



Plants & People

How we all connect
together ...

Part 1

People & Plants

- Plants Help Humans!



People & Plants

- How do humans use plants?

We use plants for:

- Food
 - Fibre (building materials)
 - Medicines
-
- Plants are vital to our survival!

Plants & Ecosystems

- Plants filter our air
(Breathe in what we breathe out)
- Plants help filter our water
(Clean up dirty water..Recall Cattails)
- Plants help keep soil in place
(Roots hold earth together and prevent soil from eroding (blowing away))

Plants & Food

- Mind – blowing fact ...

75% of the world's food supply is based on seven major crops ...

- wheat - rice - corn - sorghum

- potatoes - barley - cassava

Plants & Fibre

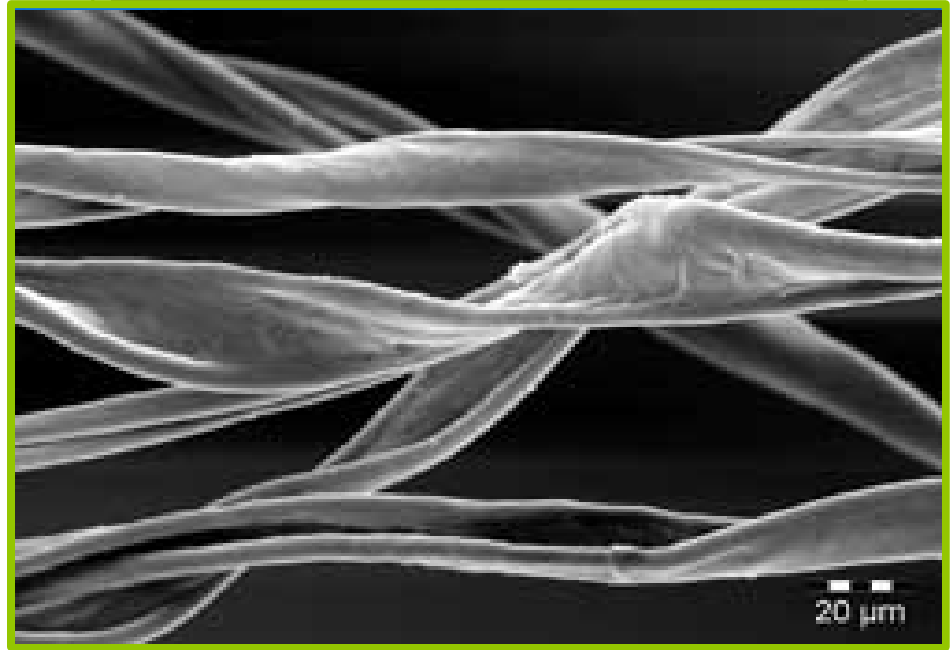
- While many things are manufactured ...
we still use 3 natural fibres!

- Cotton

- Flax

- Hemp

Cotton



- (Currently) The world's most important non-edible plant!
- Their structure (strong, flexible, gradual spiral) makes them extremely versatile!

Hemp

- Oldest cultivated plant in the world!



- Less negative effect than other fibres
- Hemp Factoids!
 - Hemp paper lasts longer than wood pulp paper
 - Ready for harvest in 1 year
 - First Bible printed on hemp paper
 - Nothing eats it so no pesticides required!

Flax

- Grows in northern, cooler regions
- Oil is squeezed out of it and used as a health supplement.
- Flax oil also used as an ingredient in wood polish.
- Fibres in stems is 2 to 3x stronger than cotton and used to make linen clothes and sheets.



Plants & Medicines

- Before over the counter medicine existed people used the plants around them
 - Ginger = upset stomach
 - Bark of white willow = pain killer
 - How Aspirin was developed
- Hundreds of examples exists like Morphine, Codeine, etc ...

