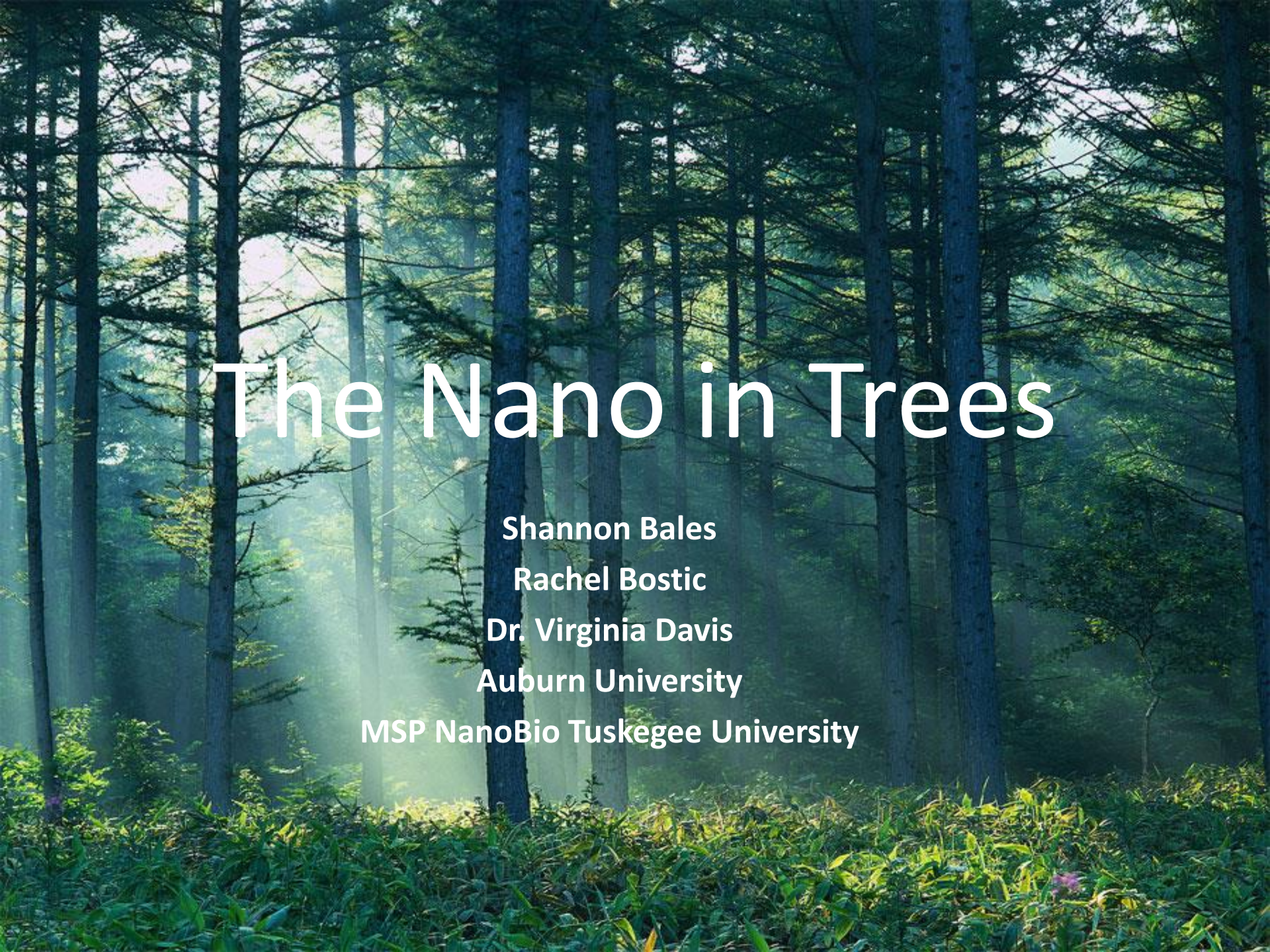


The Nano in Trees

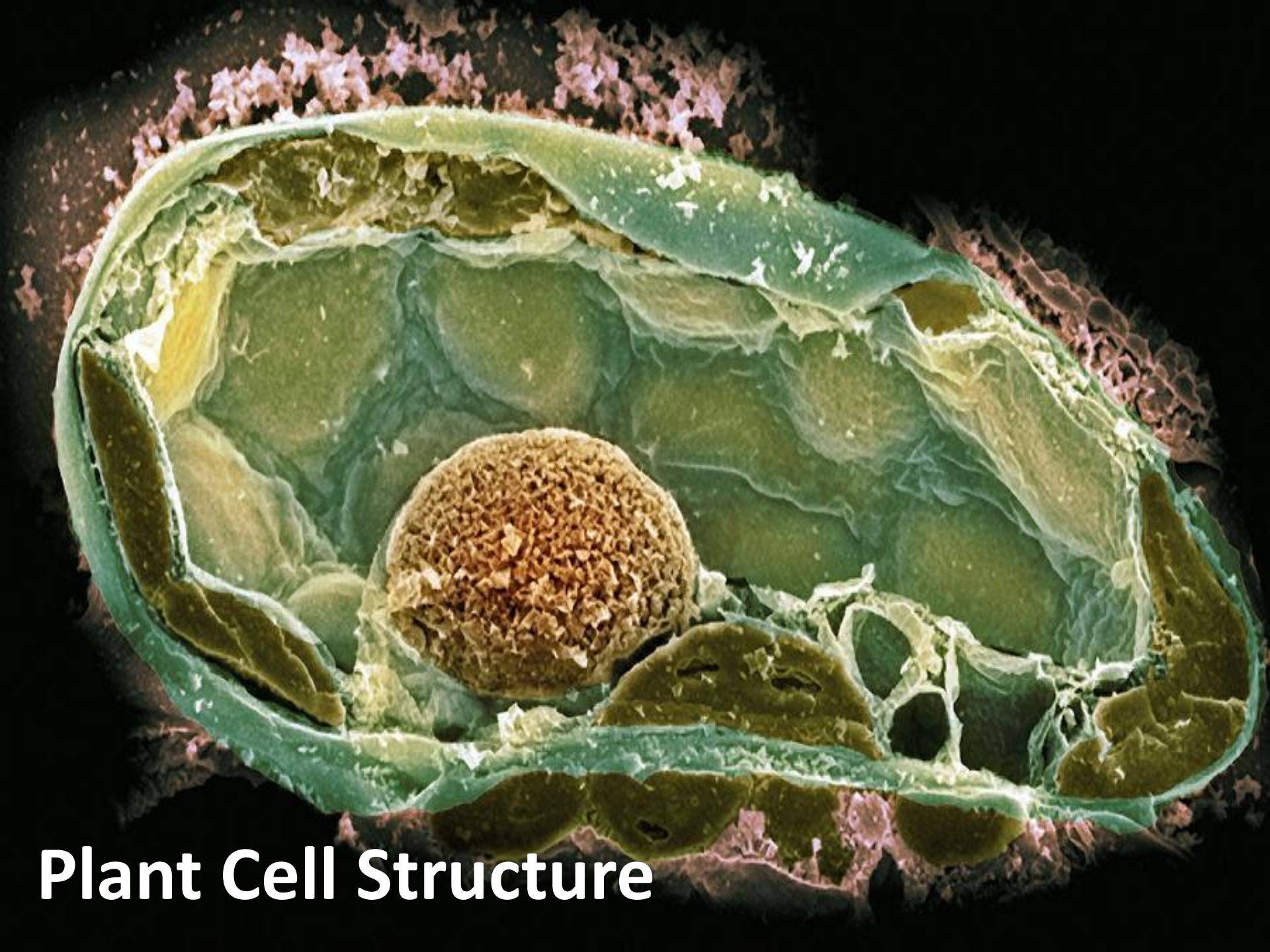
Shannon Bales

Rachel Bostic

Dr. Virginia Davis

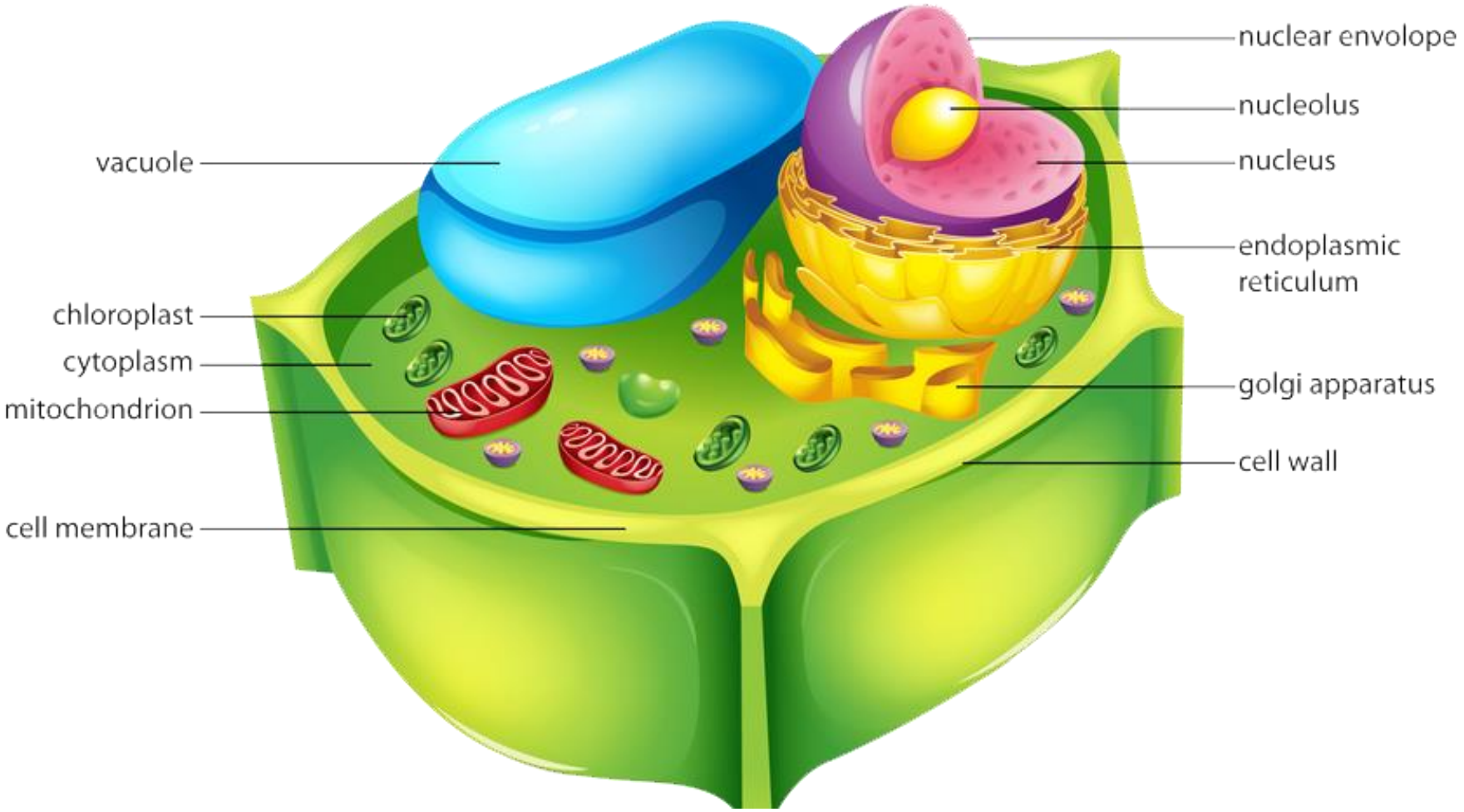
Auburn University

MSP NanoBio Tuskegee University

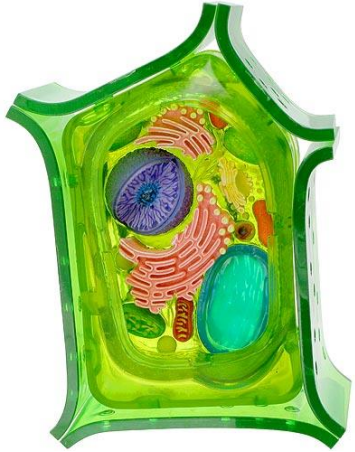


Plant Cell Structure

Plant Cell

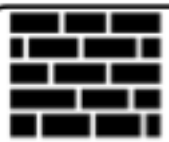

nuclear envolope
nucleolus
nucleus
endoplasmic reticulum
golgi apparatus
cell wall
vacuole
chloroplast
cytoplasm
mitochondrion
cell membrane

Parts of the Plant Cell



Cell Wall:

