



Chapter 2

Landforms

Geological History of California

California's Climate

Diversity of California Microclimates

Soil Structure and Nutrient Cycles

Decomposition

Mycorrhizal Relationships

Mining in California

Land Forms

a. California is like a bathtub

- mountain ranges
- flat valley

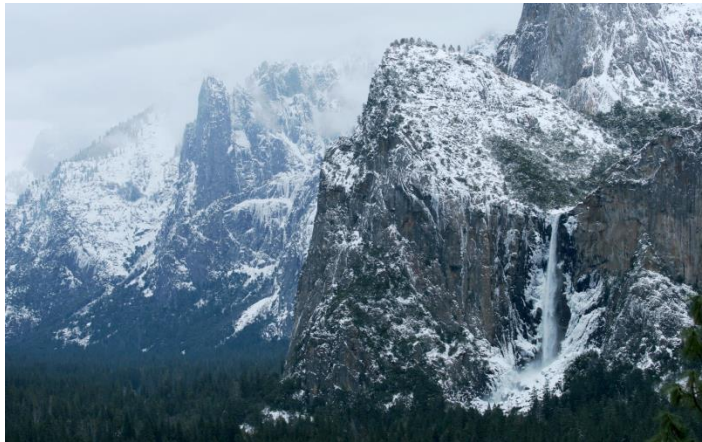


- Klamaths and Siskiyou Mountains
- Cascade Ranges
- Sierra Nevada
- North Coast Ranges
- San Francisco Bay
- Central Valley (or Great Valley)
- South Coast Ranges
- Transverse Range
- Peninsular Range
- Mojave Desert
- Colorado Desert

- the Cascade Ranges actually run from California up through Oregon, Washington, and southern British Columbia
 - North-South trending mountain



- Klamath and Siskiyou Mountains
 - link the Coast Ranges to the Sierra-Cascade axis in the North



- Sierra Nevada
 - North-South trending
 - part of Sierra-Cascade axis
 - far higher in elevation than the Coast Ranges



- North Coast Range
 - North-South trending



- Central Valley



- San Francisco Bay



- South Coast Ranges
 - North-South trending



- Transverse Range
 - links Coast Ranges to Sierra-Cascade axis in the South

- Peninsular Range



- Mojave Desert



- Colorado Desert

b. the Sierra-Cascade axis can be thought of as CA's spine/backbone



"cis-montane"

c. rivers flowing down the west slopes of the Sierra Nevada converge in the Central Valley into the Sacramento and San Joaquin Rivers and then exit out the SF Bay



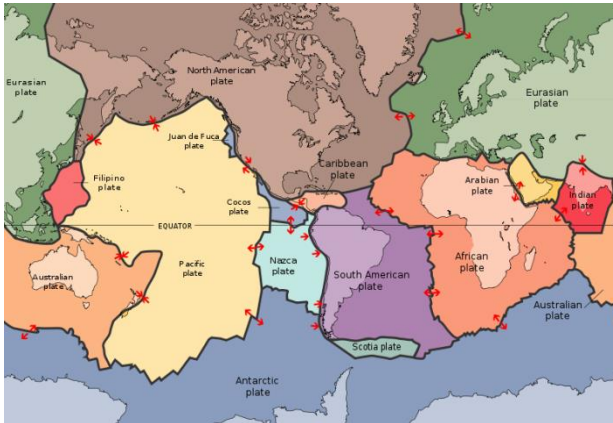
d. other miscellaneous land forms

- Sutter Butte
- remnants of a volcano that erupted 3 million years ago
- Farallon Islands
- Channel Islands