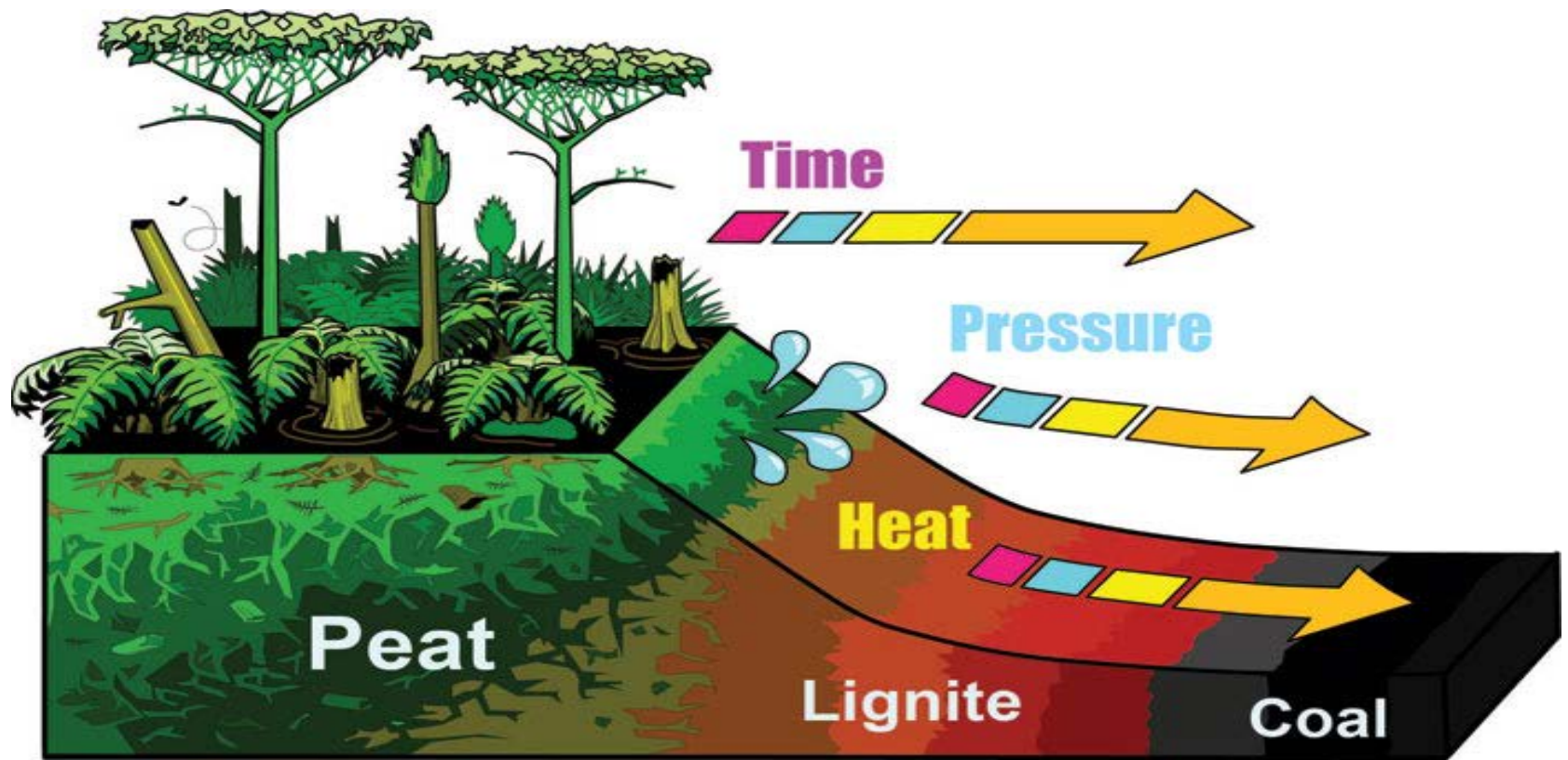


Plants & Transportation

- Rubber (latex) changed our world
- Comes from Brazilian Rubber Tree (Only source in the world)
- Synthetic exists but not as good



Plants & Fuel



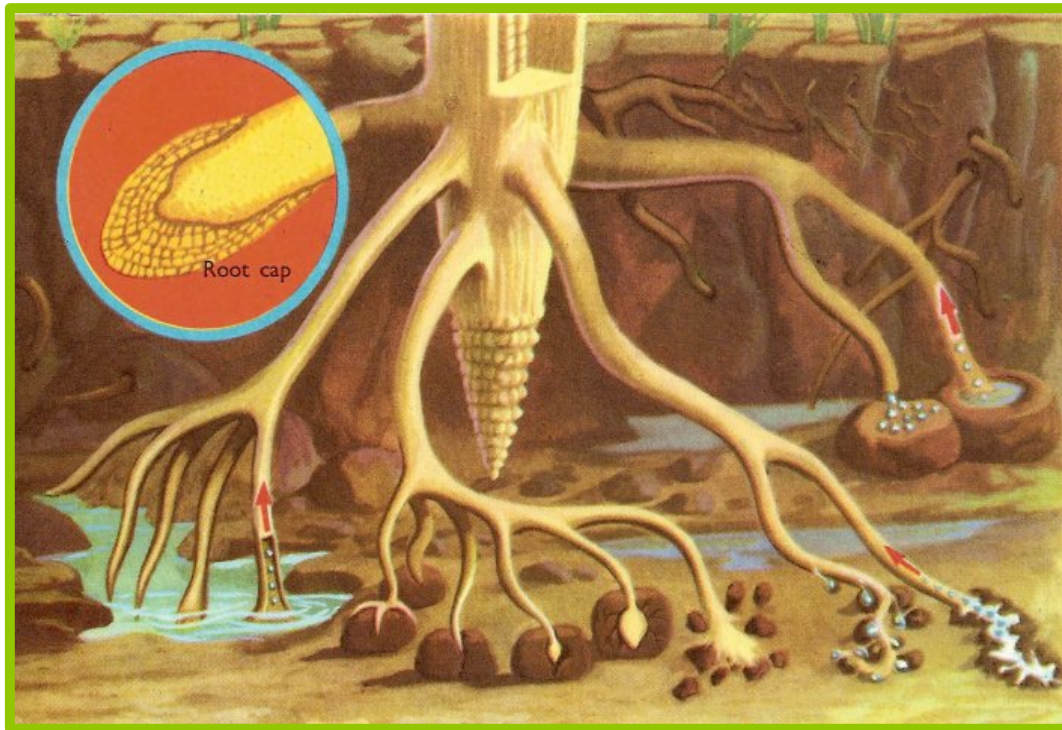
Part 2

Plant Anatomy



Roots

- Plants are like icebergs, they work like this ...



Roots

- What do they do?
 - Absorb minerals / water
 - Anchor / support plant
 - Store food

Root Crops

- You eat root vegetables you are eating a root!
- WHOA!

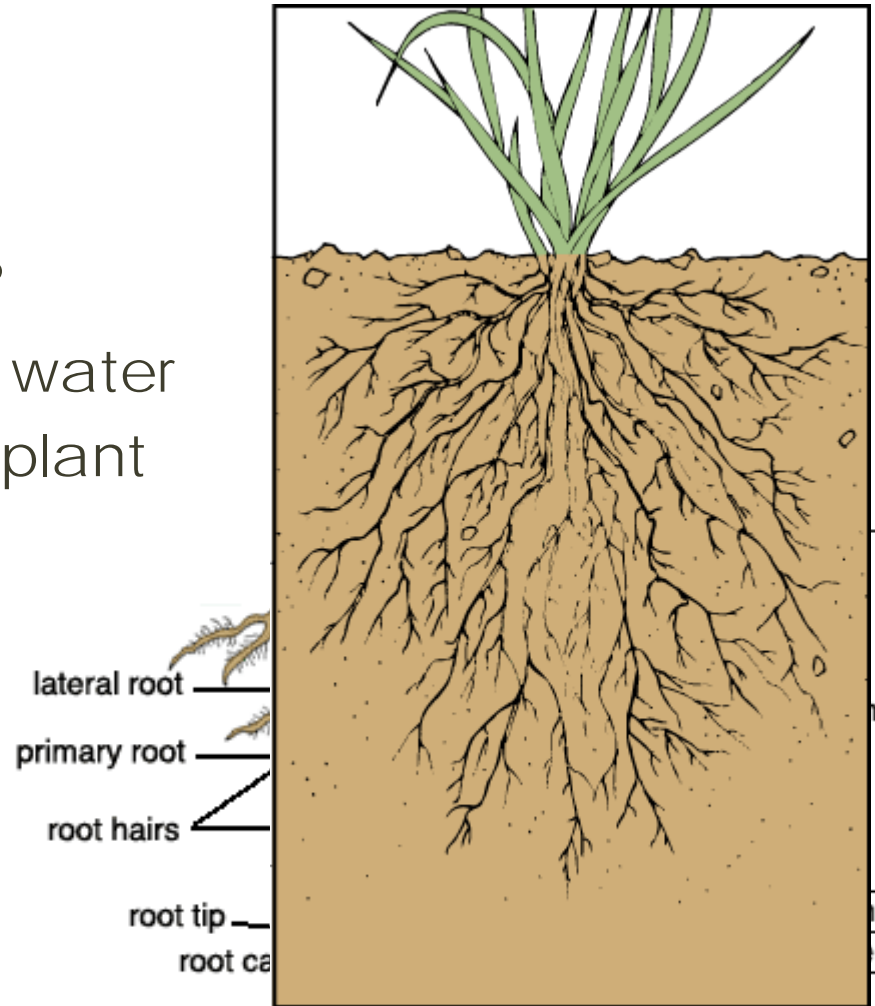
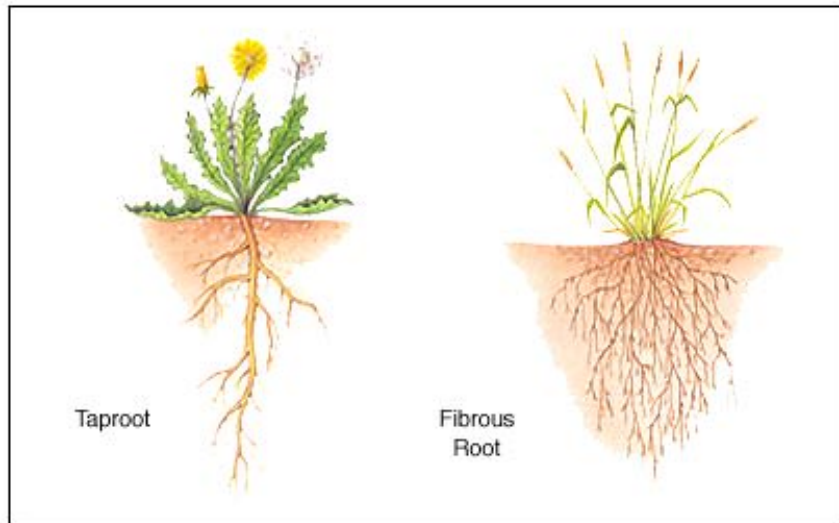