Ridged outer layer of a plant cell

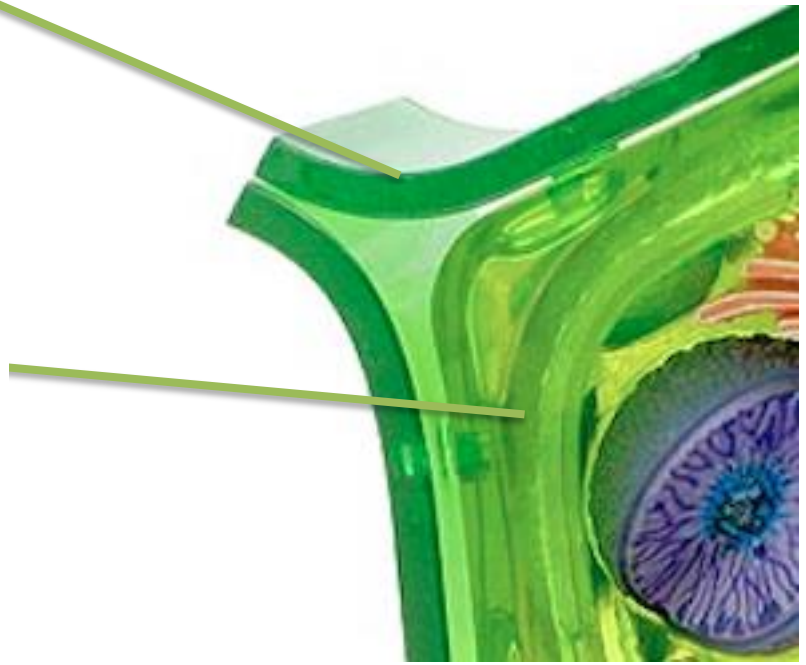


I'm a brick wall.

Cell Membrane:

Controls what comes into and out of a cell; found in plant and animal cells

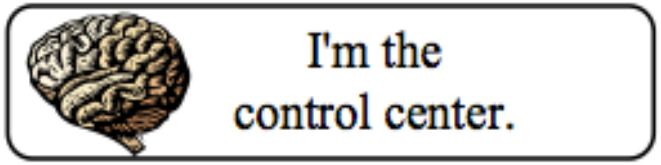
Members only can come and go.

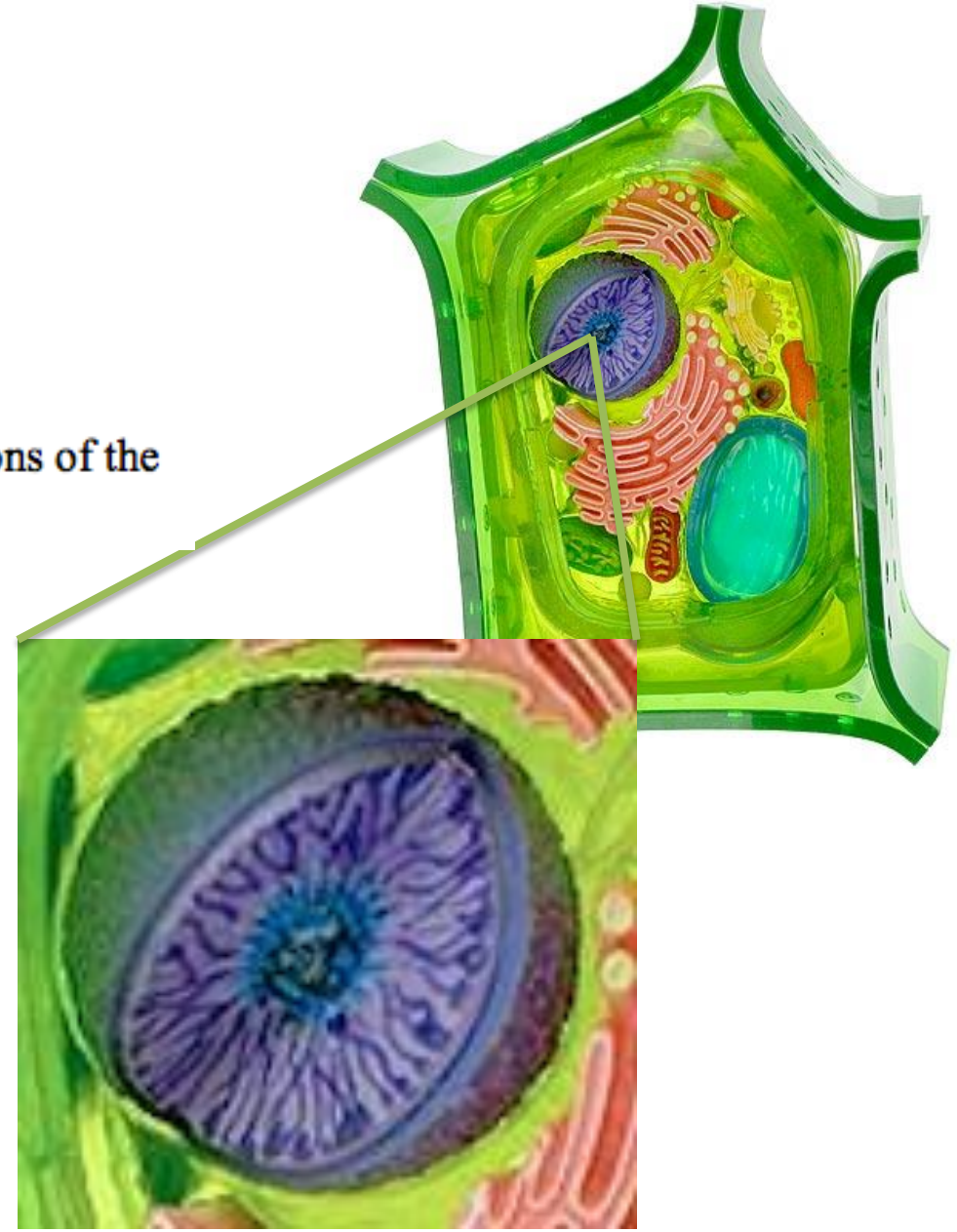


Parts of the Plant Cell

Nucleus:

Contains DNA, which controls the functions of the cell and production of proteins

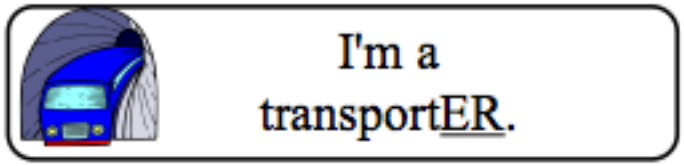




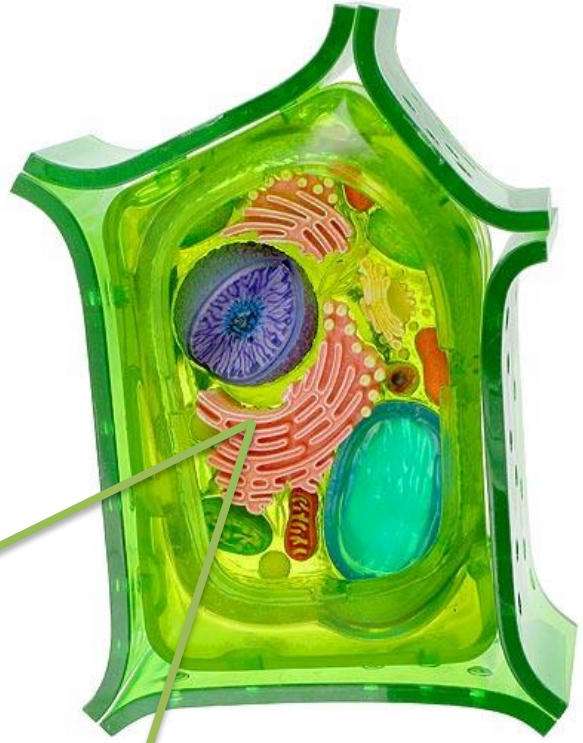
Parts of the Plant Cell

Endoplasmic Reticulum:

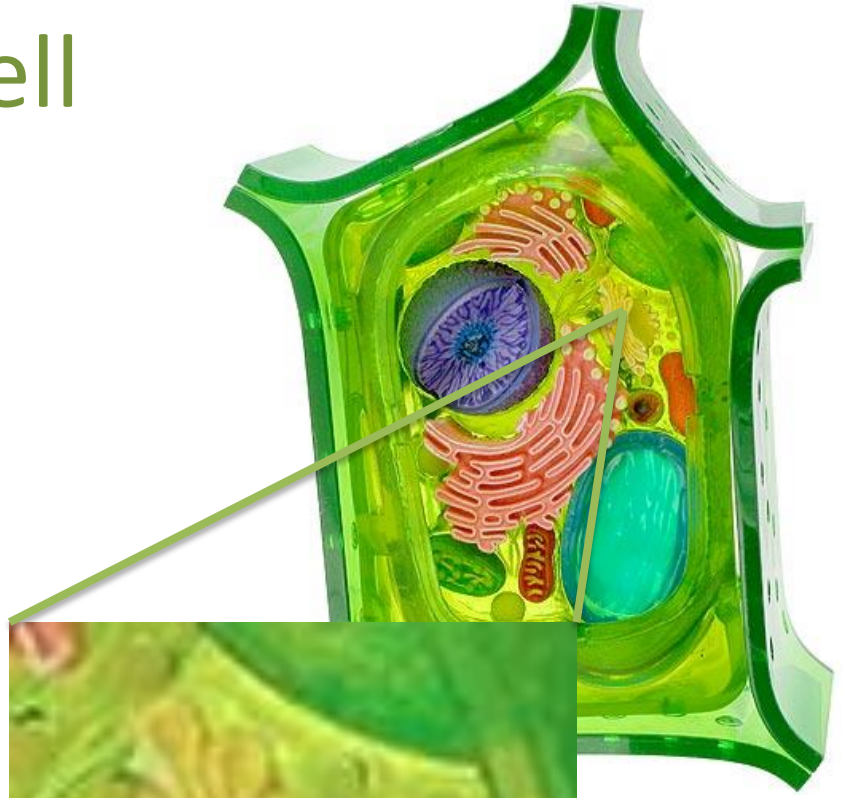
Has passageways that carry proteins and other materials from one part of the cell to another



Rough ER: with ribosomes
Smooth ER: without ribosomes

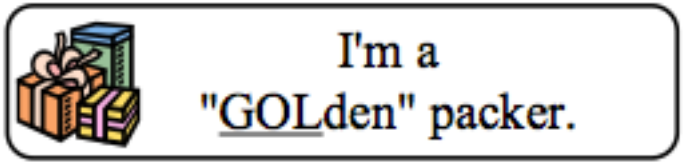


Parts of the Plant Cell



Golgi Bodies:

Receives proteins & materials from the ER, packages them, & distributes them

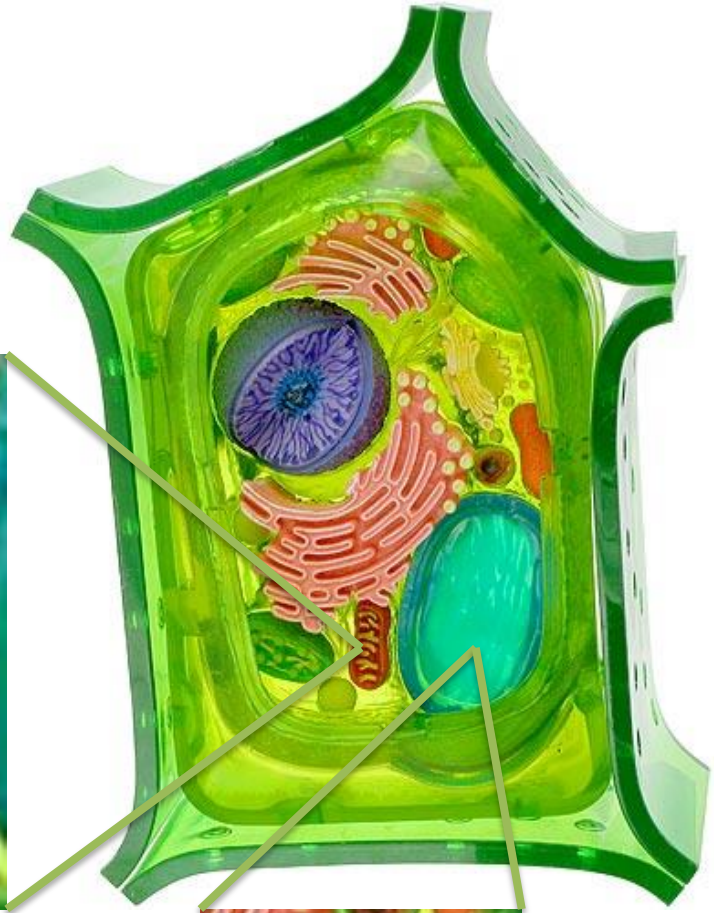


Parts of the Plant

Mitochondria:

Produces the energy a cell needs to carry out its functions

I am a "mighty" power house.



Vacuole:

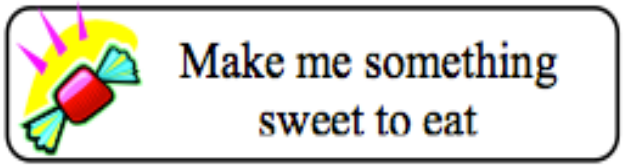
Stores food, water, wastes, and other materials

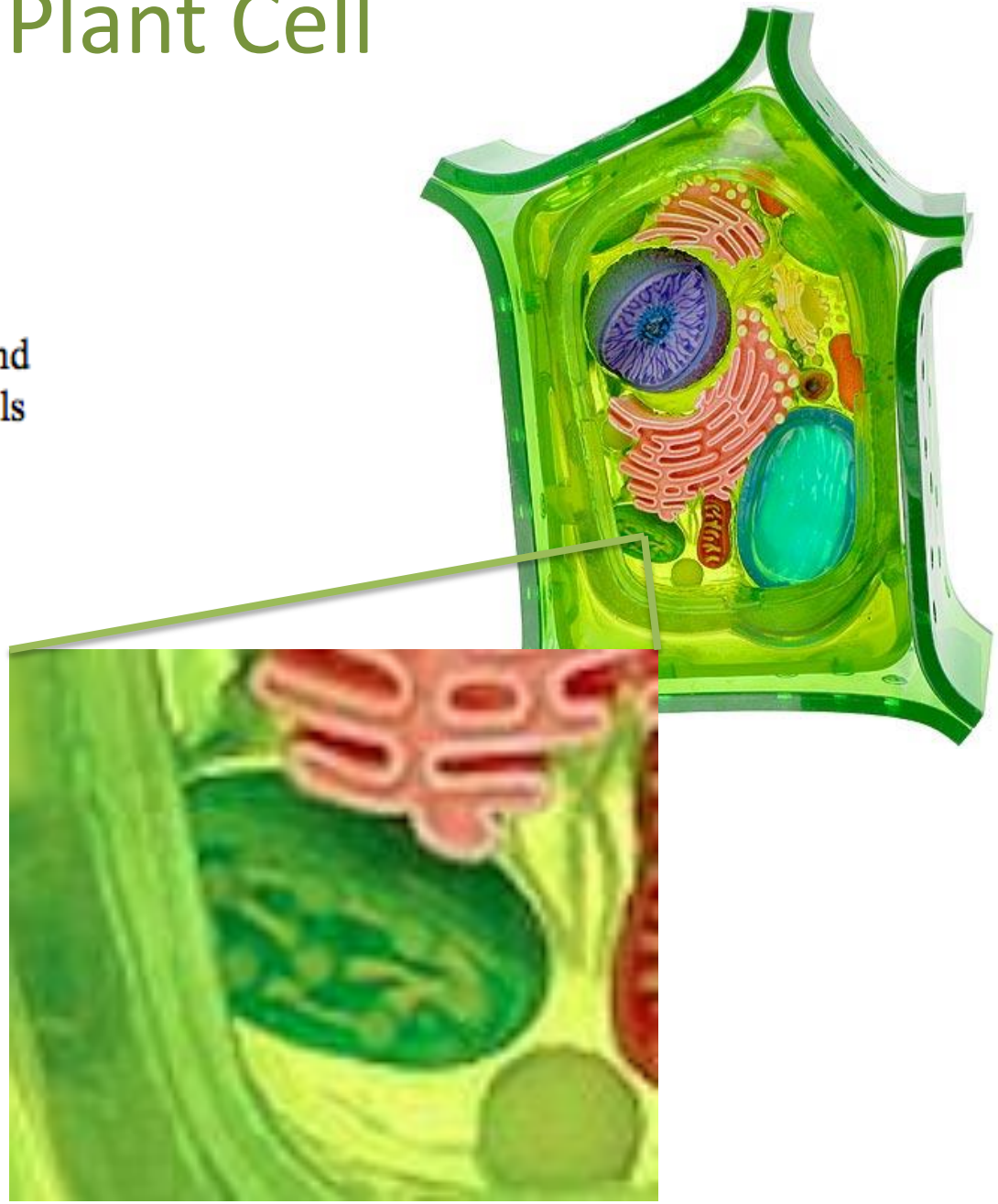
I'll store anything, (Hint: Vacuum Bags)