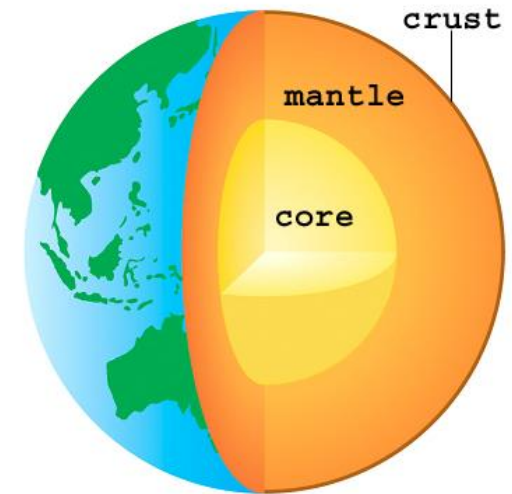
Geologic History of California

a. Plate Tectonic Theory

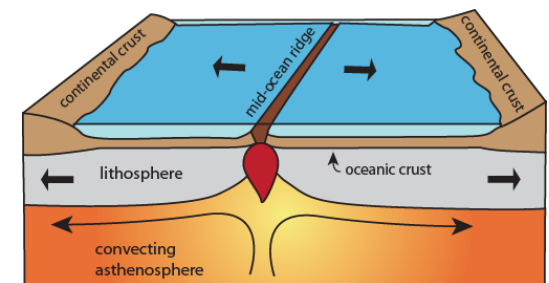
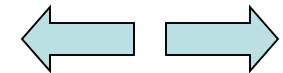
- Earth's composition
 - semisolid core
 - fluid mantle that moves very slowly
 - thin crust made of separate pieces (tectonic plates) that float over the mantle



- ways the plates can interact
 - divergence
 - creates an opening for molten material to ooze out, resulting in an elevated area called a spreading center



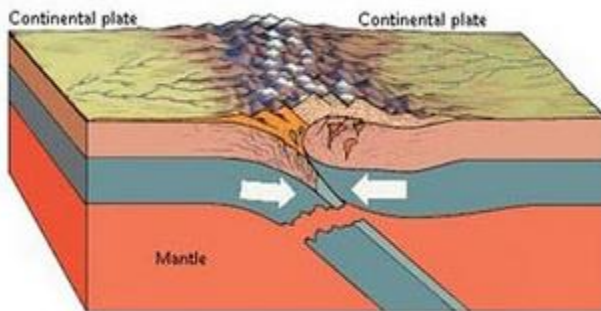
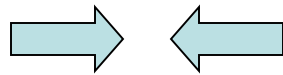
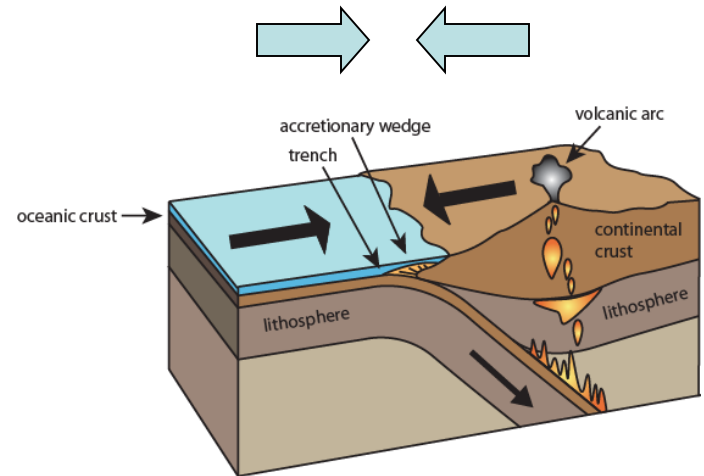
- the plates float atop the fluid mantle like cereal bits floating in milk



- convergence

- between oceanic plate and continental plate

- oceanic plate, being more dense, will slide under the continental plate and sink into the mantle
- responsible for formation of the Sierra Nevada, Klamath Mountains and Peninsular Ranges

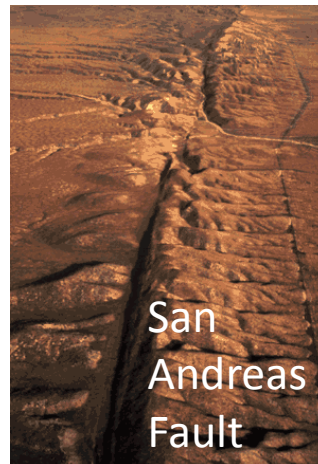
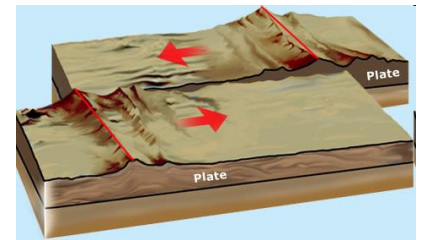
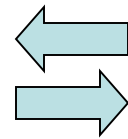


