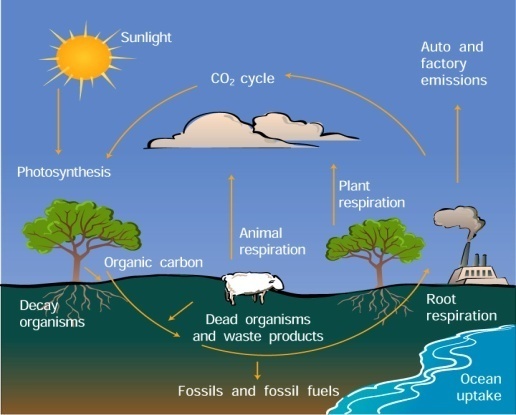
**Notes Organizer for Power Point Presentation**

**Unit 3 *Energy Photosynthesis and Cellular Respiration***

First, lets review the carbon cycle…

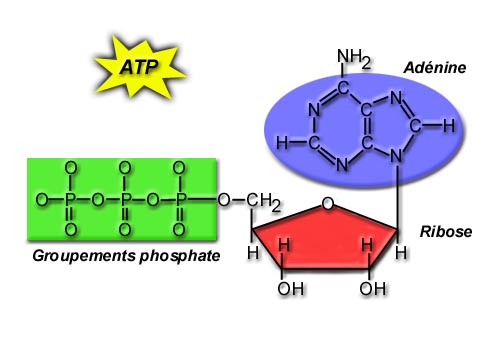


Lets talk about from where ***ENERGY*** comes from…

**Energy** is found in the chemical bonds of a molecule called \_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

When the \_\_\_\_\_\_\_\_\_\_ in the molecule \_\_\_\_\_\_\_\_\_\_\_ energy is released.



* When one \_\_\_\_\_\_\_\_\_\_ group is removed to release energy ADP is made.
* \_\_\_\_\_\_- Has \_\_ phosphate groups instead of \_\_
* Bonds between the \_\_\_\_\_\_\_\_\_\_\_ groups can be broken and then form again
* This means ATP is \_\_\_\_\_\_\_\_\_\_\_\_\_!

**Other Energy Storing Molecules:**

1. **\_\_\_\_\_\_\_\_\_\_\_\_\_**
2. **\_\_\_\_\_\_\_\_\_\_\_\_\_**
3. **\_\_\_\_\_\_\_\_\_\_\_\_\_**

*Before we discuss any more new information, lets review a little from Environmental Science:*

**Autotroph vs. Heterotroph**

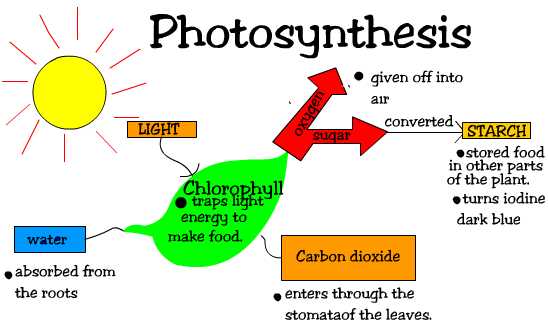
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- organisms that consume other organisms for food
  + Carnivores, Herbivores, Omnivores, Etc.
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- organism that makes its own food
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ E.g. – **Plants, which** make sugar from light.

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** makes compounds used for food from chemical energy contained in inorganic compounds like H2S or CH4

Example: bacteria that use sulfide (H2S) or methane (CH4)

**Photosynthesis**

Method of converting sun’s \_\_\_\_\_\_\_\_\_\_\_\_\_ into \_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy usable by cells.

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**Photosynthesis** **Overall Reaction**

**CO2 + H2O + light energy → C6H12O6 (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_) + O2**

**Photosynthesis** takes place in specialized structures inside plant cells called **chloroplasts**

**The** **Chloroplast**

Has two structures inside:

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\*\*Stakes of Thylakoids are called Granum

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a pigment found in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ membranes. It traps energy from the sun by losing electrons.