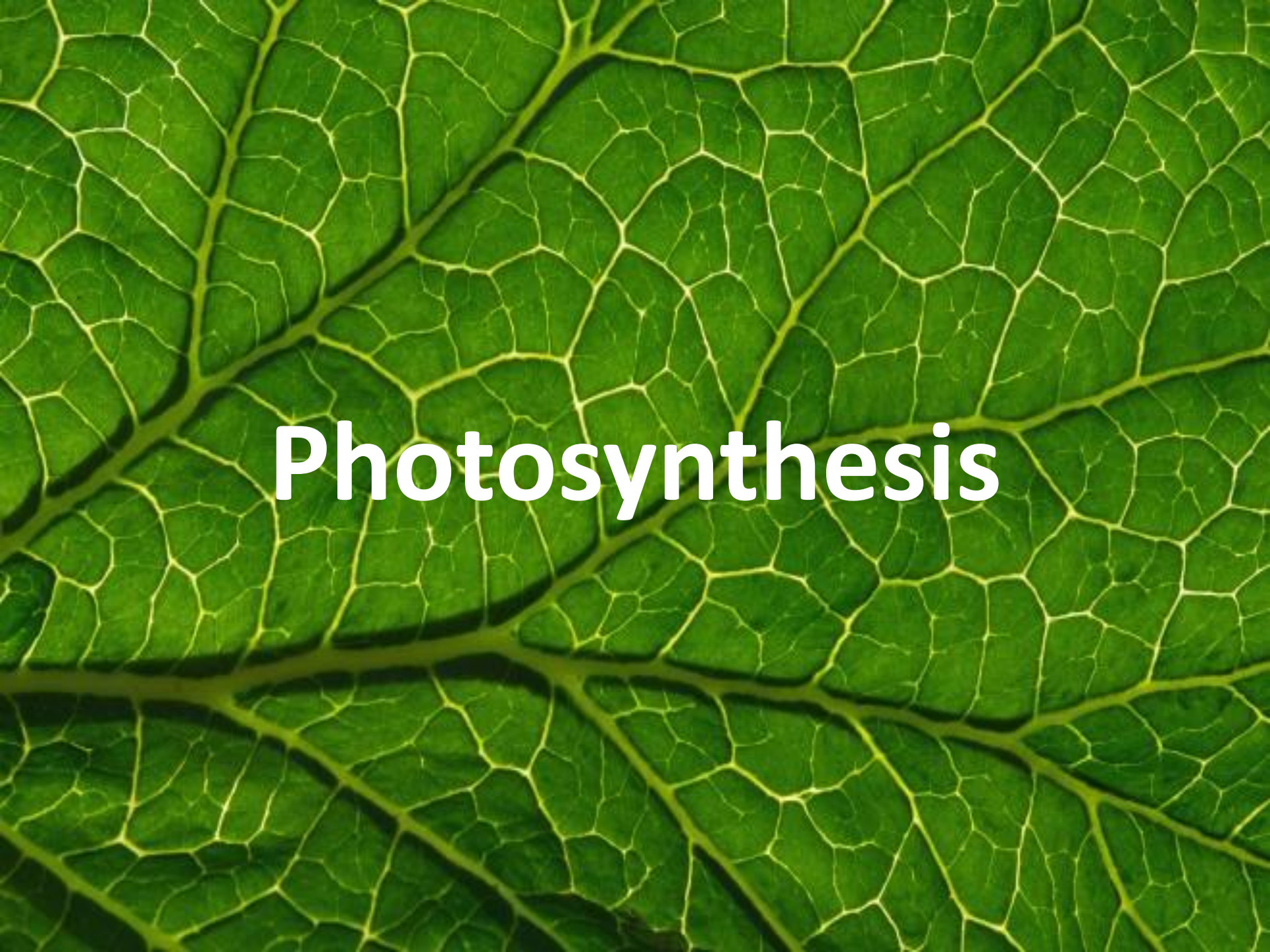
Parts of the Plant Cell

Chloroplasts-

Captures energy from the sunlight and uses it to produce food in a plant cells






Photosynthesis

How and Why do Plants Make Food?

"Photo"= light

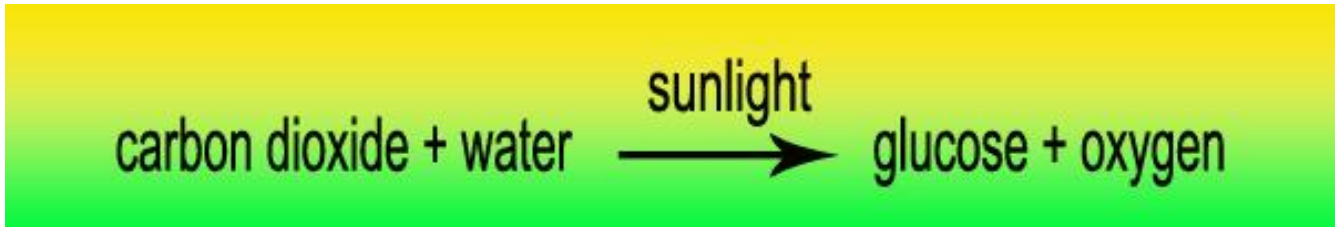
"Synthesis"= putting together

Plants need food but they do not have to wait on people or animals to provide for them. Most plants are able to make their own food whenever they need it. This is done using light and the process is called **photosynthesis**.

How do plants do this?

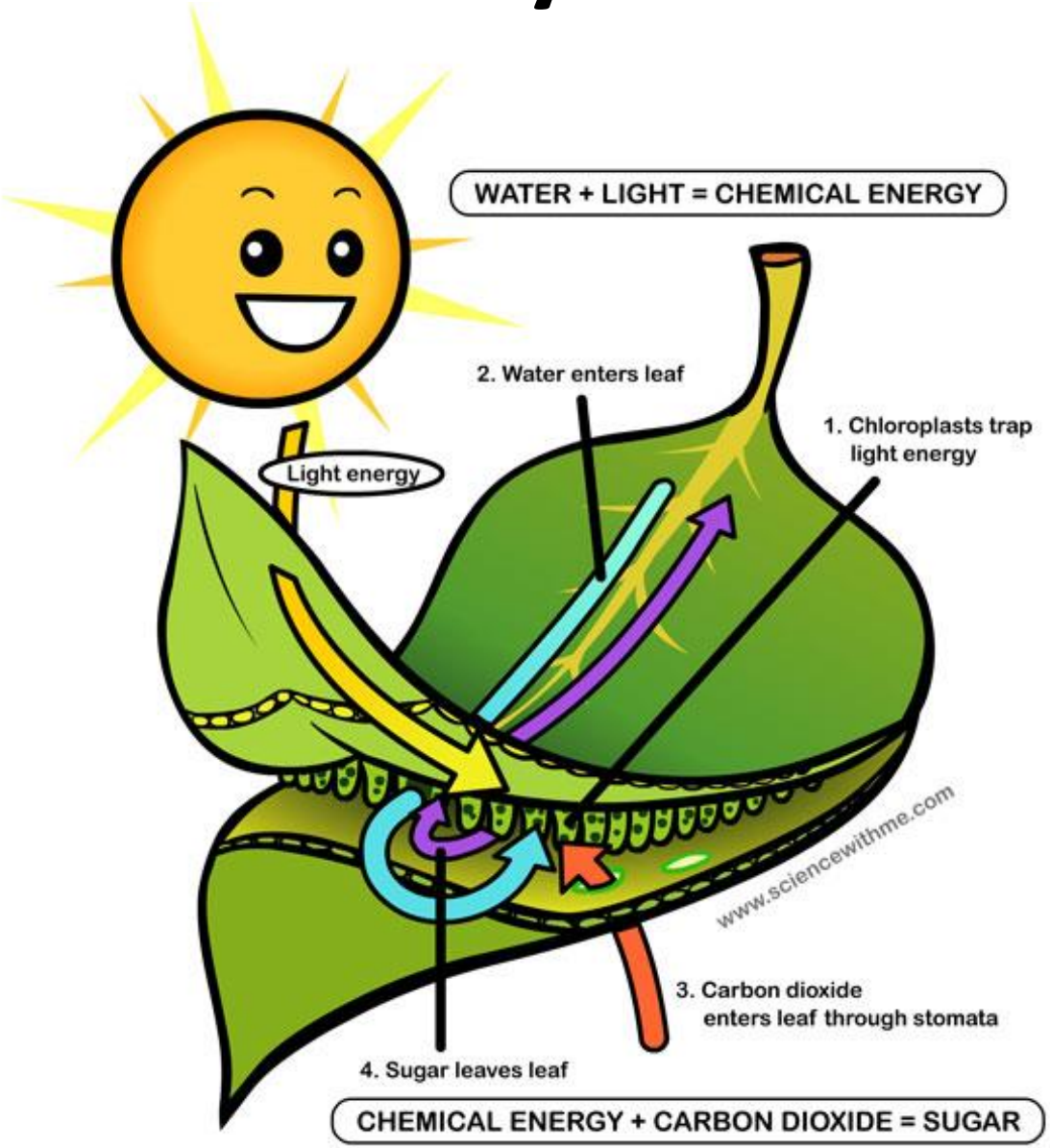
- To make food, plants need:
  - Water
  - Sunlight
  - Carbon Dioxide (CO_2)

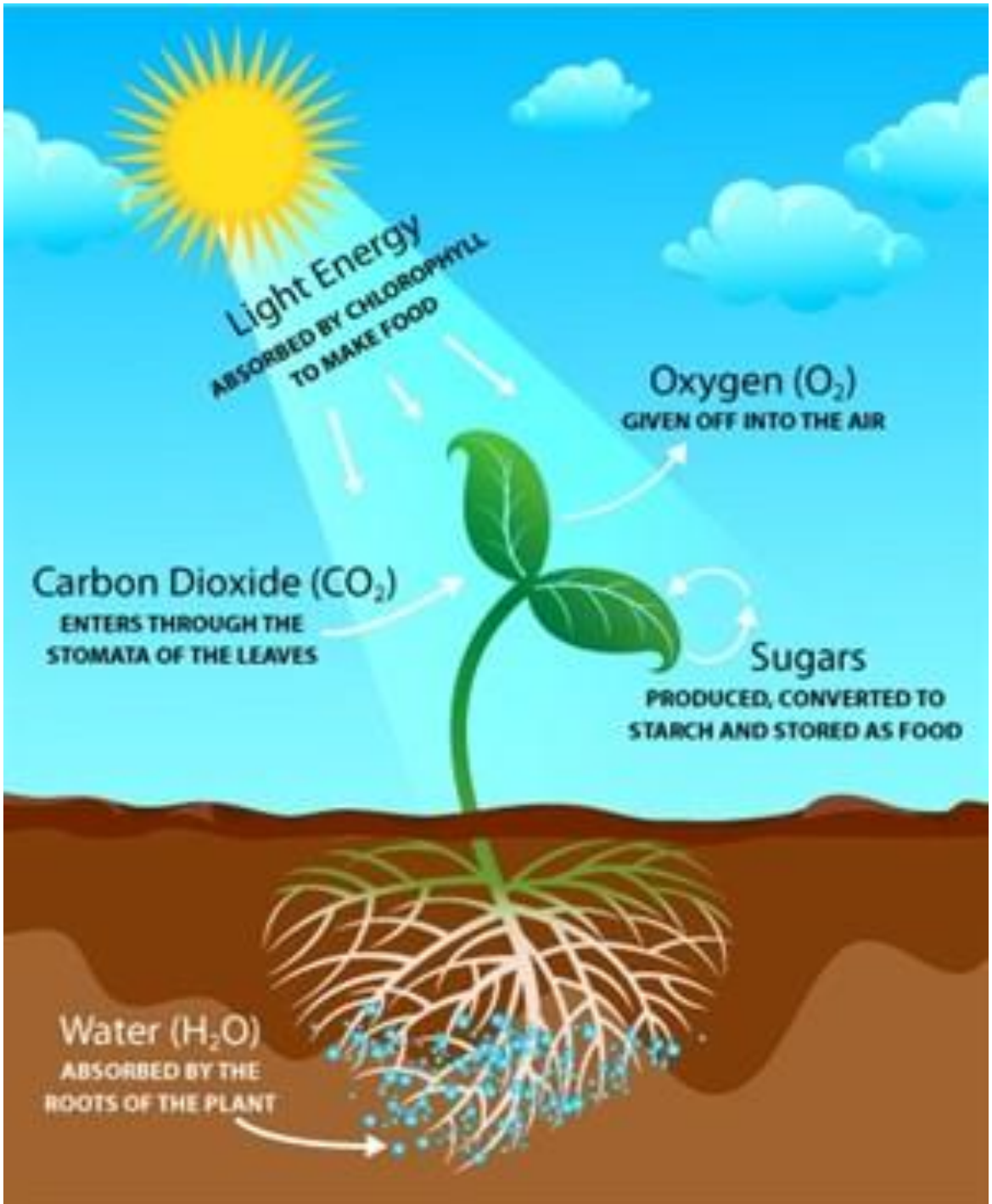
- Results in: Glucose & Oxygen



$$6\ CO_2 + 6\ H_2O \xrightarrow{\text{SUN}} C_6H_{12}O_6 + 6\ O_2$$

Photosynthesis




Light Energy
ABSORBED BY CHLOROPHYLL TO MAKE FOOD
Oxygen (O_2)
GIVEN OFF INTO THE AIR
Carbon Dioxide (CO_2)
ENTERS THROUGH THE STOMATA OF THE LEAVES
Sugars
PRODUCED, CONVERTED TO STARCH AND STORED AS FOOD
Water (H_2O)
ABSORBED BY THE ROOTS OF THE PLANT