- between continental plate and continental plate

- being roughly the same density, these plates will just push into each other like two blobs of Play-Doh to form mountains
- such processes formed the European Alps, Appalachian and Himalayan Mountains

○ transform

- responsible for continuing deposition of sediment in the Central Valley
- responsible for volcanic activity in northern CA and eastern Sierra



- the right-lateral motion along the 800 mile San Andreas is the primary cause of California's earthquakes and has offset rock assemblages, streams, and other objects on both sides of the fault by hundred of miles

b. erosion

- wind
- rain
- snow
- freezing thawing



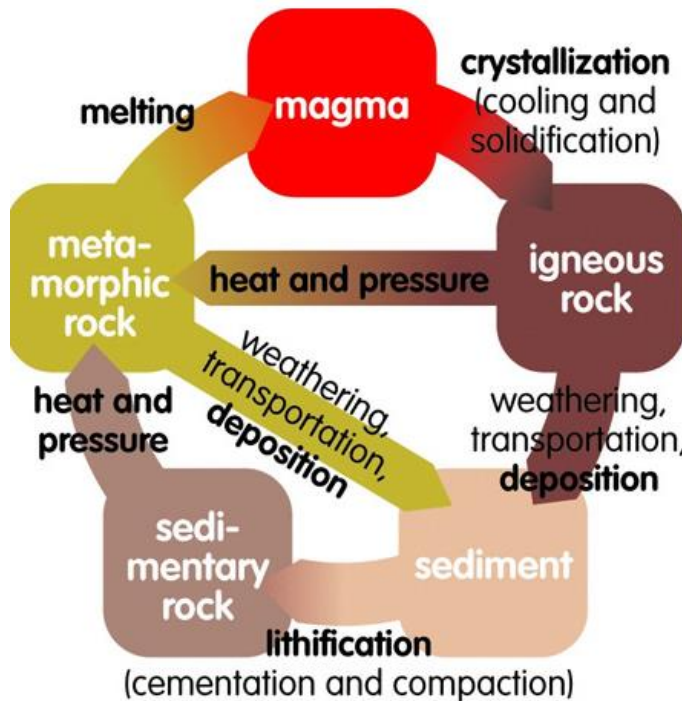
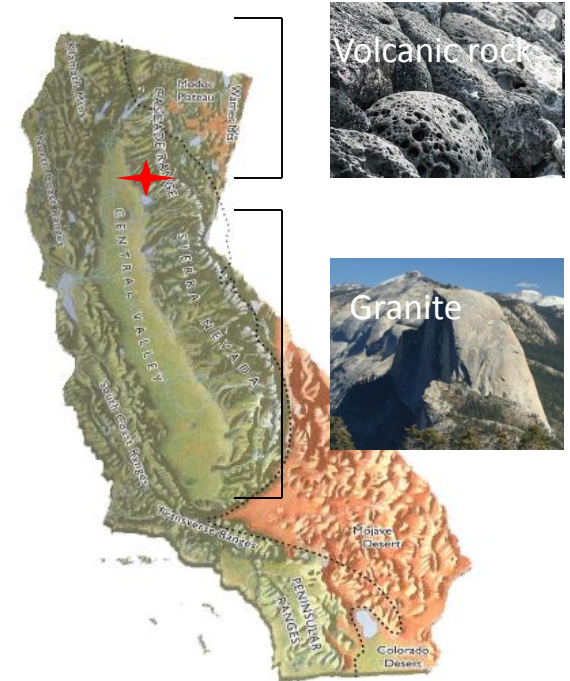
- glacial carving

- while we often think of mountains of as being stupendously old, they must constantly grow to avoid being flattened by erosion
 - Mt. Shasta is only 12,000 years old



c. rocks in California

- the movement of plates influences the kinds of rocks found throughout the state
- in CA, Mt Lassen is a convenient place marker for the dividing line between volcanic rocks to the north and granite rocks to the south



- rock cycle

- types of rocks in California

- igneous

- formed from the cooling of molten material (magma) in a process called crystallization



- sedimentary

- formed by the gradual accumulation and cementation of rock debris (usually from mountains) and frequently occurring under water

- metamorphic

- formed when igneous or sedimentary rock have been subducted deep into the earth, but instead of simply melting, undergo structural change due to extreme pressures and temperatures