Figure 2. Root Structure

2 Types of Roots



Types of Root System



Looks like a tangled mass of roots

Examples of plants With this root system are

- Banana
- Coconut
- Rice
- Corn
- Sugar Cane

Fibrous root system www.sliderbase.com

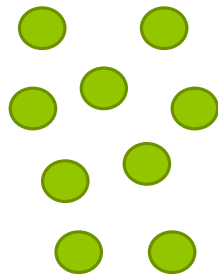
All Grasses

- Tap roots have 1 main root that goes down. The main root can grow branches. Tap roots can dig up to 75 ft into the soil to search for water & nutrients in times of drought. Very difficult to dig out of the soil.
- Fibrous roots branch out. They have so much surface area to absorb water and nutrients. They are very shallow and so are easy to rip out of the ground or get blown away during a storm or hurricane.

Roots

Diffusion & Osmosis

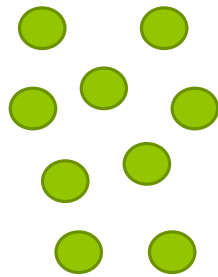
- Diffusion is key for plant roots
 - Moving and distributing evenly from areas of higher concentrations to lower concentration



Roots

Diffusion & Osmosis

- Diffusion is key for plant roots
 - Moving and distributing evenly from areas of higher concentrations to lower concentration



Roots

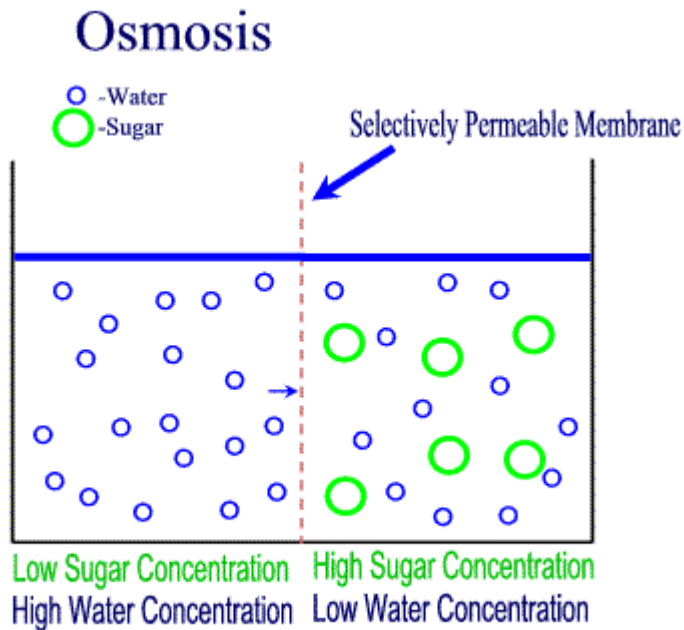
Osmosis

- Diffusion of water through a differentially permeable membrane
 - (Like a mesh bag with sand and marbles ... the sand can go through but not the marbles)
- Cells in roots are selectively permeable.
 - (Allow some things such as water & nutrients and hold the rest out)

Roots

Osmosis

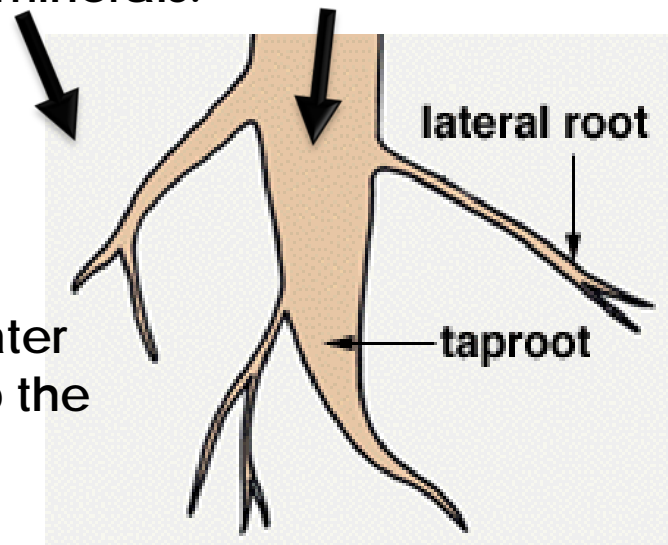
- In osmosis, water always moves to the side that is more packed with salt, minerals or sugar.