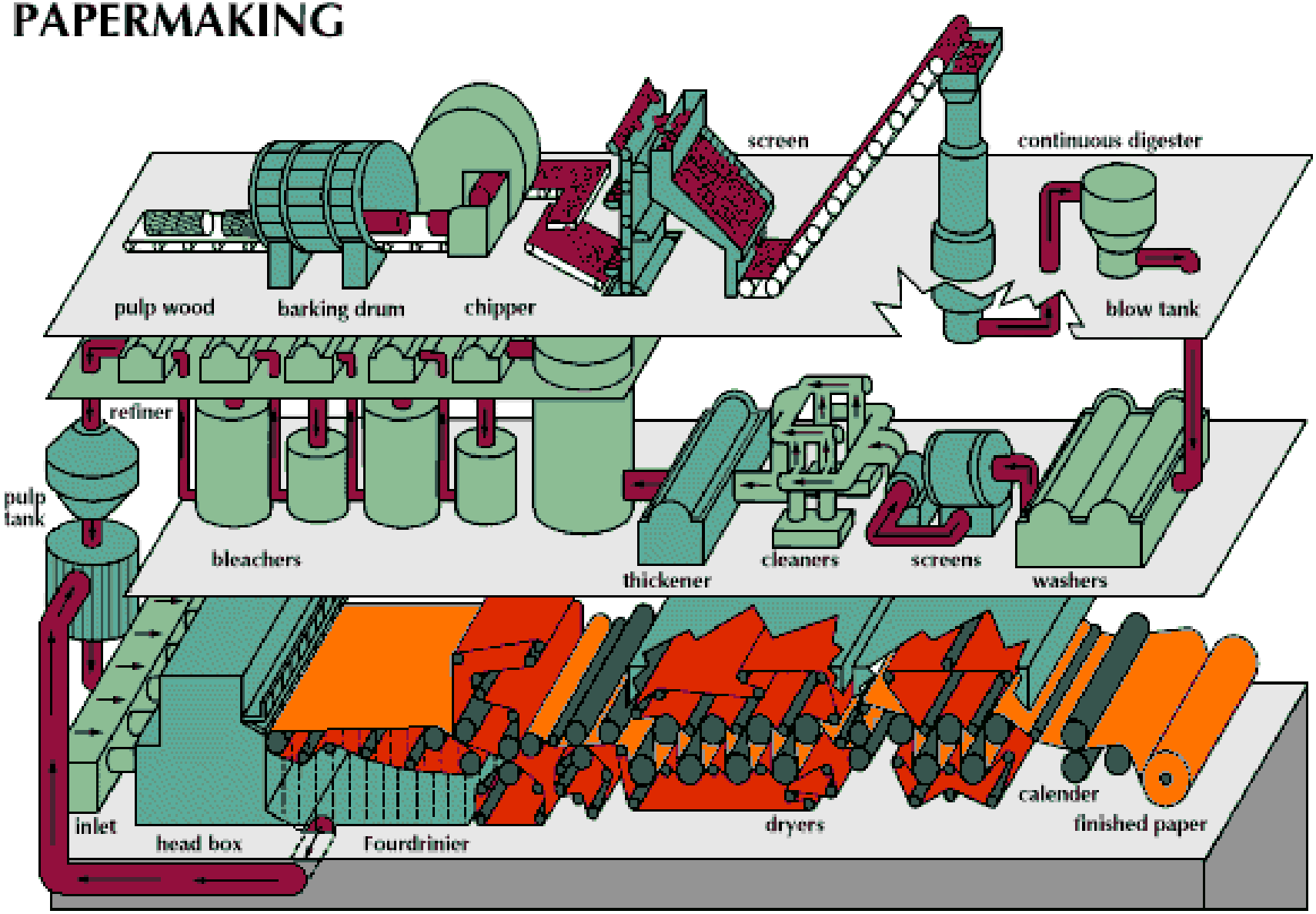
Why do we need Plants?

- They provide a source of food and energy for animals and humans.
- They provide oxygen for us to breathe.
- They provide many useful products:
  - Building materials
  - Medicine
  - Clothing
  - Paper

Using Trees to Make Paper

- The wood from trees is chopped up into small pieces
- The wood and fibers (which contains **cellulose**) are then boiled until it is a slush called “pulp”
- The pulp is then poured onto a fine mesh and water is drained and pressed
- Once dried, paper is formed

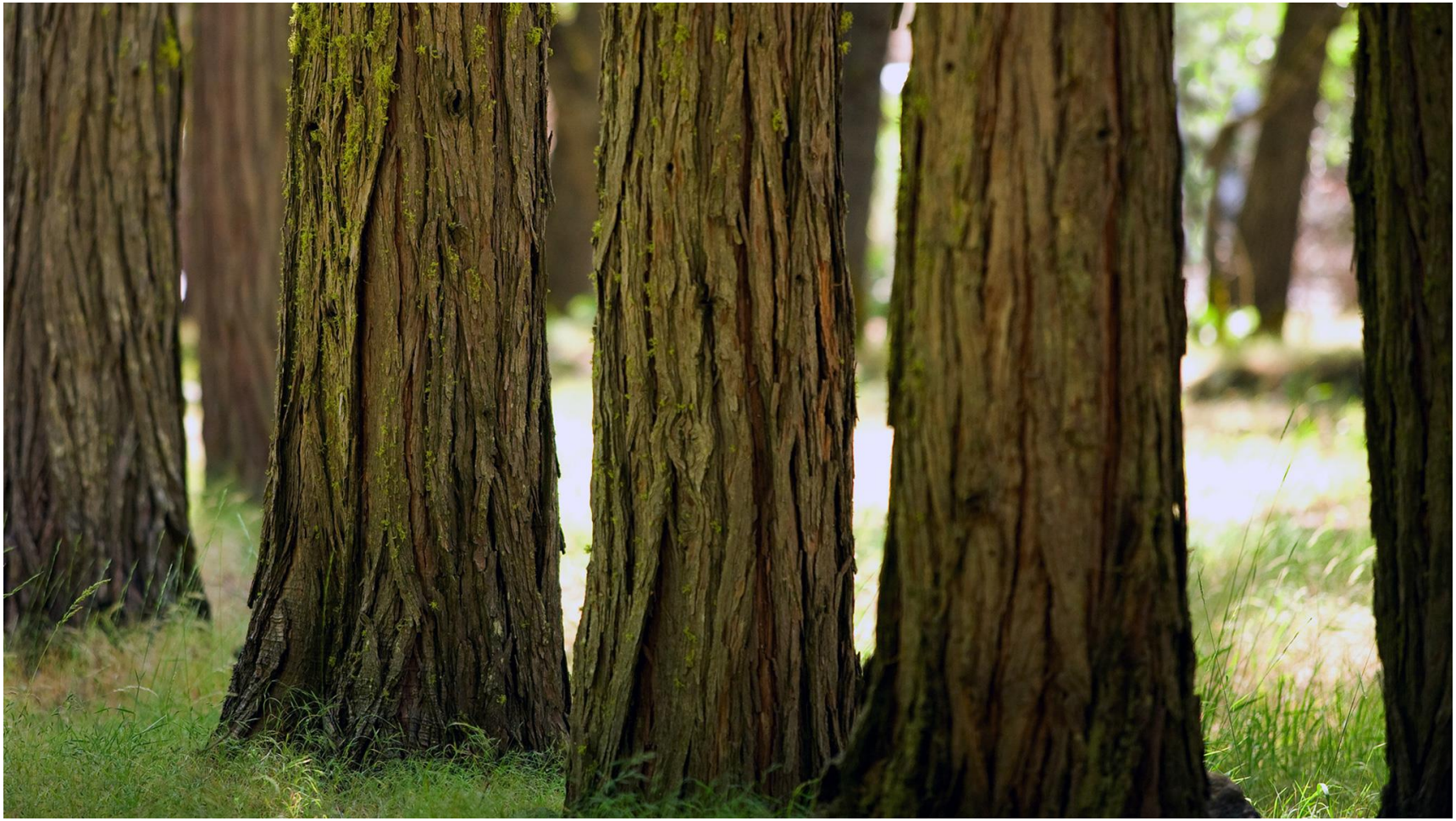
PAPERMAKING




Now WE are
going to make
PAPER!


How Small is the Nano in Trees?

What do you see?



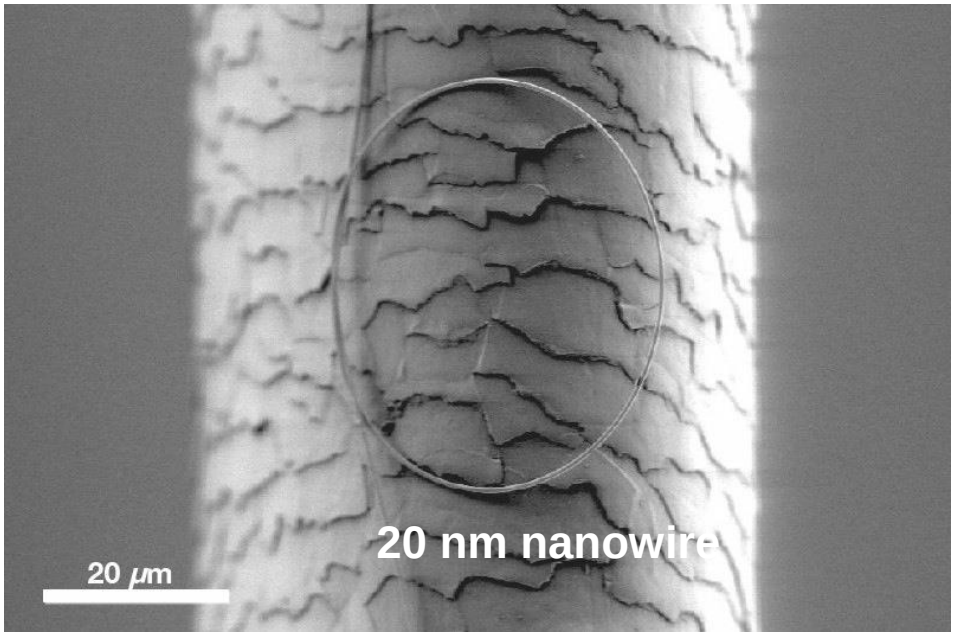
What do you think this would look like at the nanoscale level?