- common types of igneous rock in CA
 - granite
 - coarse grained, light colored
 - forms high peaks of Sierra Nevada and Yosemite



- basalt
 - fine grained, black to rust colored
 - common to volcanic areas like Modoc Plateau, Mt Lassen

- volcanic rock
 - tuff is light colored, low density
 - obsidian is black and glassy rock
 - common to Cascade Ranges volcanoes and eastern Sierra



○ common types of sedimentary rock in CA

➤ shale

- extremely fine grained rock
- forms in calm environments
- common in Coast Ranges and foothills of Sierra Nevada



➤ sandstone

- medium grained rock
- found in near-shore marine environments
- common in Central Valley and desert provinces

➤ chert

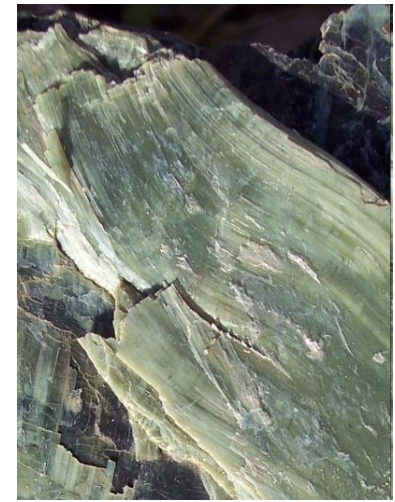
- chemical sedimentary rock composed of layers of microscopic shells
- commonly rust colored
- common in Coast Ranges and foothills of Sierra Nevada



- common types of metamorphic rock in CA

- serpentine

- our proud state rock
- green to black color
- waxy and extremely soft
- common in the Coast Ranges and Sierra Nevada foothills



- slate

- fine grained foliated rock
- common in Sierra Nevada foothills

- schist

- fine grained, foliated rock
- common in Sierra Nevada foothills



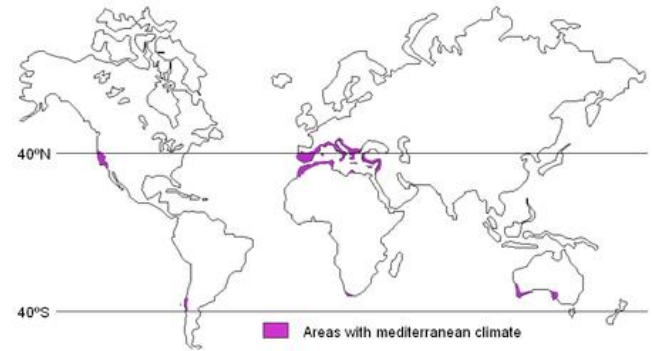


- rocks falling into bowl
 - sedimentary rocks and debris made from the erosion of Coast Ranges and Sierra Nevada have covered the Central Valley in layers of sedimentation up to 20,000 meters in thickness
 - contributes to the richness of soil in Central Valley



California's Climate

- a. California is one of only five regions in the world with a Mediterranean climate
 - all the areas with Mediterranean climate occur on the *western edges* of the continents
 - the earth spins in one direction, and the atmosphere above remains relatively still (wind)



- hot, dry summers (May to October)

- cool, wet winters (November to April)



c. California's seasons

- spring occurs in November



- periods of animal dormancy occur in the heat of summer
 - amphibians and small mammals *estivate* during this time

- some species never lose their leaves
 - *Sequoia sempervirens* (evergreen)