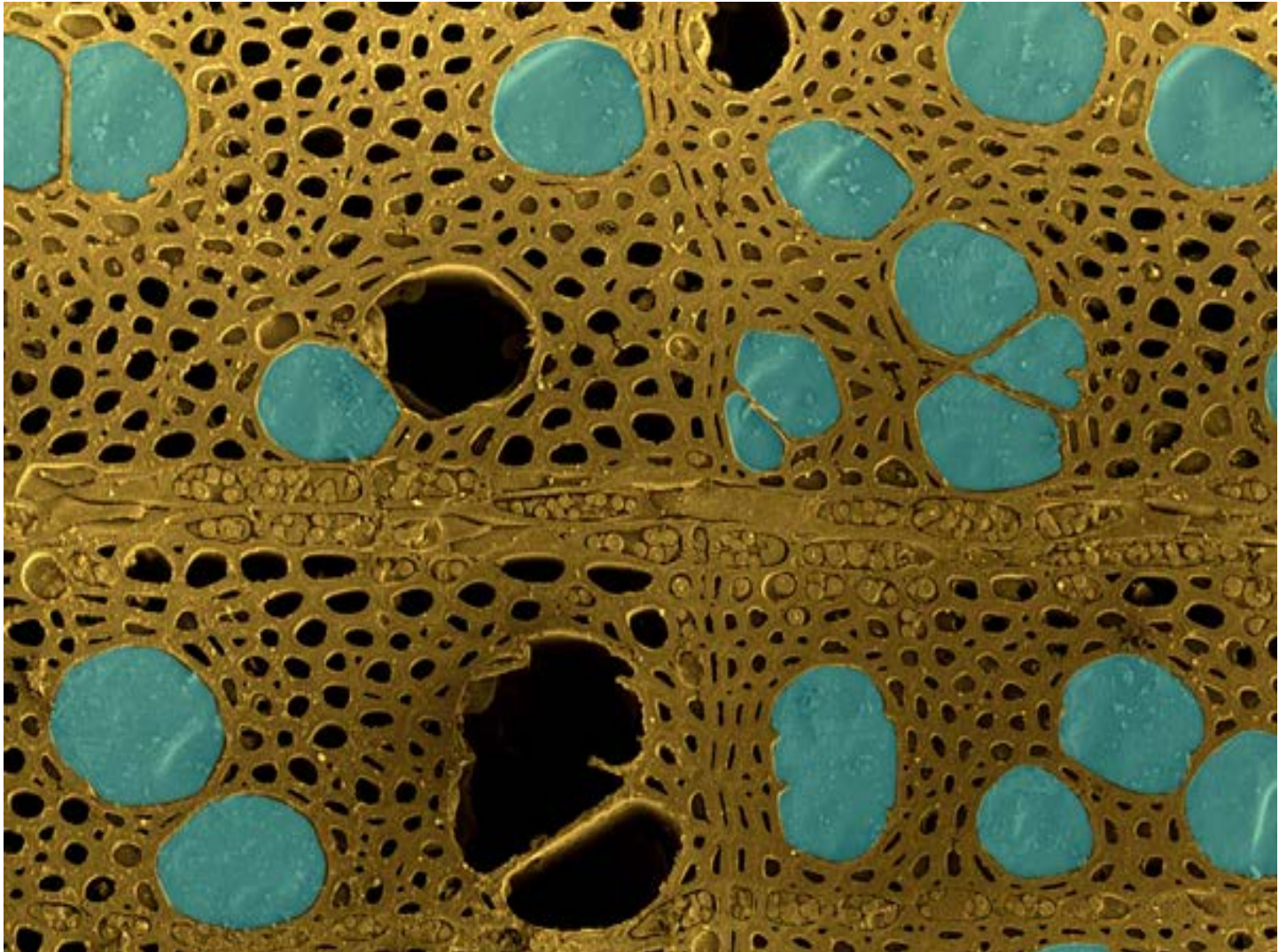
2. Soil not as crowded with salts, sugars and minerals.

1. Very Crowded with salts, sugars, and minerals

3. So water goes into the root.

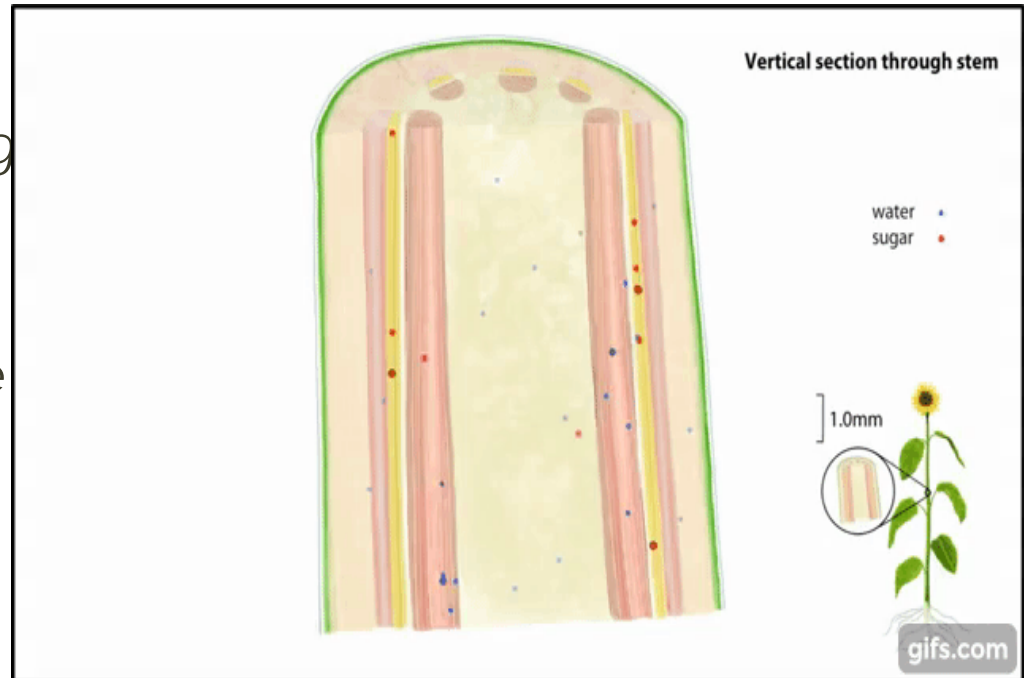
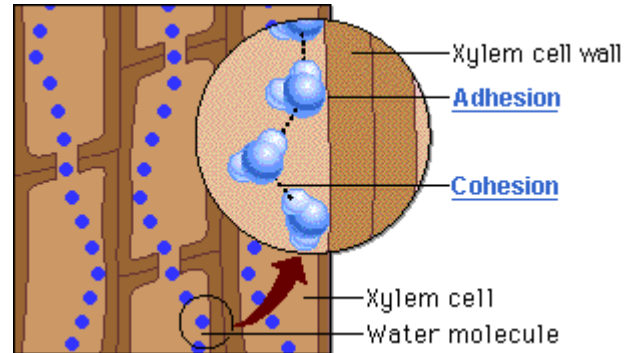


Roots



Stems

- Support the plant.
- Xylem: internal piping system that transports water from the roots to the leaves.
- Phloem: internal piping system that takes the sugar (food) that is made in the leaves and transports it to the rest of the plant to feed it. It is like a pathway for the chef to deliver food.*



Stems Cont ...