What exactly does nanoscale mean?

What is Nano?
nanometer = one billionth of a meter

About a billion blades of grass in Jordan Hare stadium

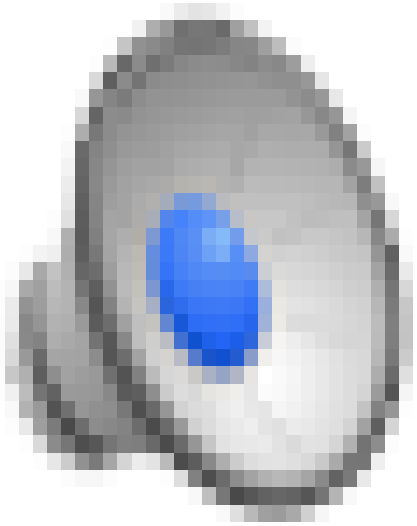
A human hair is about 100,000 times bigger than 1 nm !



human hair ~ 100,000 nm
www.nisenet.org

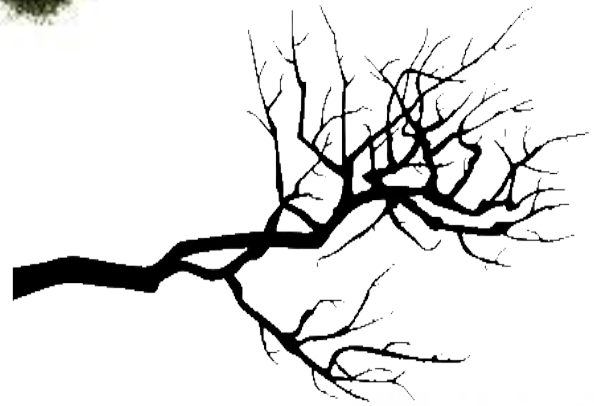
Things are different at the nanoscale. Size and shape determine properties such as color

Cellulose Nanocrystals



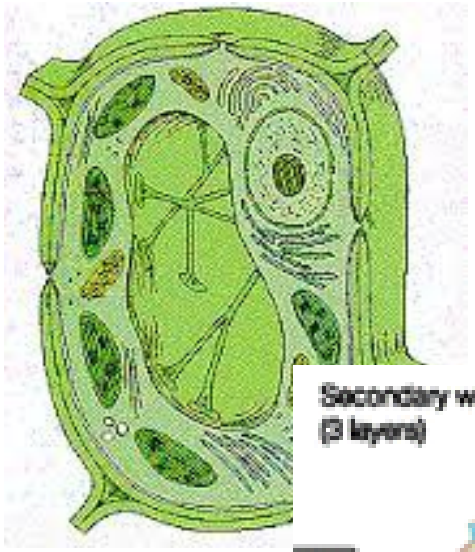
Forest
Kilometers (Km)

Tree
Meters (m)

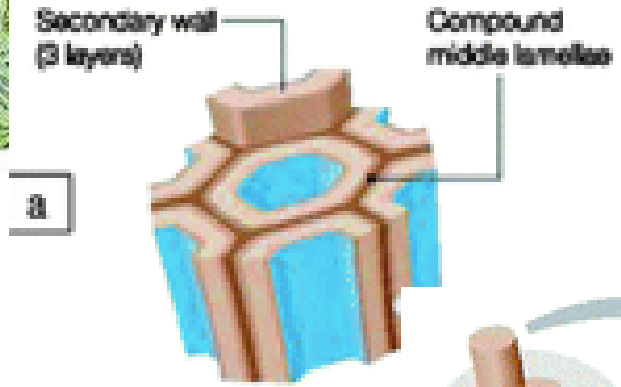


Branch/twig
Centimeters (cm)

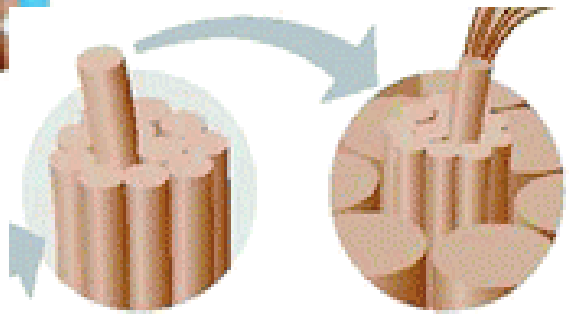
Width of Bark
Millimeters (mm)



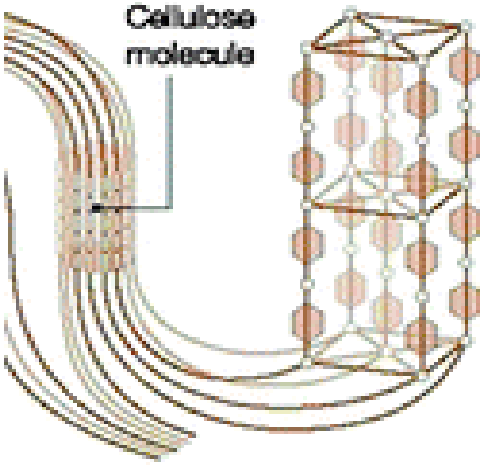
Plant Cell
Micrometers (µm)



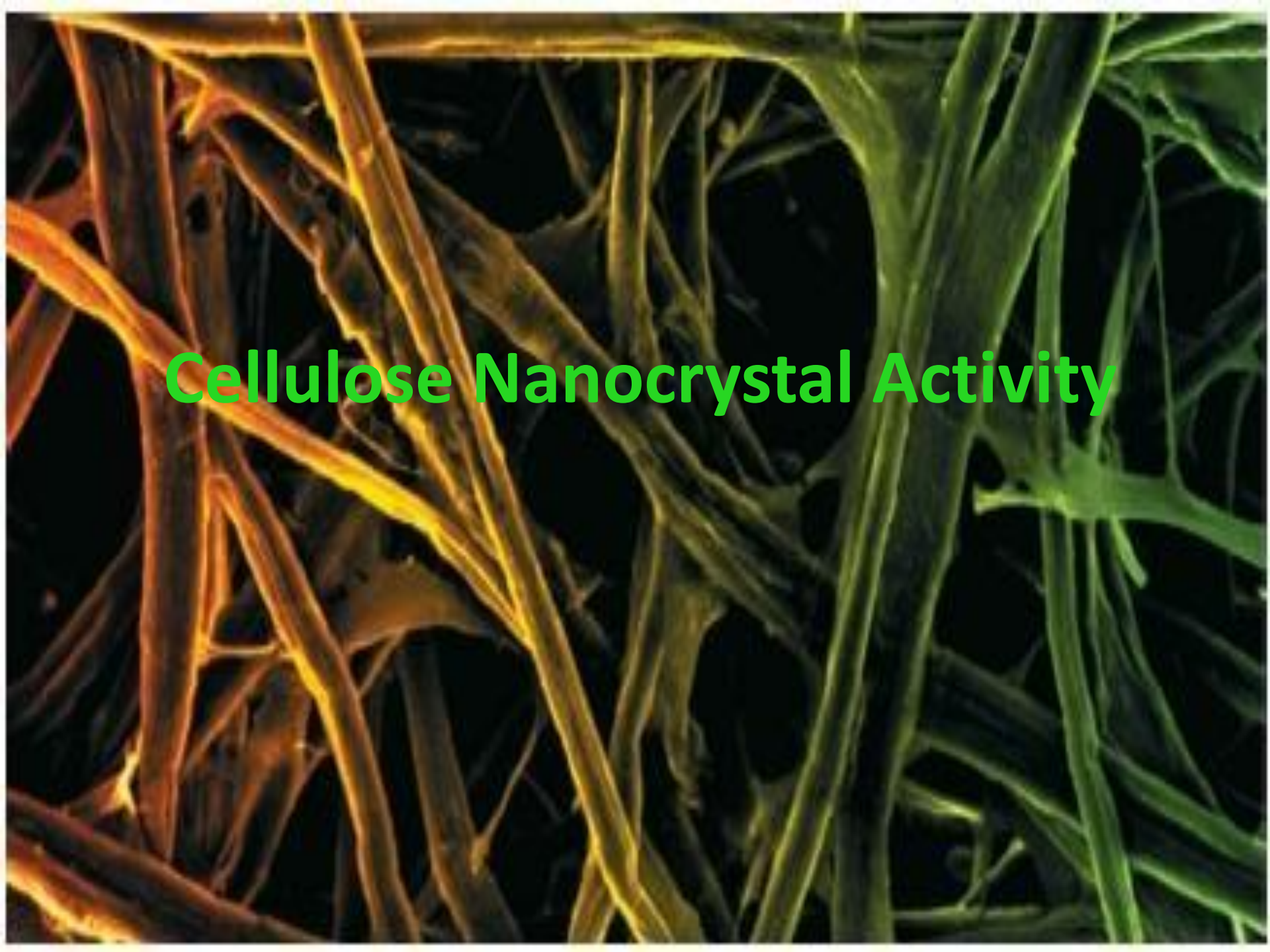
Fibers
Micrometers (µm)