Diversity of California Microclimates

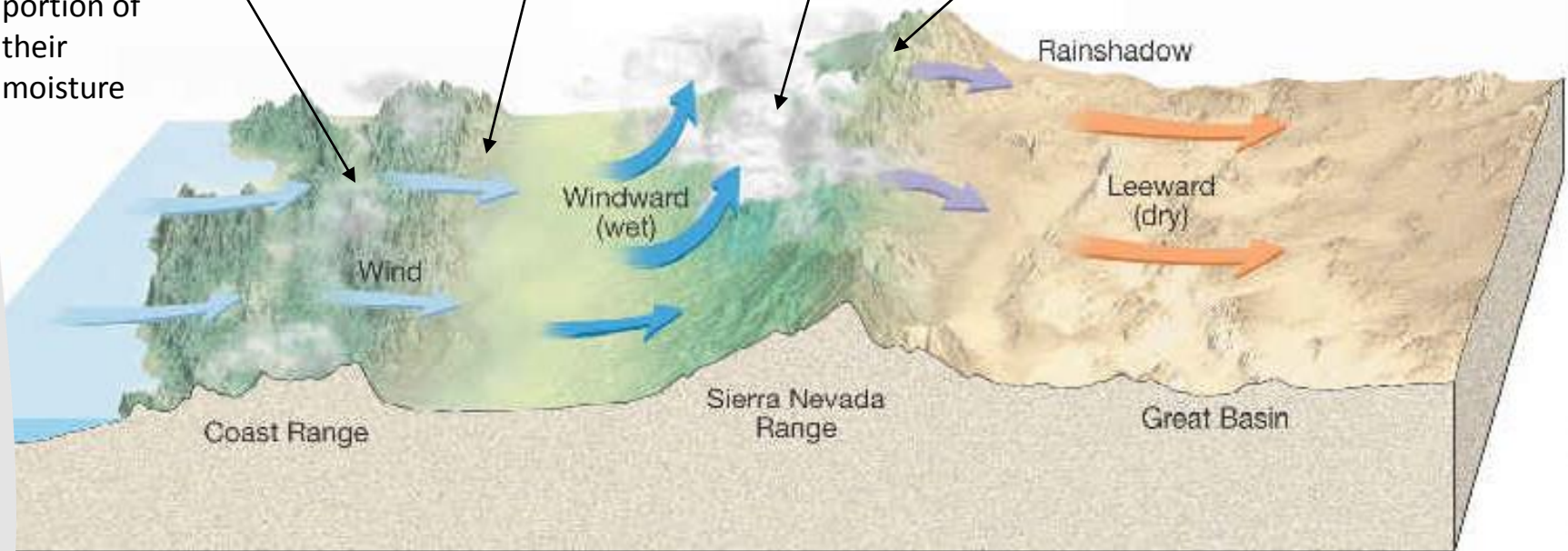
a. coastal winds drive clouds over mountains to produce rain

1. Moist clouds blown inland from Pacific winds are driven up in elevation by the Coast Ranges until they have been wrought of a portion of their moisture

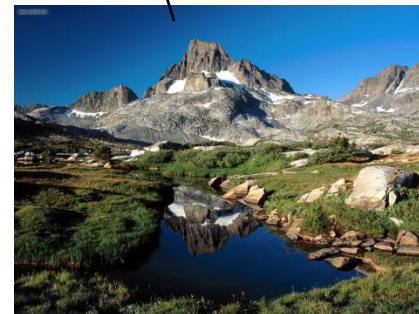
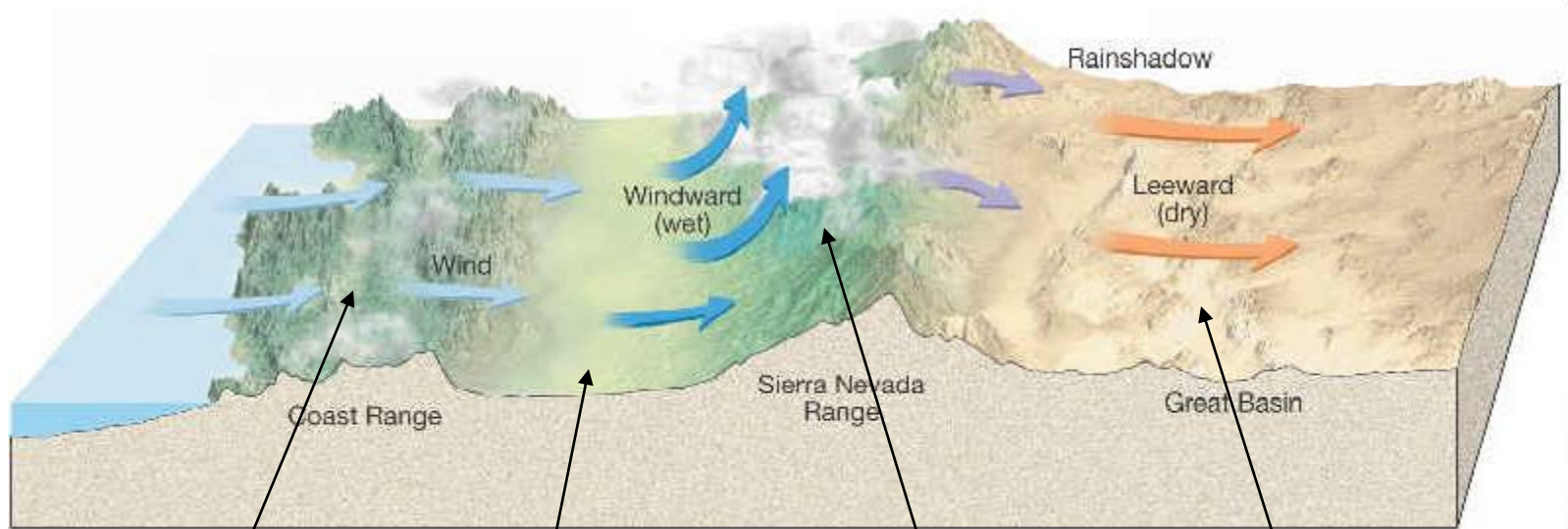
2. The clouds descend into the valley, where they increase in temperature