Stems Cont ...



- Food Storage
 - They store food produced by the leaves. How does the food get from the leaves to the stem?
- Underground vegetables (i.e.: potato) have *tubers* which are underground stems. Tubers store food in the form of a plant sugar called starch for the potatoes to use to get energy to grow.
- *Factoid!*
 - The barrel cactus does this so well it can last a year without water

Leaves

- The Kitchen of the plant.
- The leaves make food (sugar)..yummy.
- Leaves are green due to a chemical called chlorophyll.
- Leaves use the sun to make food turning the light into chemical energy (sugar)...yummy.
- But how...?
- They need 2 ingredients
 - Water
 - Carbon Dioxide



Leaves

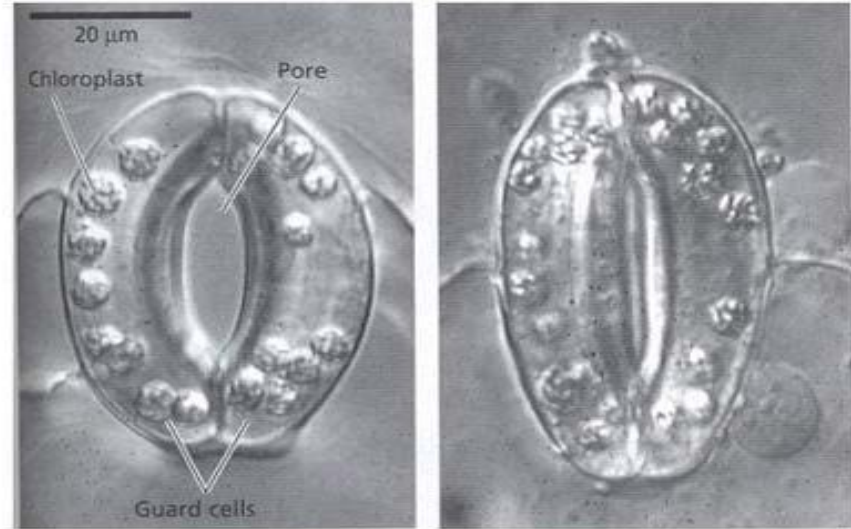
- Water + Carbon Dioxide = Sugar
- This is the plants energy storing chemical.
- The process is known as photosynthesis!

[Video Explanation!](#)

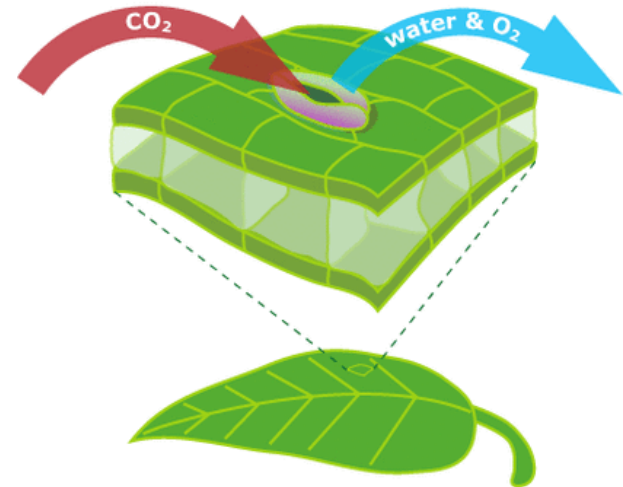
Leaves

Stoma/Stomata

- The windows of the leaves.
- This is where breathing (Gas exchange) occurs.
- Found on the underside of all leaves.
- Open during day
- Close at night.
- Carbon Dioxide enters through stomata and goes into chloroplasts
- Reaction occurs that produces sugar and oxygen

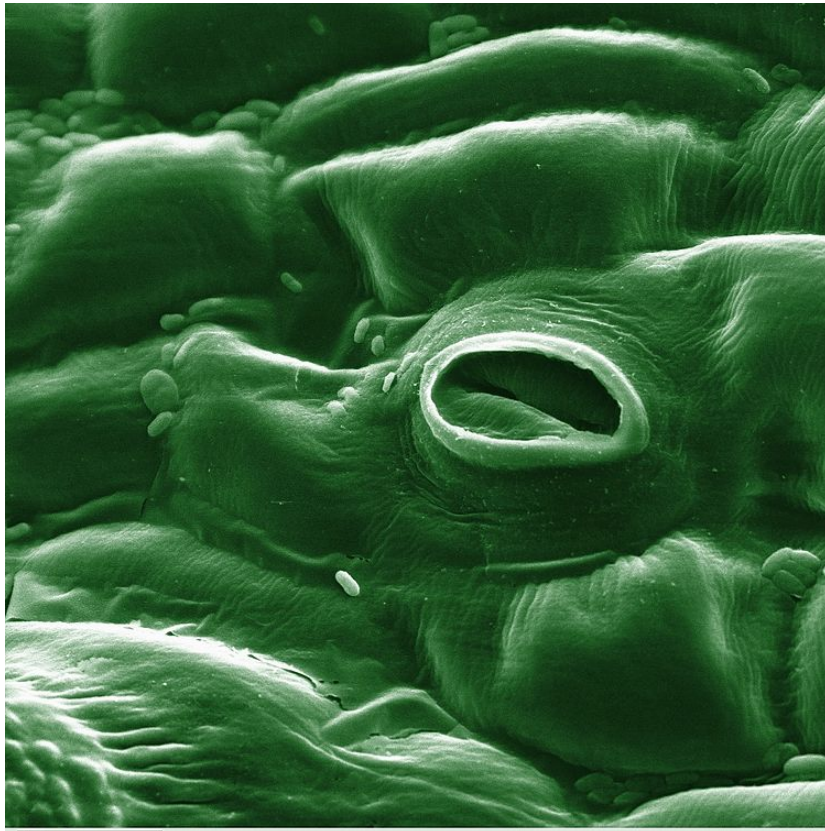


Carbon dioxide enters, while water and oxygen exit, through a leaf's stomata.