Photosynthesis has 2 phases:

1. \_\_\_\_\_\_\_\_\_\_-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ reactions
2. \_\_\_\_\_\_\_\_\_\_-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ reactions

**Light-dependent Reactions Overview**:

Occurs in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Light energy is converted to \_\_\_\_\_\_\_\_\_\_\_\_ energy

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**Products**:

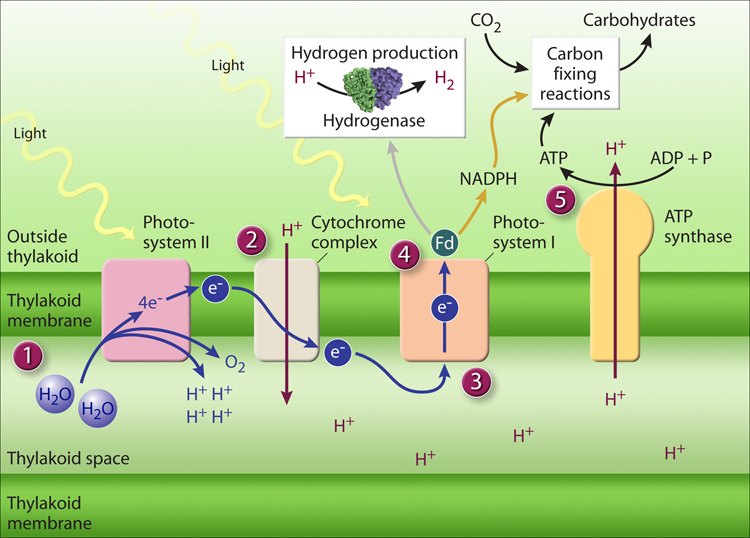
1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (for us to breath)
2. \_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_ (Energy carrying molecules)

**Process of Light Dependent Reactions:**

1. Light from \_\_\_\_\_\_\_ is transferred to chlorophyll at the top of the ­­­­­­­­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_ proteins which lose an electron
2. Water is split into \_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_ ions, and \_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Energized electrons are passed down the Electron Transport Chain
4. Excited electrons do one of 2 things
   1. Replace the electron lost by \_\_\_\_\_\_\_\_\_\_\_\_\_\_ when it becomes excited
   2. Is used to form \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is released as a product
6. Hydrogen ions build up in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ membrane
7. Hydrogen ions are pumped through the \_\_\_\_\_\_\_ synthase to make ATP.
8. ATP and NADPH are then transferred to the second phase of photosynthesis

**Electron Transport Chain**

* A series of \_\_\_\_\_\_\_\_\_ complexes that are imbedded in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ membrane
* Along the way, the electrons lose \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



**Photosystems**

* \_\_\_\_\_- First protein complex the electrons encounter
  + First step in the \_\_\_\_\_\_\_\_
* \_\_\_\_\_- Second protein complex the electrons encounter
  + Are reenergized to make NADPH which will go on to the Light \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Reactions

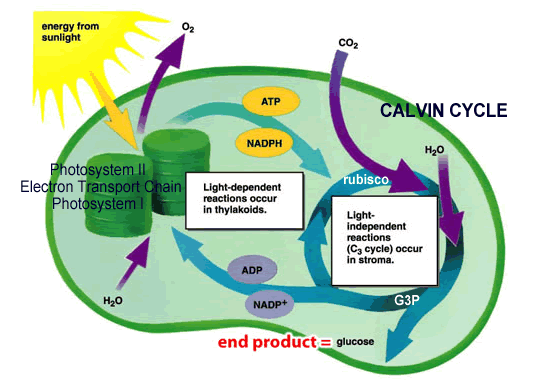
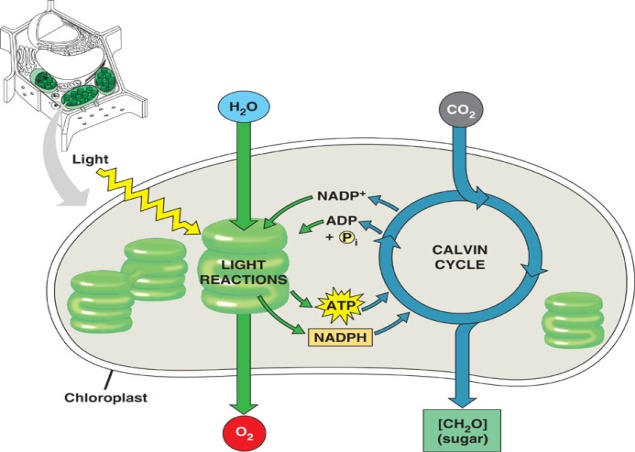
**Splitting Water: Photolysis**

* This is done so that the \_\_\_\_\_\_\_\_\_\_\_\_\_ that chlorophyll lost when they trapped the light can be replaced.
* The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from this process is released to the air
* The electrons return to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* The H+ ions are used to make \_\_\_\_\_\_\_\_\_

