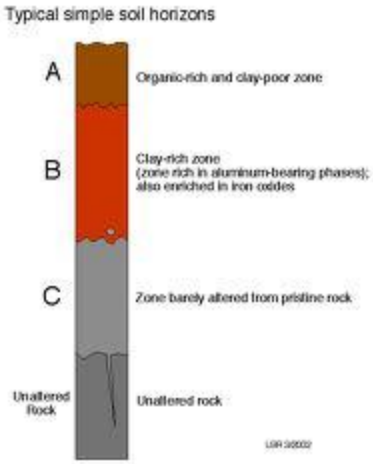
- Gradually, soil develops layers called horizons. A **soil horizon** is a layer of soil that differs in color and texture from the layers above or below it.




Humus
Topsoil (A horizon)
often rich in humus
and minerals
Subsoil (B horizon)
poor in humus,
rich in minerals
Weathered rock
fragments (C horizon)
little or no plant or
animal life
Bedrock
(D horizon)

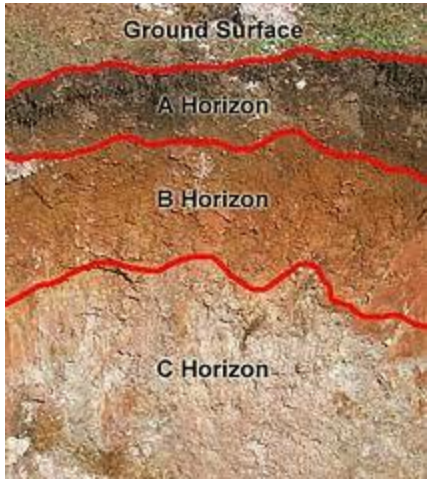
A Horizon

- The A horizon is made up of **topsoil**, a crumbly dark brown soil that is a mixture of humus, clay and other minerals.



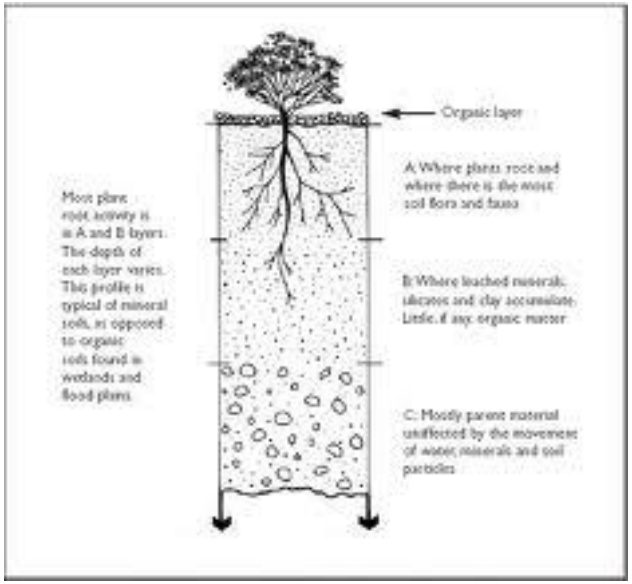
B Horizon

- The B horizon, often called the subsoil, usually consists of clay and other particles washed down from the A horizon (but little humus).