Leaves

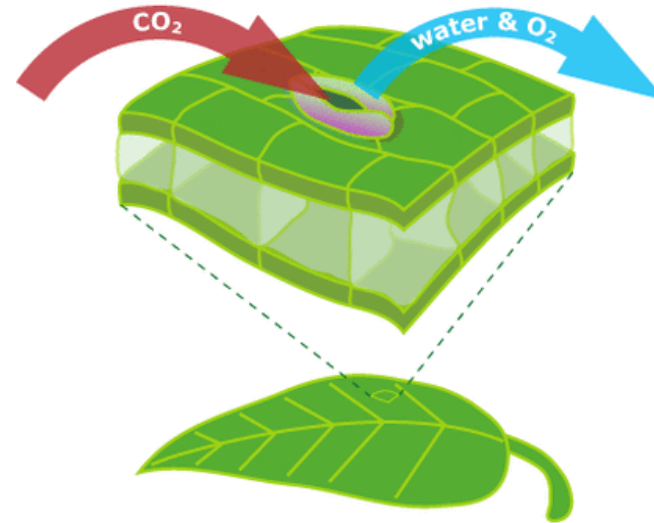
Actual Stomata Image



Based on what you know about stomata, was this picture taken during the day or was it taken during the night?

Leaves

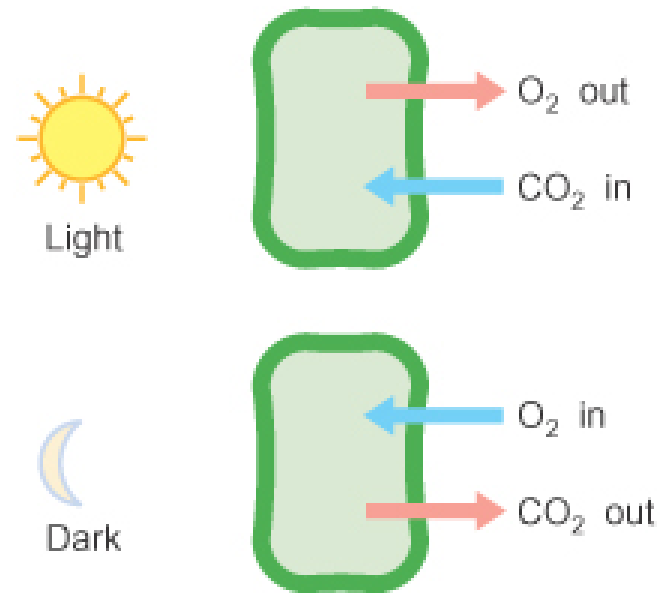
Carbon dioxide enters, while water and oxygen exit, through a leaf's stomata.



- For Every Molecule of CO₂ that enters a plant, **hundreds** of molecules of water exit the plant and evaporate into the air.
- This can be **good** and **bad**.
- We shall revisit this point later.

Leaves

- The sugar feeds the plant
- The oxygen is produced and exhaled from Stomata.
- Plant need oxygen too!
 - At night, when no sunlight is around, plants breath in Oxygen and release CO₂ into the air.
 - This is called Cellular Respiration.



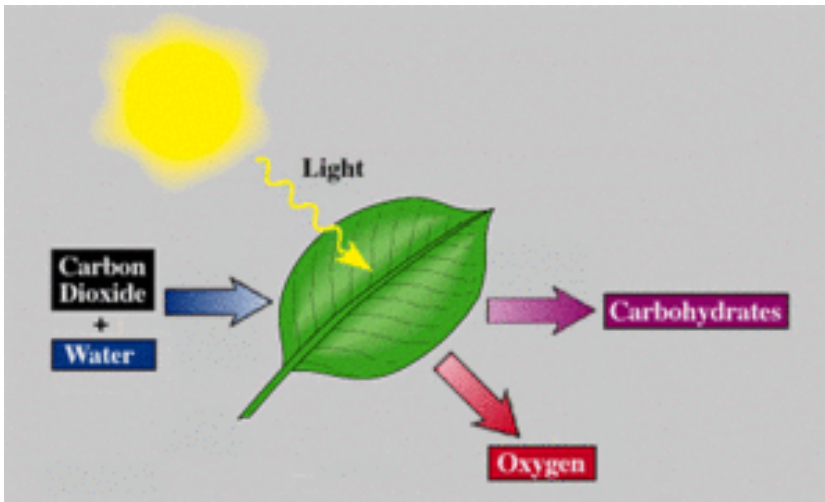
You might be wondering how gas exchange occurs at night when stomata are closed. Ans: Stomata do Not completely close. Leaks are still present.

Leaves

In Summary

Photosynthesis

(makes Sugar (carbohydrates))



Respiration

(Converts Sugar Into Energy)
It is Reverse Photosynthesis

Carbohydrates + Oxygen
Produces Water, CO₂ and
Energy

The Water and CO₂ that is produced is pumped out of the plant through the stomata.

Leaves

Open Stomata Create a Potential Problem in Dry Conditions

- A plant's gotta breathe.... yes indeed. However, something else that is super precious is exiting the plant when Stomata are open to allow for breathing. What is it?
- Water!
- Water leaving the plant is called transpiration.
- If the soil is wet, the plant will easily replace this water.
- What if the soil is dry though?
- If the soil is dry, plants will CLOSE their stomata during the daytime to trap water inside.

Leaves

- You may think that is an excellent security measure. And you would be correct, but it does come with a sacrifice.
- If stomata close, gas exchange stops/slows down.
- This means that the plant can't photosynthesize (make sugar)...nor can it use its own sugar for fuel (respiration)
- It is a sacrifice a plant needs to make to trap water so it can survive in a period of drought.
- That is why its important to keep your plants well watered on a hot day when transpiration will be super high.
- That way, water that exits the stomata can easily be replaced with new water from the soil.

Part 3

How Does Water Rise Up a Plant?



How Does Water Get All The Way Up There?