**Light Independent Reactions (aka \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_)**

**Overview:**

* Occurs in \_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_ made in light reactions are used to fuel the reactions to make… **Product:** Sugar🡪 Glucose

****

**Step 1: Carbon Fixation**

* \_\_\_\_\_\_\_\_\_\_ is absorbed into the plant through small pores on the underside of the leaves called \_\_\_\_\_\_\_\_\_\_\_\_\_
* The CO2 binds with a 5 carbon sugar called ribulose biphosphate (\_\_\_\_\_\_\_\_\_)
* Result is a 6 carbon sugar (NOT GLUCOSE)

**Step 2: 6 Carbon sugar Splits**

* The 6 carbon sugar then splits into 2- \_\_\_\_ carbon sugars
* This requires \_\_\_\_\_\_\_\_
* The 3 carbon molecule is called diphosphoglycerate

**Step 3: ATP and NADPH are used**

* More energy carrying molecules change the diphosphoglycerate made previously into phosphoglyceraldehyde (\_\_\_\_\_\_\_\_)
* This is done because the bonds in this molecule have more \_\_\_\_\_\_\_\_\_\_\_

**Step 4: Making Sugar**

* 1 of the 6 PGALs made goes to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ where it will be used to make sugar
* The others are used in the next step of the \_\_\_\_\_\_\_\_\_\_\_ cycle

**Step 5: Making RuBP**

* The RuBP must be replenished so the cycle will continue
* So 5-3 carbon PGALs make 3- 5 carbon \_\_\_\_\_\_\_\_
* This also requires \_\_\_\_\_\_\_\_
* And the cycle starts over!

**Why couldn’t we just use CO2?**

* CO2 can’t hold as much \_\_\_\_\_\_\_\_\_\_!
* We like \_\_\_\_\_\_\_\_\_\_\_\_\_ better. It holds more.

Like a pickup truck holds more than a Beetle.

Once the plants make the food, animals can eat it.

Voila! The food chain begins!

*Somehow, that glucose needs to be changed into a \_\_\_\_\_\_\_\_\_\_\_ form. In other words, we need the energy out of the glucose!*

***Here’s how…***

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ***\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_🡪*** Getting energy out of glucose

It happens the same way in plants and animals.

**Overall Reaction: C6H12O6 + 6O2 → 6CO2 + 6H2O + E**

***NOTICE: CELLULAR RESPIRATION IS THE \_\_\_\_\_\_\_\_\_\_\_\_ OF PHOTOSYNTHESIS*!**

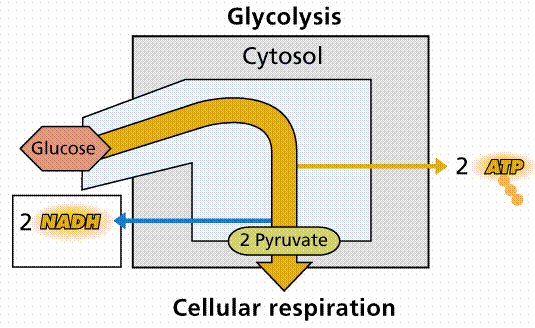
*Except: we* ***don’t*** *get light back out of respiration, we just get other forms of energy, like* ***heat****.*

Cellular Respiration has 3 phases:

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_(Kreb’s) Cycle
3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_

**Glycolysis Overview**:

* Occurs in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the cell
* Breaks glucose (6C) down into 2 pyruvic acid (3C) molecules

****

**Required Molecules:**

* 1 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* 2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* 2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Products:**

* 4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* 2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* 2 \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_

***After Glycolysis***

1 of 2 things can happen!!

1. If \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is present, cellular respiration will continue
2. If no **oxygen** is present, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ will occur

**Oxygen is Present**

1. First, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_ produced in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ must be changed into another molecule (\_\_\_\_\_\_\_\_\_\_\_-\_\_\_\_\_-\_\_) before Kreb’s can begin.
2. Once the molecule has been changed, it enters the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Parts of Mitochondria**

1.

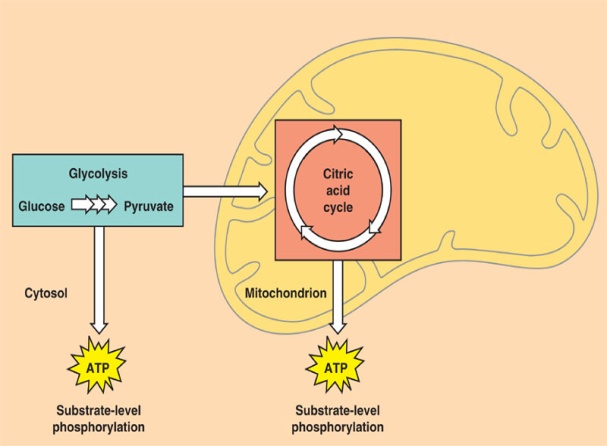
2.