3. The clouds begin to regain their moisture as they rise up the Sierra. By the time they reach mid elevation, they have enough moisture to rain again

4. Having spent all their moisture at mid-elevation, the now dry clouds continue their eastward journey....



- b. the western slopes of the Coast Ranges and Sierra experience dramatically higher rainfall than the eastern slopes



Soil Structure and Nutrients

- a. the parent rock of a soil determines its chemistry and thus how it will affect various plant species
- promotion of growth
 - inhibition of growth
 - ex. when salt is leached out of the rocks in a mountain range and ends up in basins, a salt lake forms that is toxic to most plants



- b. serpentine soil
- characterized by low concentrations of calcium (which plants absolutely need) and excessive concentrations of magnesium
 - many generalist plants are excluded from serpentine soil
 - calcium and magnesium are chemically very similar so generalist plants don't bother to distinguish between the two and consume themselves to death
 - specialists have come to inhabit this niche

c. nitrogen fixation

- Nitrogen is present in limited quantities in most soils, but generally not enough to allow for luxuriant growth
- some plants have found ways to extract nitrogen from the air and thus obtain some degree of independence from their soils
- these plants have nodules in their roots that are perfect habitats for specialist bacteria that eat atmospheric oxygen



- when the bacteria complete their life span and die, they decompose in the nodule and release nitrogen to the plant
- when these plants die, they decompose and release the nitrogen into the soil
- ex. Ceanothus

Soil Structure and Nutrient Cycling

"Outside of a few infalling meteors and outflying spaceships, the Earth is a closed chemical system."

William H. Schlesinger



- a. materials cycling through the Earth's systems go in and out of biotic and abiotic stages
- living things grow, reproduce, die, decompose, and become part of other living things



- non-living things accumulate, break down, are utilized by or stored in other organisms, get excreted and redeposited, get reformed or reused

- nutrients remain in different reservoirs or states for different residence times
 - carbon remains in plants for 5 years on average
 - carbon found in rocks remains locked there for millions of years



b. tampering with the Nitrogen Cycle, as with any other natural cycle, induces a chain reaction of problems

- Nitrogen is important for agriculture because its often a limiting factor for plant growth
- farmers often apply large amounts of nitrogen in the form of nitrate to yield crops



- this however, puts into the nitrogen cycle far more nitrogen than the plants can possibly absorb
- this excess nitrate becomes a source of pollution in streams and rivers and other bodies of water
- polluted water bodies may experience explosions in growth of phytoplankton, which often chokes off water oxygen levels and suffocates local fish populations

Decomposition

Everything in the biosphere can be and is used again

- a. raccoon falls from a tree and dies on impact



- b. within a few hours
 - bacteria break into its cells to eat up nutrients
 - coyotes, foxes and vultures rip open and devour the best parts of the carcass
 - flies begin laying eggs on the carcass

