



# **PLANT PROCESSES**

# Photosynthesis



# Importance

- The “Reaction of Life”: The conversion of the sun’s energy into a form man and other living creatures can use.
  - “Photo” – light
  - “Synthesis” – to put together

# 3 Important Processes

- First, it transforms light energy from the sun into chemical energy which is transported and stored in plants.
- Second, it “fixes” carbon dioxide into a solid form. (Component in all organic matter.)
- Third, produces oxygen as a by-product.

# Energy Transformation

- The Earth receives vast quantities of energy from the sun each day in the form of solar radiation (light).
- The useful form of radiation energy is called chemical energy.
- One energy-yielding chemical which photosynthesis produces is sugar ( $C_6H_{12}O_6$ ).

# Carbon Fixation

- The process of photosynthesis where carbon is fixed from atmospheric carbon dioxide and converted into carbohydrates by green plants.
- It has been estimated that 620,000,000,000 tons of carbon is converted annually.



*This is enough to  
fill 97 railroad cars  
every  
second of every  
day all year long.*

# Oxygen Production

- Oxygen is considered a by-product of the photosynthetic process.
- Plants produce enough of it to be considered the primary source, world wide.





# What Is Unique?

- Because of their ability to produce their own energy, plants are self-sufficient (autotrophic).
- All other forms of life need sustenance from other living creatures (heterotrophic).

Examples: animals, fungi, bacteria, viruses, etc.







(Carbon Dioxide + Water  $\rightarrow$  Sugar + Water + Oxygen)

Also written as:



# Requirements of Photosynthesis

- Living plant
- Supply of carbon dioxide from atmosphere
- Water from soil or atmosphere
- Light, usually from the sun

# Products of Photosynthesis

- Carbohydrates such as sugars and starches
- Water
- Oxygen

# Factors Affecting Photosynthesis

- Light Quality – chlorophyll reacts only to certain wavelengths of light.
- Light Intensity – some plants are sun loving and others prefer shade. The general rule, the brighter the light, the more efficient the process.

# Absorption of Light by Chlorophyll

Chlorophyll absorbs blue-violet & red light best

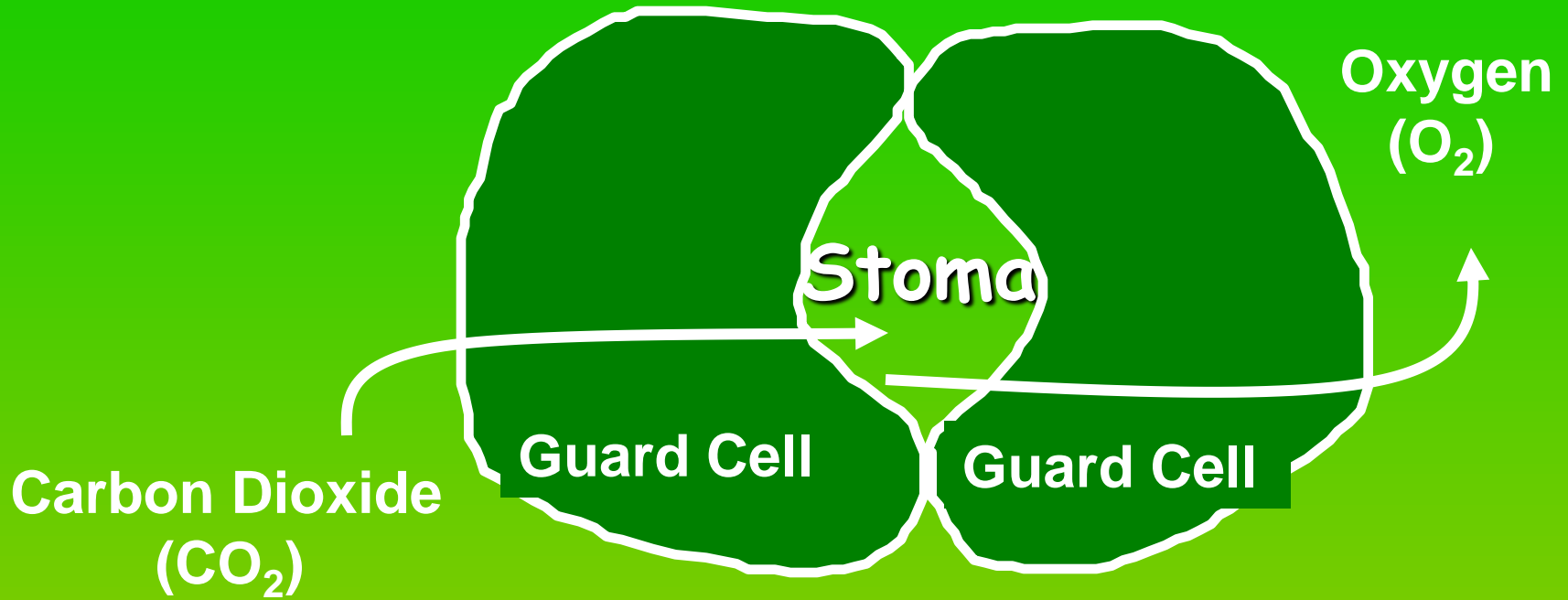


- Light Duration – the longer the day, the more photosynthesis takes place, and the more the plant grows.
- Carbon Dioxide Concentration – an increase causes a greater rate of photosynthesis.
- Temperature – an increase in temperature normally increases photosynthesis.
- Water Availability – plants with water stress will close their stomata and slow activity.



# Review

- Write the equation for photosynthesis.
- List 3 important processes in plants:
- What is light duration?