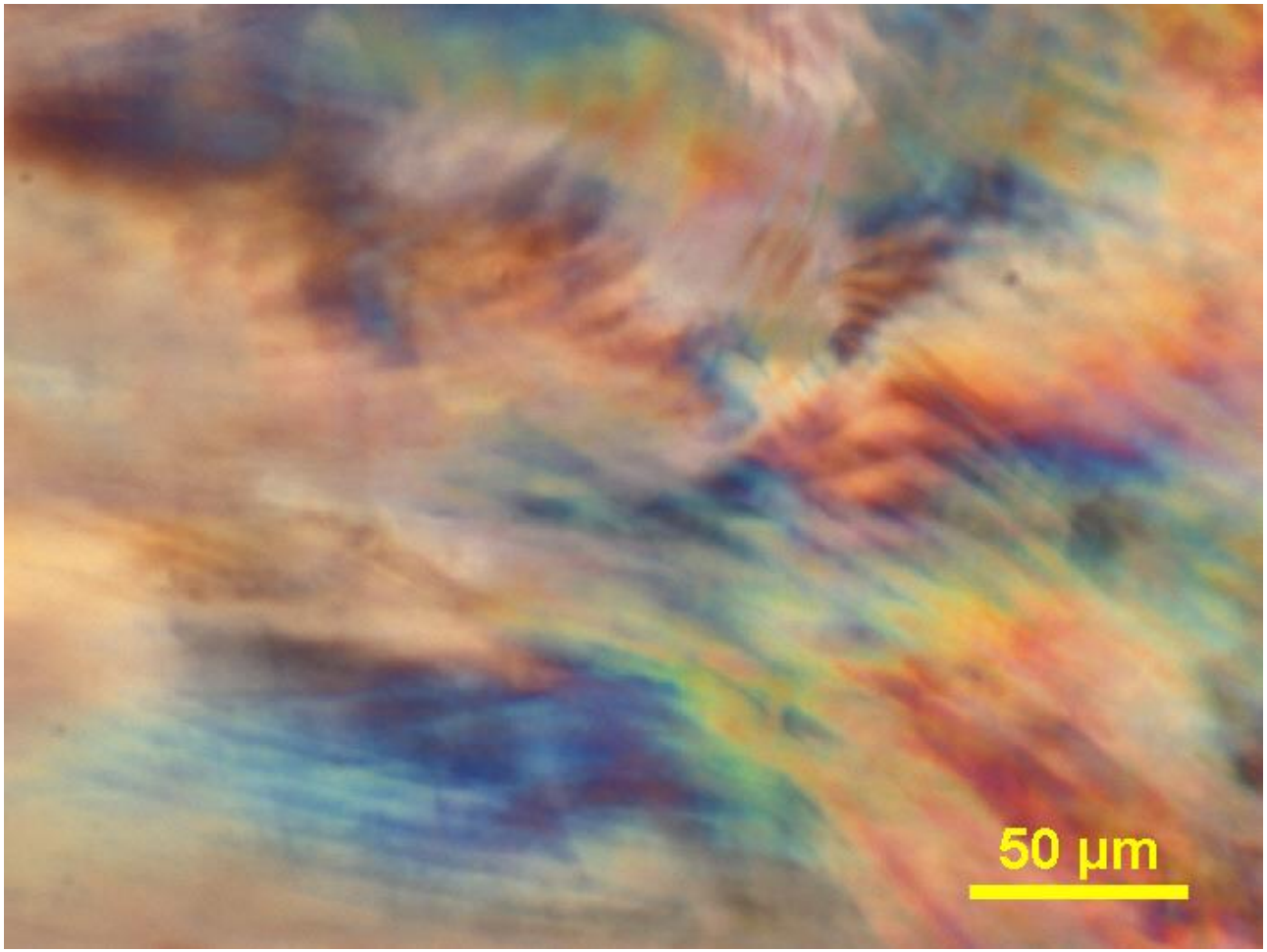
Fibrils
Nanometers (nm)



Cellulose Nanocrystals
Nanometers (nm)