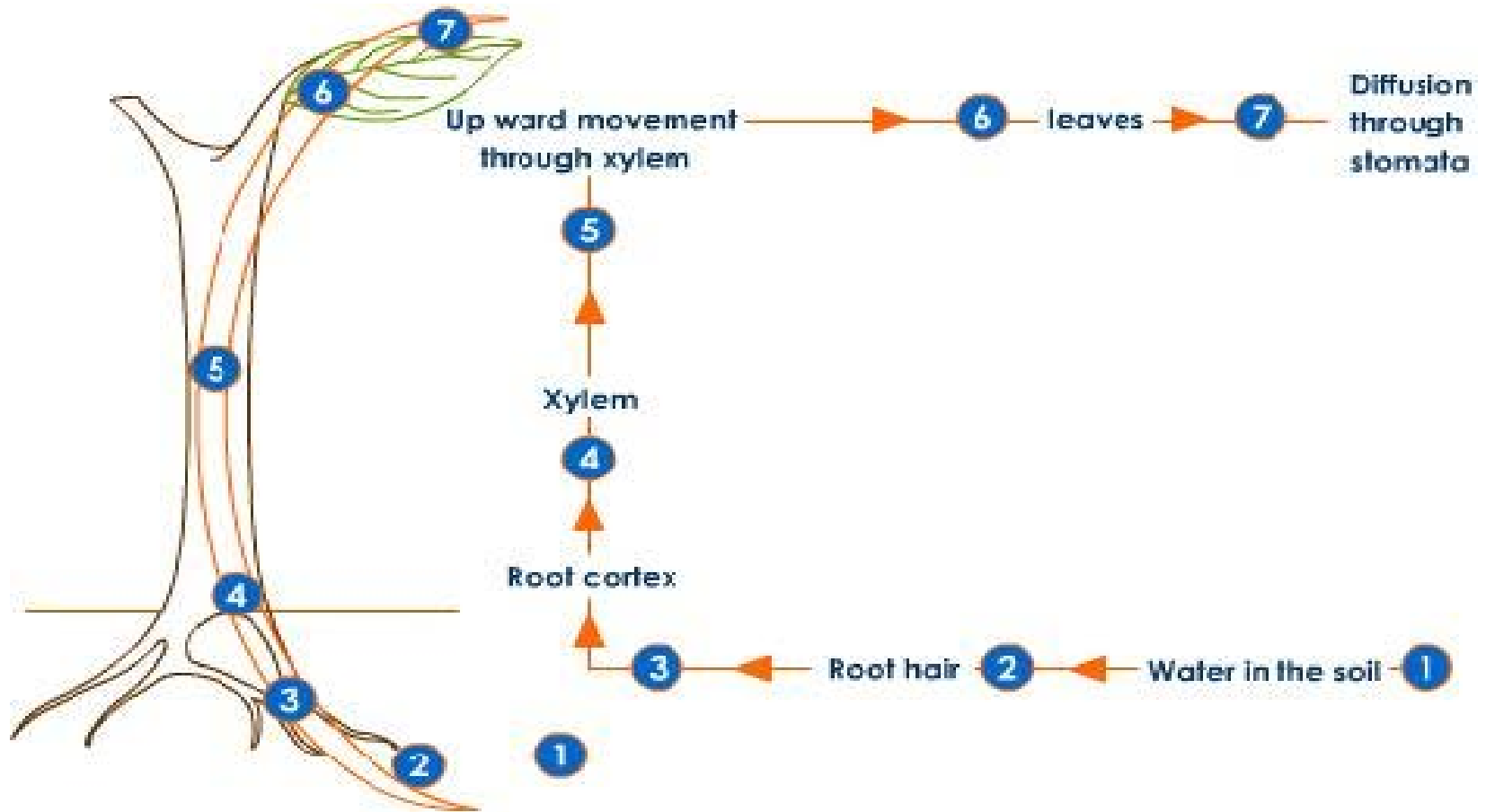
Some trees, such as these California Redwoods, grow up to 100 meters tall!!!!

How does water get to the top of a plant?

- Ready for the answer?
- Transpiration!!!!
- When water exits from the leaf, it pulls on all the other water molecules below it.
- **How?**
- Remember, water sticks together. Recall the particle theory...molecules are attracted to each other.
- So When One Moves up, the others follow.

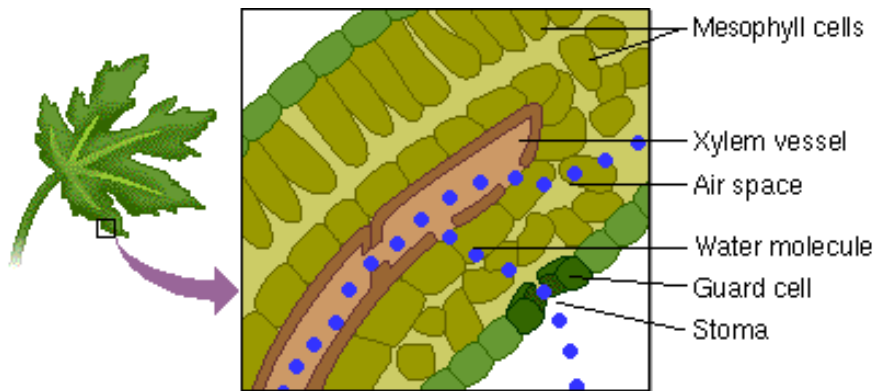
How water Moves Up a Plant

[Simple Video](#)



How Water Moves Up A Plant

(Watch in full screen to see Animations)



When water exits a leaf, it tugs on the water behind it which pulls on all of the other water molecules behind them in a chain reaction.

These guys get pulled by the men on the other side. This is similar to how water molecules that exit the leaf tug on all of the other water molecules behind them.

This is called Transpiration Pull

WHY Do Plants Allow Water To Transpire (Evaporate) and Leave?

- Wouldn't it be better to have the plant keep all of its water? Why does it allow it to escape...and even encourages it to leave by opening its stomata nice and big?
- Stop and think about this:
- the main reason plants allow water to evaporate and leave is so that new water gets pulled up. Otherwise it would have no way of sucking water up.
- #Mindblown

So Why does a plant suck up so much water into its leaves?

- Call it out !!!
- Did you say for photosynthesis?
- Wrong!
- Only 1% of the water in the leaves is used for photosynthesis.
- What's the point of having the other 99%? Why so much extra water?
- Review the previous slides for your answer.

Part 4

Plant Nutrition



Healthy Plants

Healthy plants require six nutrients

- 1) Nitrogen
- 2) Phosphorus
- 3) Potassium
- 4) Sulfur
- 5) Calcium
- 6) Magnesium

**Large Amounts
(Primary Nutrients)**

**Smaller Amounts
(Secondary Nutrients)**

Nitrogen

- Major ingredient needed to make chlorophyll.
- What color is chlorophyll?
- Why is chlorophyll important for a plant?
- What would a plant lacking nitrogen look like?



Phosphorus

- Animal Manure and Bones are rich in phosphorus.
- Phosphorus also helps a plant create new tissue so that it grows larger.
- No Phosphorus means no growth.
- Helps flowers grow large and bloom brighter.



Phosphorus—Environmental Hazard

- Phosphorus causes flowers to bloom and grow faster.
- If Phosphorus leaks into lakes and rivers, it can cause Algae to bloom and grow over the water.
- This is awful because it clogs up the rivers and lakes and suffocates all life in the water.



Potassium

- Helps a plant open and close its stomata.

Why is this important? In periods of drought, stomata need to be closed to avoid further water loss.