3.

4.

**Citric Acid (Kreb’s) Cycle Overview:**

Series of reactions that occur in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to “charge” energy carrying molecules

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**Required Molecules:**

* \_\_\_\_\_\_\_\_\_\_\_\_\_-\_\_\_-\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_

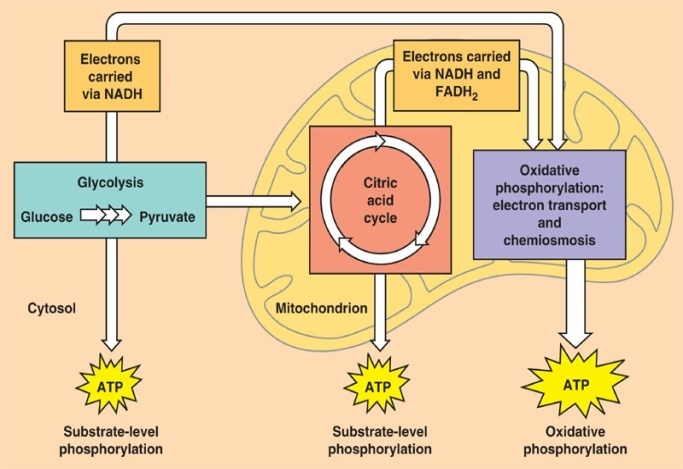
**Products:**

* 2 \_\_\_\_\_\_\_\_\_\_
* 2 \_\_\_\_\_\_\_\_\_\_(we exhale this)
* 3 \_\_\_\_\_\_\_\_\_\_
* 1 \_\_\_\_\_\_\_\_\_\_

**Electron Transport Chain** Overview:

Occurs in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The energy carrying molecules from the \_\_\_\_\_\_\_\_ cycle go through a chain-like series of steps (staircase) to make \_\_\_\_\_\_\_.



**Required Molecules:**

* \_\_\_\_\_\_\_\_\_ from Glycolysis
* \_\_\_\_\_\_\_\_\_ from Kreb’s Cycle
* \_\_\_\_\_\_\_\_\_ from Kreb’s Cycle

**Products:**

As electrons drop down stairs, energy released to form a total of **\_\_\_ \_\_\_\_\_\_\_**

**Oxygen is not present**

If oxygen is not present, after glycolysis the Pyruvic Acid goes into the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ process

*Meaning it skips Kreb’s and the Electron Transport Chain*

**Fermentation**

There are 2 types of fermentation

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ acid fermentation-

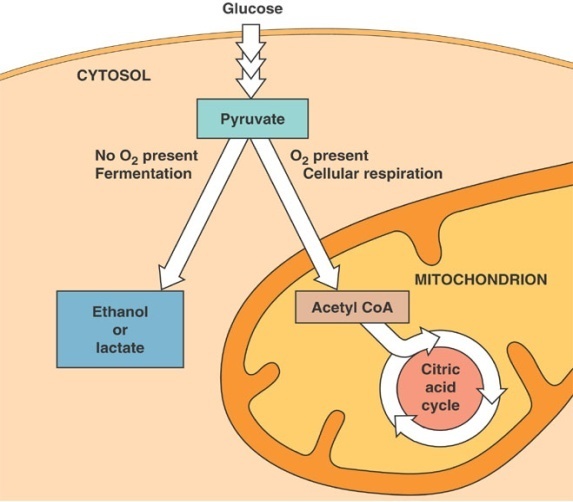
*This is what causes your muscles to cramp after working out*

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ fermentation-

* *­­­\_\_\_\_\_\_\_\_\_\_\_: This is what causes bread to rise.*
* *\_\_\_\_\_\_\_\_\_\_\_: This is how beer and wine are produced.*

**We have discussed two types of respiration:**

* 1. **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (a.k.a. Fermentation): Does not need oxygen
  2. **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** Needs oxygen

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**Energy Tally**

36 ATP for aerobic vs. 2 ATP for anaerobic

Glycolysis 2 ATP

*Kreb’s 2 ATP*

*Electron Transport +32 ATP*

\_\_\_\_ **ATP**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ organisms can’t be too energetic but are important for global recycling of carbon.