# Respiration

# The Respiration Process

- Respiration is necessary in all living cells.
- It is the controlled expenditure of an organism's energy reserves to sustain its life processes.
- Plants only have photosynthesis during daylight hours in cells with chlorophyll, but respire 24 hours a day in all cells.

- Respiration uses up stored energy and gives off heat.
- Releases energy, evolves carbon dioxide, and uses up oxygen.
- This has the opposite effect of photosynthesis.

# Factors Affecting Respiration

- Temperature – as it increases, so does the rate of respiration.
- Oxygen Concentration – lower oxygen concentrations in the environment will result in a lower respiration rate.

- Soil Conditions – compacted or water-logged soils exclude air, and therefore oxygen inhibiting respiration.
- Light – since plants grown in low light photosynthesize at a reduced rate, the level of available carbohydrates and rate of respiration is reduced.



# Respiration Affects Ag

- Since respiration is taking place 24 hours a day, it is important that the plant be able to photosynthesize enough during the day to provide for respiration during the day and night.
- If not accomplished, no energy will be available for growth and the plant will stagnate or die.

- Most plants grow best when night temperatures are about 9 degrees lower than daytime temperatures.
- Night temperatures in a greenhouse kept too warm will cause respiration rates to be high and stall a crop's growth.

- Respiration is closely tied to the degradation (the breakdown of the tissues) of harvested crops.
- By slowing respiration rates after harvest, we can improve the quality of goods reaching the consumer.

- Two Strategies:

Refrigeration

Increasing Atmospheric Concentration of Nitrogen



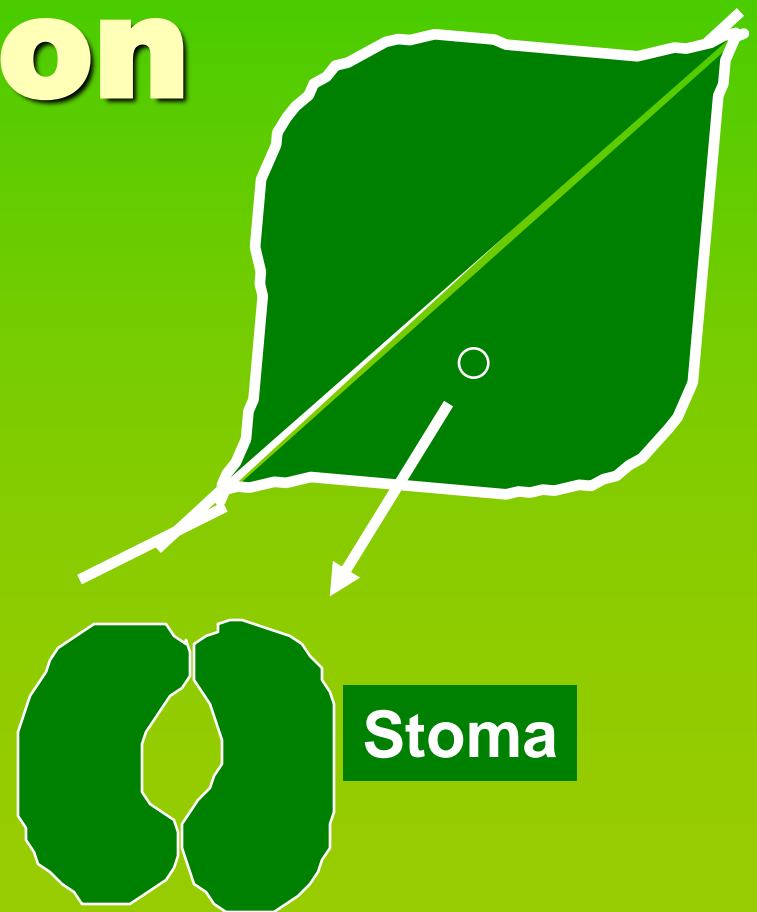
# Comparison

<i><b>Photosynthesis</b></i>	<i><b>Respiration</b></i>
Requires Carbon Dioxide and Water	Requires Oxygen and Carbon Compounds
Produces Oxygen and Carbohydrates	Produces Carbon Dioxide and Water
Light Energy Trapped by Chlorophyll	Energy Released
Takes Place in Light Only	Takes Place in Both Light and in Darkness
Occurs Only in Cells With Chlorophyll	All Living Cells Respire

# Review

- Does respiration occur in all living cells?
- Why is respiration inhibited in water-logged soils?
- What does refrigeration do for agriculture crops?

# Transpiration





# Transpiration

- The process by which a plant cools itself and releases water.
  - About 90% of all water that enters the plants from the roots is given off during transpiration.
  - The other 10% becomes involved in chemical processes or is tied up in the plants structure.

- The lower surface of the leaf is dotted with special pore-like structures called stomatas.
- Openings occur in the stomata during the daylight hours to permit the exchange and release of water vapor.
- Stomata close at night or when the plant is water stressed.

# Translocation



# Translocation

- Water enters the plant through the root system and is transported throughout the plant.
- The process is made possible by the “solvent of life”, plain water.

Example: Celery Stalk Lab



# Functions

- Transportation of Nutrients
  - Water is moved up through the sieve tubes from the roots through the xylem to the rest of the plant.
  - The water carries nutrients and important metabolites.
    - Metabolites are the products of the chemical reactions or “metabolism” of the plant.

## ■ Transportation of Photosynthesis Products

- Water also moves through the phloem sieve tubes to transport sugar produced by the leaves during photosynthesis to all parts of the plant.
- Roots have no other means to nourish themselves, and would die without translocated sugars manufactured in the leaves.



- Physical Support

- Water being translocated adds turgor or stiffens the cells.
  - This pressure helps to provide support to leaves and new tissue.

# Review

- What does turgor pressure do for plants?
- Where does water enter a plant from?
- What is the “solvent of life”?