- Plants that absorb enough potassium can open and close their stomata easily.
- Plants lacking potassium cannot do this very well and dry up and wilt easily.
- Potassium works with Phosphorus to help a plant grow to full size.
- Potassium also helps protect plants from disease.

Potassium

- Potash is a great source of potassium for plants.
- Potash is a Potassium Salt.
- Canada (Saskatchewan) is the largest miner of potash.



Potash

Cool Fact

Pot = Potassium

Magnesium

- Magnesium is the central atom in chlorophyll.
- Why is chlorophyll important?
- Without enough magnesium, plants start to look yellow.

Importance of Magnesium in the Planta



Remember how Nitrogen was also needed to make chlorophyll?

Can you find the Nitrogen?

Sulfur

- Importance often neglected by people.
- Sulfur helps Nitrogen work.
- What did Nitrogen do again???
- How would you know if a plant did not receive enough sulfur?
- Also helps protect the plant against disease.

Sources of Magnesium and Sulfur

- Found naturally in soil, but if soil is deficient, you can supplement the soil with Epsom Salt.
- Do not confuse Epsom Salt with Table Salt.
- Epsom Salt is Magnesium Sulfate so it has both Magnesium and Sulfur.



Calcium

- In Humans calcium strengthens our bones.
- In plants, calcium strengthens plant tissue.
- Calcium also prevents fruits from rotting.
- Calcium deficiency causes fruits to rot on the bottom.

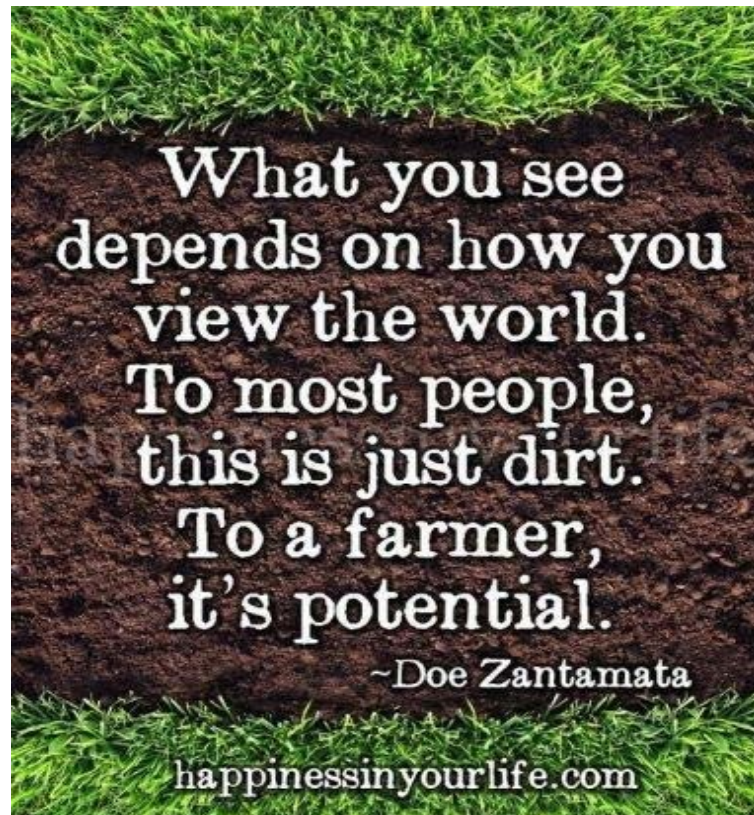


Lime Juice and Chalk dust are great sources of calcium for plants.

Calcium moves very slowly up a plant so apply early in a plants life.

Part 5

Healthy Soil



The Soil

What is Soil?

- Soil = Broken down rocks + dead and decomposed plant and animal matter.
- Soil contains many of the nutrients that we have discussed.
- Air pockets are necessary in soil to allow soil creatures and plant roots to breath.
- Overwatering soil will remove the air pockets and suffocate the living things (including plant roots) that are buried in the soil.
- Be sure to fluff out your soil to allow air to go in. Or let earthworms do it for you.

The Soil

- **Humus:** A dark soil rich in nutrients and holds water well.
- Healthy soil needs decomposers to break down dead organisms so that plants can use the nutrients. There are 4 key types of decomposers:



- 1) **Bacteria** – actively break down dead material
- 2) **Fungi** – make nutrients available to plants
- 3) **Microscopic actinomycetes** - special kind of bacteria that help to create humus
- 4) **Earthworms** – Grind, digest and mix soil. Their poop adds phosphorus to the soil.

Soil Problems

- Problem 1: Salty Soil
- **The Situation:** If there are too much salt and minerals in the soil, water **will not** enter plant roots. The plant dies of thirst.

Why? Remember how osmosis works? Water only goes to the area that is more crowded with salts and minerals.

How does salty soil occurs?

- Overwatering your soil or not having enough plants.
- Water naturally has salts and minerals in it. When you water your plant, the roots suck up some of those salts and minerals. If too much water is present, the plant will refuse to soak up the extra salts.
- Salt builds up in soil.
- Plant is not able to absorb water.

Prevention

Do not overwater your soil. Also, be sure to have enough plants present to absorb the salts present in the water so that the salt doesn't build up.

Soil Problems

Problem 2: Erosion

- Erosion is when water and wind blow/wash away the soil.

The Cause: Too much wind entering the area and not enough plants holding the soil down.

Solution1: Plant Shelter Belts to block the wind.

What is a shelter belt? Shelter belts is a wall of trees. It helps block the wind.

Solution2: Grow enough plants so their roots hold the soil. In the fall, do not remove the dead plants because that will expose your soil to air and water causing it to wash away.

Shelterbelt-protects soil from wind



Soil Problems

Problem 3: Poor Soil Drainage

What is Soil Drainage?

- Soil drainage is how well water soaks into the soil.
- Healthy Soil allows water to soak in nicely, evenly coating the soil with water.

The Problem: Soil that has too much clay and sand will reduce drainage. The water puddles up.

The Solution: Add lots of compost and manure (poop).



Does your back yard look like this
after it rains?

Then You've got poor soil
drainage!

Earthworms Are Essential For Good Soil Health

Watch Video Below

If You Have No Earthworms, Or Very Few, **Attracting Them To Your Garden Can Allow You To Take Advantage Of All Of Their Benefits**



2:08 / 3:43

CC HD

Hydroponic Technology

- Growing plants without dirt!
- **Hydroponics** is a subset of hydroculture and is a method of growing plants using mineral nutrient solutions, in water, without soil.
- Seems good but any cons?
- High energy cost!!
- High initial start up cost!