- c. after 8-20 hours
 - the maggots hatch and begin cleaning up all the easily available soft tissue



d. now there is just a pile of hair, skin and bones left

- beetles that specialize in hair or skin now arrive to deposit their eggs



- e. after 3-6 months, the bones are finally bare and clean
- mice seeking calcium will now gnaw on the bones

f. decomposition is essential for continuing the circle of life

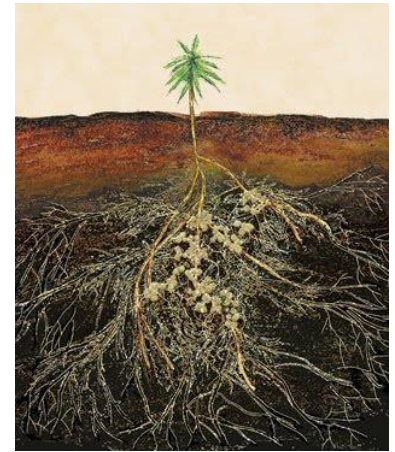


Mycorrhizal Relationships

- a. mycorrhizal fungi
 - elongate, tubular string-like cells called *hyphae*



- the mushroom is the reproductive body part



- hyphae form white filamentous mats called mycelium, which constitutes the actual body of the organism



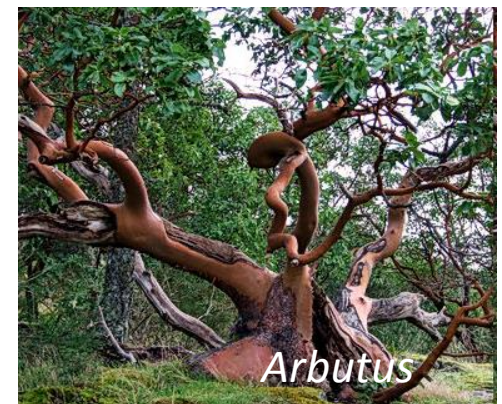
b. mycorrhizal fungi and trees share a symbiotic relationship

- hyphae wrap around or penetrate the roots of trees
- the tree and fungus then exchange products



- tree gives the fungus products of its photosynthesis (sugars)
- fungus gives the tree water and mineral nutrients like nitrogen and phosphorus
- the mushroom hyphae are far finer in diameter than tree roots and can thus extract more water and nutrients from the soil than the roots can

- this symbiosis is so successful that about 80% of species of trees worldwide use it



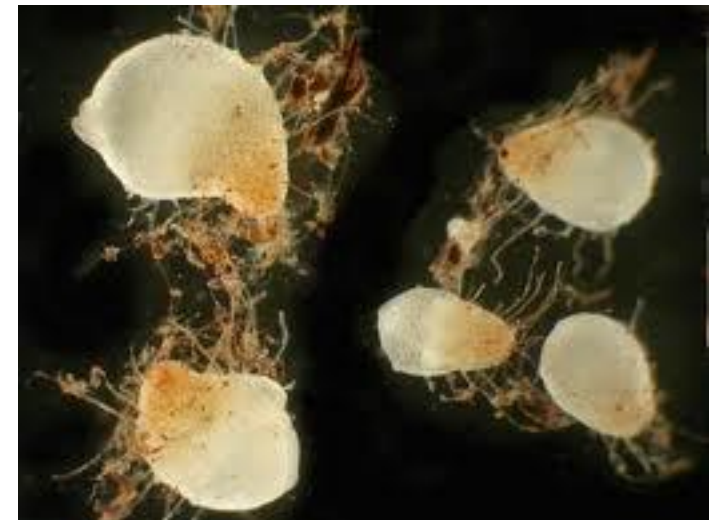
c. mycorrhizal fungi also have a symbiotic relationship with orchids

- orchids make the smallest seeds of any flowering plant, with each pod containing up to 25,000 seeds



- this extreme reduction in size could only have been achieved by leaving out the "essential" element of a seed: food for the embryo

- the fungus helps out by supplying food to the seedlings



Mining in California

- a. California's forays in mining did not end with the Gold Rush, but continue on till this very day
- ranked second in the U.S. non-fuel mineral production



- b. these industrial minerals form the backbone of modern society, yet at the same time, their harvesting imposes severe burdens on the environment

- c. even historic mines continue to have environmental impacts

- mercury used in gold mining during the Gold Rush continues to be a continual source of pollution and toxic conditions for fish, wildlife, and our drinking water.
- Iron Mountain Mine had uncontrolled acid drainage making it the largest source of surface water pollution in the US before it was shut down in 1963