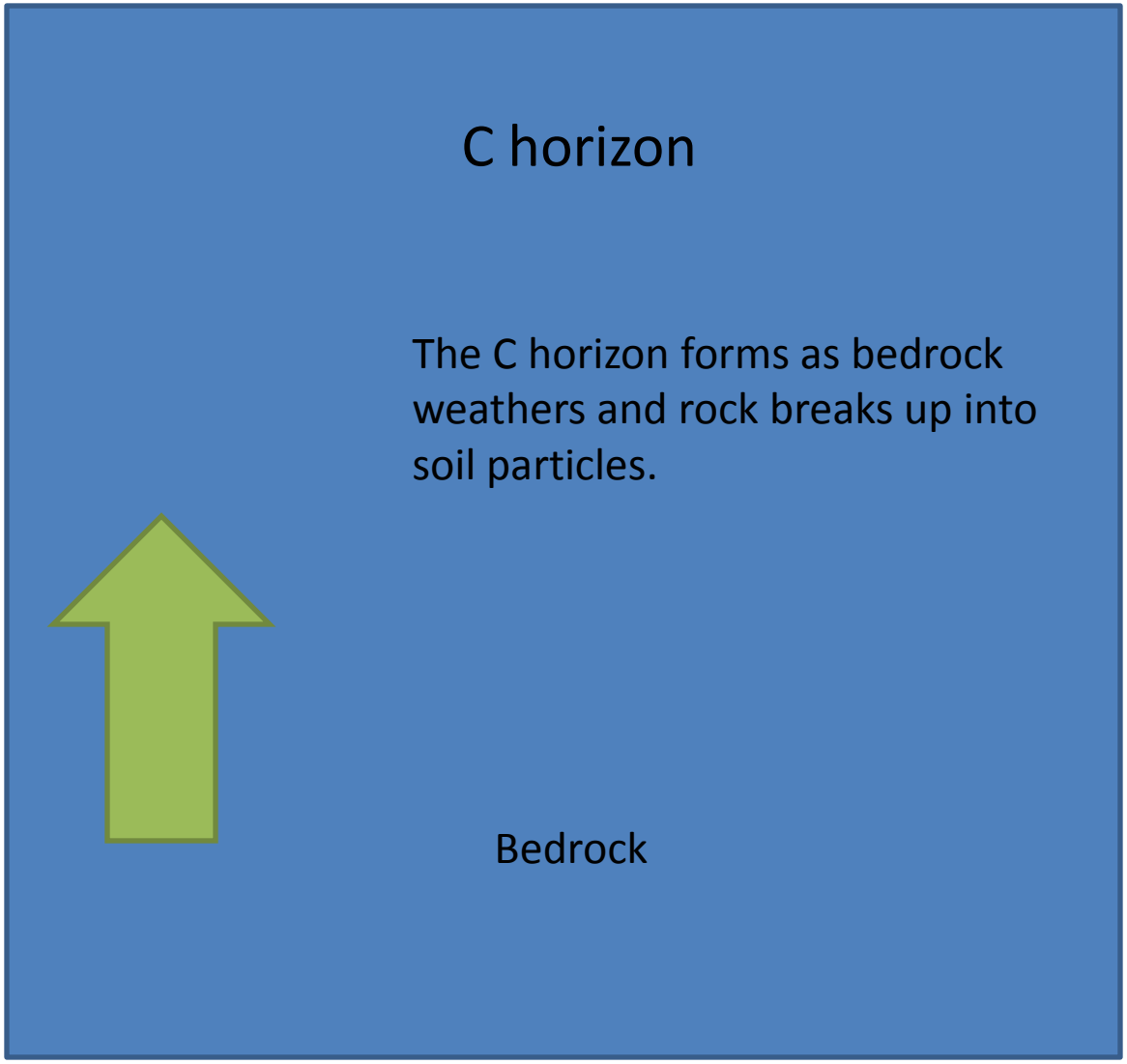


C Horizon

- Contains only partly weathered rock



The process of soil formation



A Horizon

C Horizon

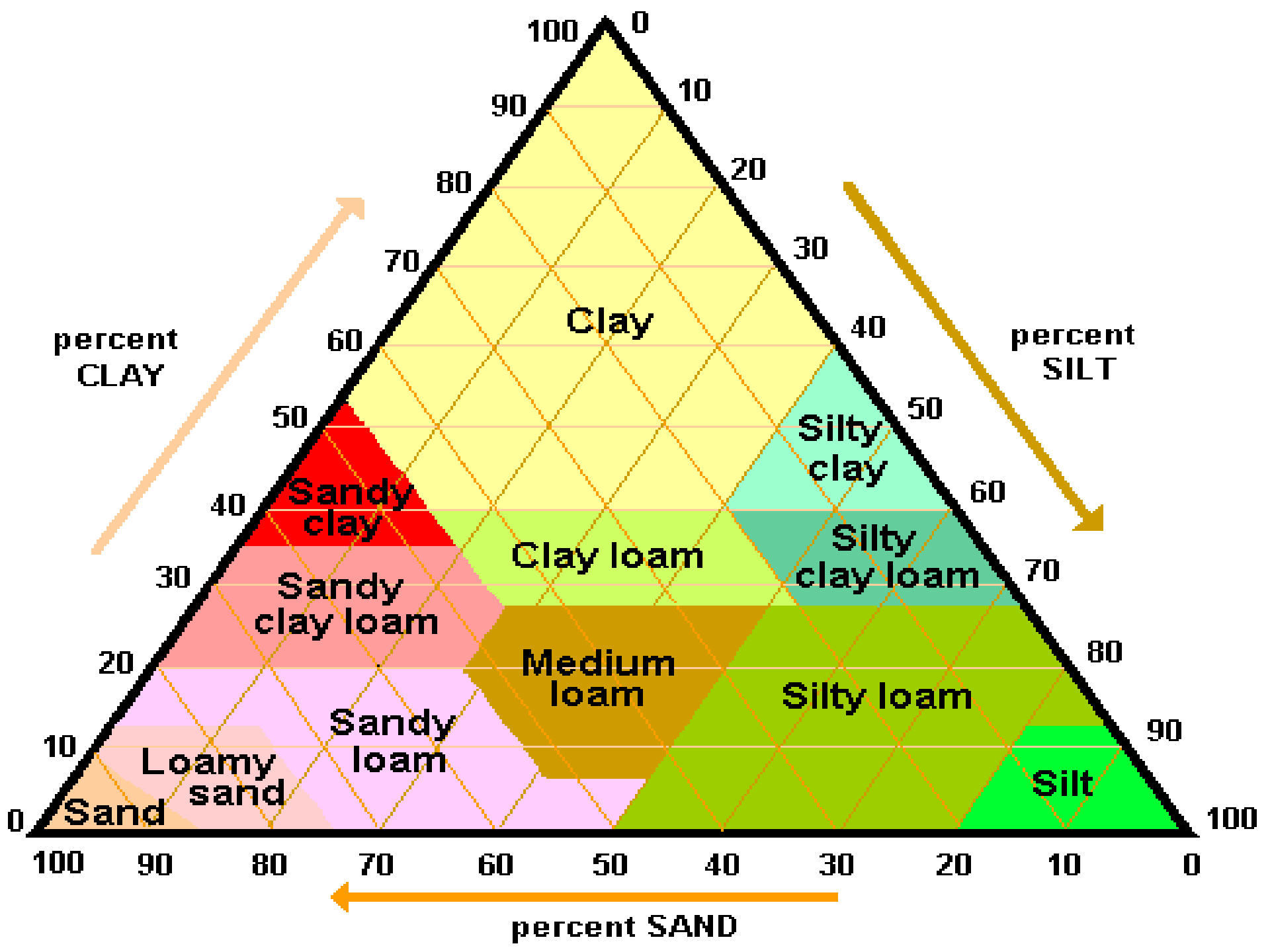
The A horizon develops as plants add organic material to the soil and plant roots weather pieces of rock.

A Horizon

B Horizon

The B horizon develops as rainwater washes clay and minerals from the A horizon to the B horizon.

C Horizon


percent CLAY
percent SILT
percent SAND
Clay
Silty clay
Sandy clay
Clay loam
Silty clay loam
Sandy clay loam
Medium loam
Silty loam
Sandy loam
Loamy sand
Sand
Silt
100
90
80
70
60
50
40
30
20
10
0

A Square Meter of Soil

- Outdoors, measure an area of one square meter. Mark your square with string.
- Observe the color and texture of the soil at the surface and a few centimeters below the surface. Is it dry or moist? Does it contain sand, clay, or gravel? Are there plants, animals or humus?
- When you finish, leave the soil as you found it.

- What can you conclude about the soils fertility?
- Draw a picture representing your square inch of soil.
- On the classification of soil texture, depict where your plot is and WHY?