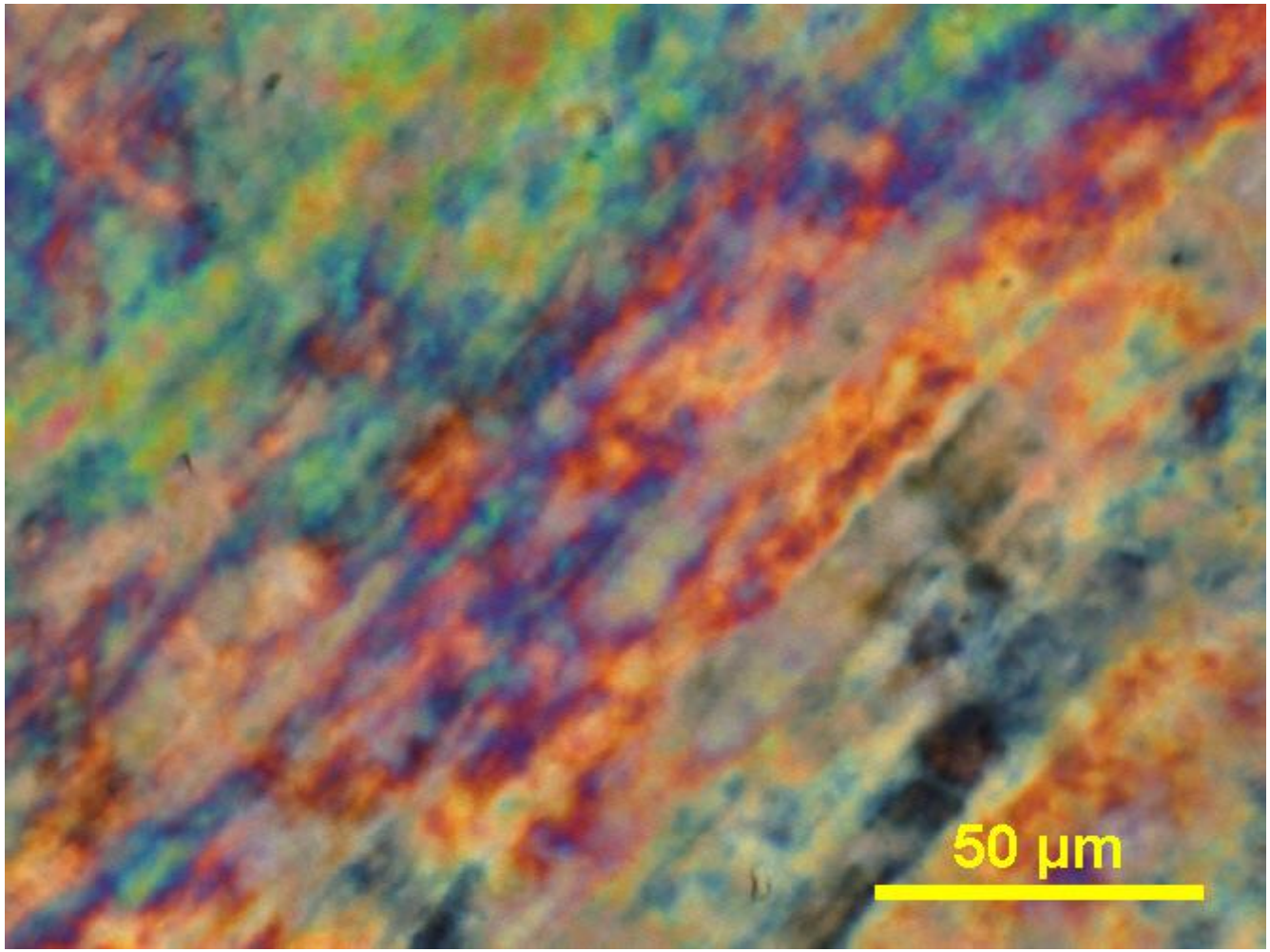

Cellulose Nanocrystal Activity

Cellulose Nanocrystals



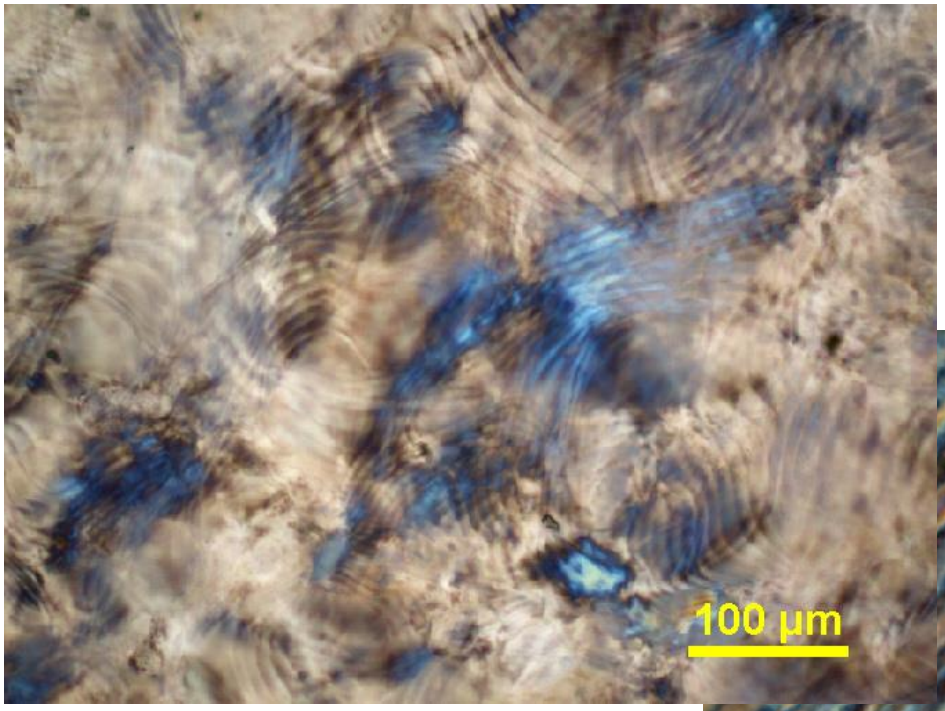
Courtesy of Alexander Haywood

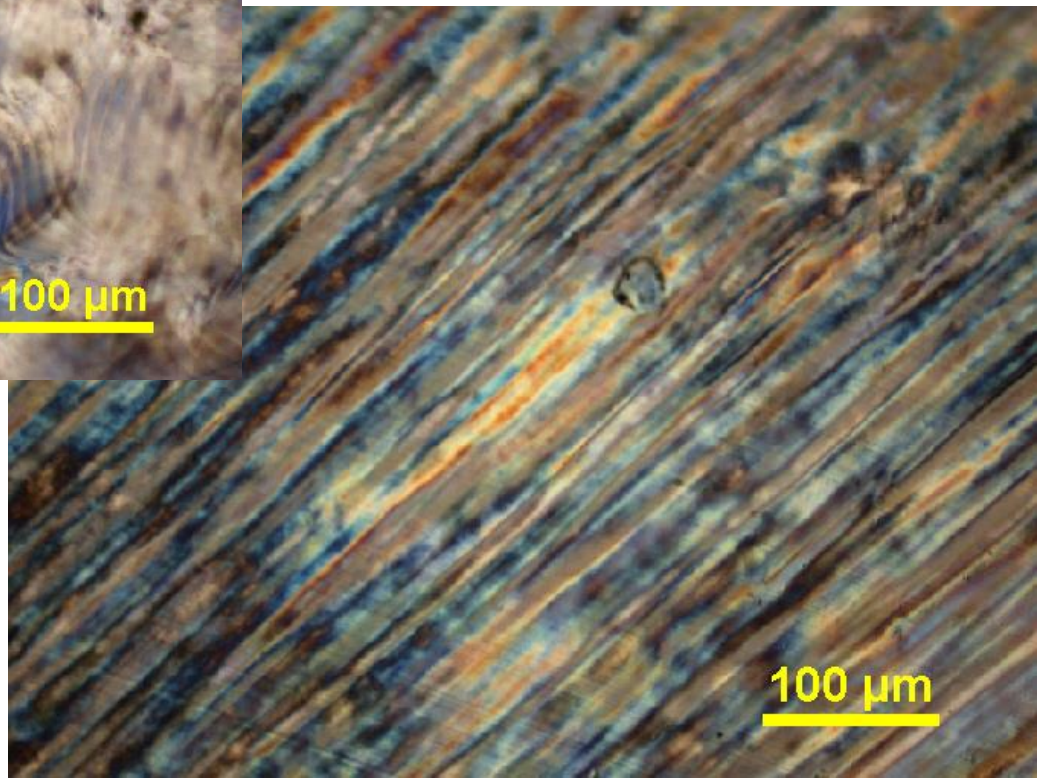
Cellulose Nanocrystals



Courtesy of Alexander Haywood

Cellulose Nanocrystals





Courtesy of Alexander Haywood

Why do we see the colors when we look at the cellulose?

We can NOT see the individual nanocrystals.

However, the size and shape of these nanocrystals determine what colors we see in the microscope!

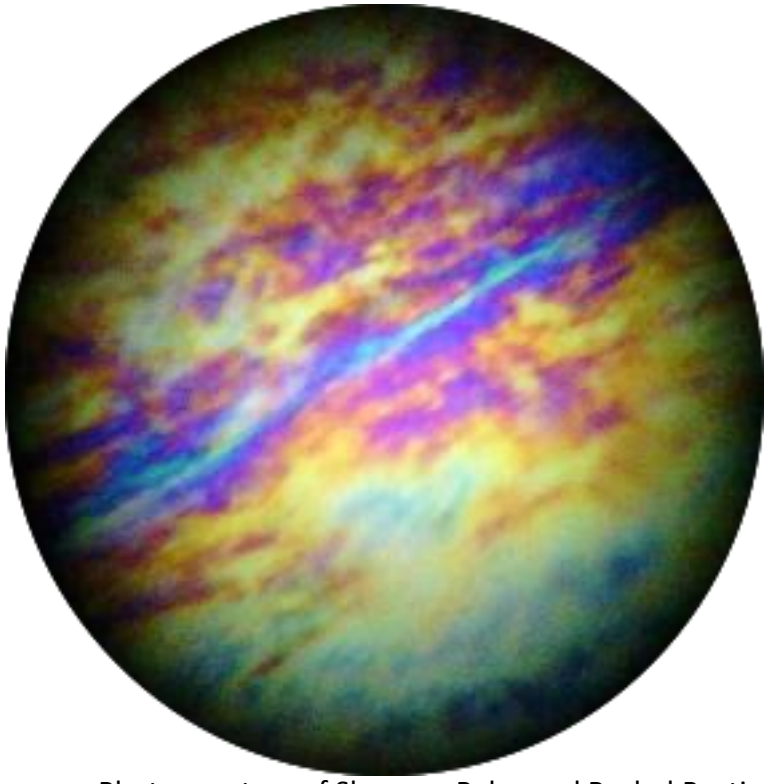
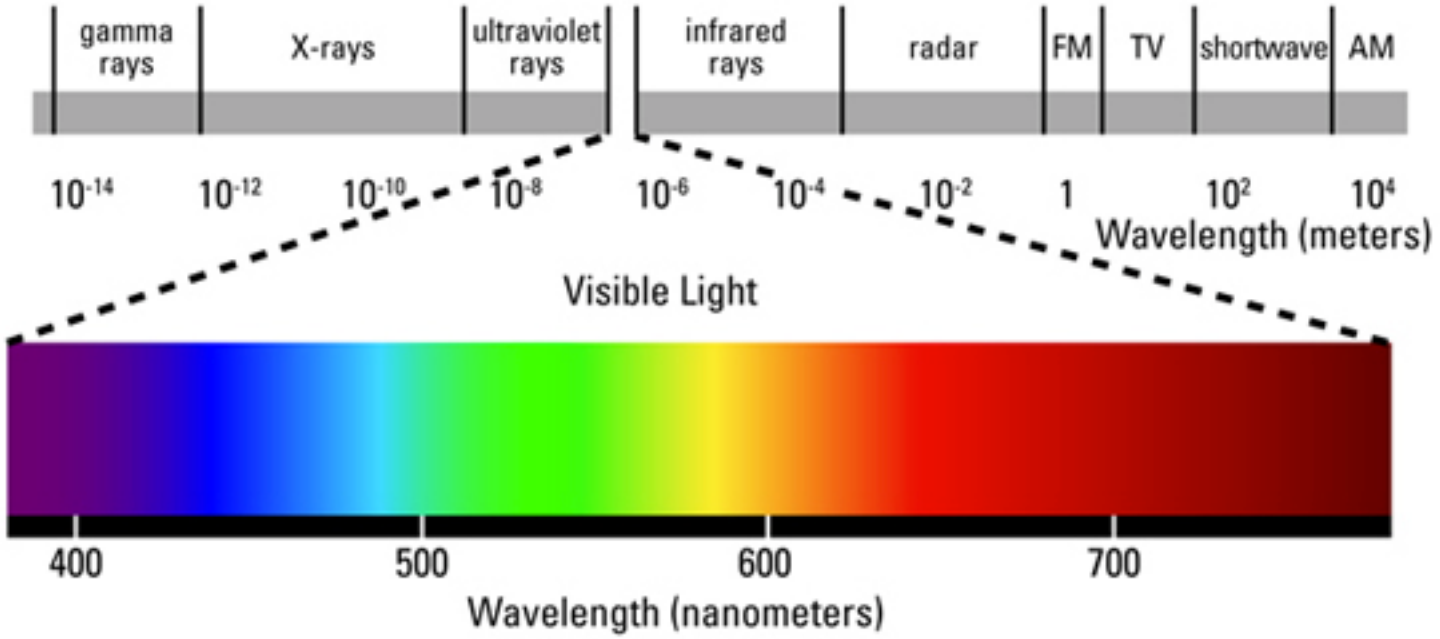


Photo courtesy of Shannon Bales and Rachel Bostic

Why are there different colors of light?

- There are different colors of light because light waves have different wavelengths



Why do these crystals look so colorful?

Remember:

Things are different at the nanoscale. Size and shape determine properties such as color.

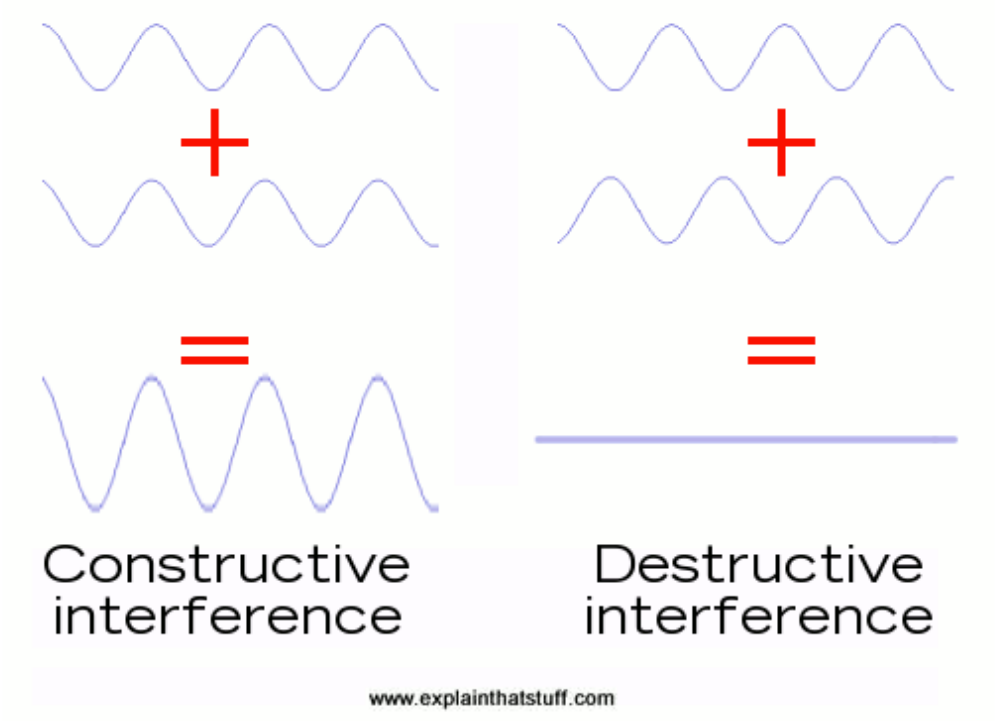
We also see these colors because of the interference of different wavelengths of light.

What is Interference?

Definition:

- Interference is the overlapping of two or more waves resulting in a new wave pattern.

2 Types:



- Light hits the nanocrystal material and splits into 2 different waves traveling at 2 different speeds

- The rays will then exit the material at different speeds causing interference

- Different color wavelengths interfere differently

- Some wavelengths interfere constructively and some interfere destructively, therefore causing different colors to be seen

Resources

- http://www.buzzle.com/articles/plant-cell-functions.html
- http://photosynthesiseducation.com/photosynthesis-for-kids/
- http://www.kidsbuilder.com/FunFactsForKids/light.html
- http://academickids.com/encyclopedia/index.php/Interference
- http://www.explainthatstuff.com/thin-film-interference.html

- Pictures:
- www.theledlight.com.cn
- http://www.poweranimalsunleashed.com/enchantedforest.htm
- http://pixels.com/featured/plant-cell-sem-dr-david-furness-keele-university.html
- http://www.shutterstock.com/pic-141162655/stock-vector-illustration-showing-the-plant-cell-anatomy.html
- http://www.addorganicgardening.com/plant-cells/
- www.outsidethefray.com
- sciencewithme.com
- www.thegrowscene.com
- kids.britannica.com
- www.asknature.org
- www.stormgrounds.com
- myorganicchemistry.wikispaces.com

- Video
- http://www.tappi.org