**Module 3**

**Chapter 5 – Microbial Metabolism**

**Catabolic and Anabolic Reactions**

* Metabolism – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Two general types of metabolic reactions:
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Recall from Chapter 2:
	+ Energy can be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ when \_\_\_\_\_\_\_\_\_\_\_\_\_ bonds \_\_\_\_\_\_\_
	+ Energy can be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ when \_\_\_\_\_\_\_\_\_\_\_\_\_ bonds \_\_\_\_\_\_\_
* Catabolism –
	+ Purpose is to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
		- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
		- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Anabolism –
	+ Requires \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to form bonds
	+ Purpose is to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Catabolic reactions are “coupled with” anabolic reactions
	+ Coupled by \_\_\_\_\_\_\_\_\_
* A metabolic pathway is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of chemical \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in a cell
* Metabolic reactions are controlled by proteins – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Enzymes**

* Enzymes are biological catalysts
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for a \_\_\_\_\_\_\_\_\_\_\_\_ chemical reaction
* Specificity is due to \_\_\_\_\_\_\_\_\_\_\_\_\_ of enzyme
	+ Proteins (enzymes) have characteristic \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Structure is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* If enzyme \_\_\_\_\_\_\_\_\_\_\_\_\_, enzyme doesn’t \_\_\_\_\_\_\_\_\_\_\_\_\_
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Enzymes act on one or more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bind at \_\_\_\_\_\_\_\_\_\_
* Each enzyme is specific
* Names of enzymes end in “\_\_\_\_\_\_\_\_\_\_\_\_”
	+ Sucr*ase*, catal*ase*, DNA polymer*ase*

*Enzyme components*

* Many enzymes are made entirely of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Some consist of 2 components
	+ Apoprotein:
	+ Cofactor:
		- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: organic cofactor
* Holoenzyme:

*Enzyme Mechanism*

* The general sequence of events in an enzymatic reaction
	+ Substrate(s) binds to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
		- This is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ The substrate(s) is transformed
	+ Transformed molecule(s), the \_\_\_\_\_\_\_\_\_\_\_\_\_\_, released from enzyme
		- No longer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
		- Enzyme only \_\_\_\_\_\_\_\_\_\_\_ to \_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Enzyme is free to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Sequence continues until enzyme is \_\_\_\_\_\_\_\_\_\_\_\_, or enzyme \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Factors influencing enzymatic activity*

* Enzymes require \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to function
* Hostile environments can cause proteins to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Temperature
	+ In general, chemical reactions speed up as temp \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ For enzymes, too \_\_\_\_\_\_\_\_\_\_ temperature causes \_\_\_\_\_\_\_\_\_\_\_
* pH
	+ pH is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ All enzymes have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ pH
	+ \_\_\_\_\_\_\_\_\_\_\_ from preferred pH will \_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Inhibitors
	+ Certain chemicals that bind to enzymes
* Two classes of inhibitors:
	+ Competitive inhibitors – bind \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
		- *\_\_\_\_\_\_\_\_\_\_\_\_\_\_* with substrate for the \_\_\_\_\_\_\_\_\_\_\_\_\_ of the enzyme
		- \_\_\_\_\_\_\_\_\_ drugs inhibit \_\_\_\_\_\_\_\_\_\_\_\_\_ (an essential \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_) synthesis via competitive inhibition
		- \_\_\_\_\_\_\_\_\_ drugs were the first effective antibacterial drugs
	+ Noncompetitive inhibitors – bind \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
		- Aka \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ inhibition
		- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ prevents replication of HIV via noncompetitive inhibition

*Feedback inhibition*

* Control of enzymatic activity by use of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Energy Production**

* Energy is stored in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Recall, covalent bonds form by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Energy is stored in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ covalent bonds
* Catabolism involves stripping “high energy” \_\_\_\_\_\_\_\_\_\_ from molecules and concentrate them in the bonds of ATP
* Reactions that involve removing and adding electrons are called “\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_” reactions

**Oxidation-Reduction reactions**

* Oxidation:
* Reduction:
* \_\_\_\_\_\_\_\_\_\_ reaction: an oxidation reaction \_\_\_\_\_\_\_\_\_ with a \_\_\_\_\_\_\_\_\_\_ reaction
* Catabolism is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ of highly \_\_\_\_\_\_\_\_\_\_\_\_\_\_ molecules

**The Generation of ATP**

* Energy released by redox reactions “trapped” by \_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_ is generated by the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of \_\_\_\_\_\_\_\_\_\_
	+ Addition of a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Requires energy
* 3 types of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to generate \_\_\_\_\_\_\_

Substrate-level phosphorylation

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of a PO4- to \_\_\_\_\_\_\_ generates \_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ process
* \_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_

Oxidative phosphorylation

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from organic molecule (\_\_\_\_\_\_\_\_\_\_\_\_\_\_) used to generate \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_) gradient
	+ Gradient used to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ production

Photophosphorylation

* Occurs only in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cells
* \_\_\_\_\_\_\_ transfers energy to \_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrons
	+ \_\_\_\_\_\_\_\_\_ get excited
* Excited \_\_\_\_\_\_\_\_\_\_\_\_ used to generate \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ gradient, drive \_\_\_\_\_\_\_\_ production
	+ Similar to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ phosphorylation, using \_\_\_\_\_\_\_\_ instead of \_\_\_\_\_\_\_ to build dam

**Metabolic pathways of energy production**

* Catabolism involves series of controlled reactions
	+ Releasing energy in one reaction generates too much heat
	+ Energy cannot be harnessed efficiently
* Catabolism involves a series of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ reactions
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ extracted to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Sequence of reactions called a \_\_\_\_\_\_\_\_\_\_\_
* Every reaction in a pathway is performed by \_\_\_\_\_\_\_\_\_\_\_

**Carbohydrate catabolism**

* Carbohydrates are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of energy
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_ is most common energy source
* Glucose is broken down via two general processes:
	+ Cellular respiration
	+ Fermentation

**Cellular Respiration**

* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (catabolism) of glucose
	+ Waste products are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Most of the \_\_\_\_\_\_\_\_\_\_\_\_\_ is produced via \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ phosphorylation
* Two types of respiration
	+ **\_\_\_\_\_\_\_\_\_\_\_\_\_** Respiration – with \_\_\_\_\_\_\_\_\_\_\_\_\_
	+ **\_\_\_\_\_\_\_\_\_\_\_\_\_** Respiration – without \_\_\_\_\_\_\_\_\_\_\_\_\_
* Multiple pathways involved

*Glycolysis*

* The \_\_\_\_\_\_\_\_\_\_ of glucose molecule (6 Carbons) to 2 pyruvic acid molecules (3 C)
* Main end-products
	+ 2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ 2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ 2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ via \_\_\_\_\_\_\_\_\_\_
* Electron Carriers
	+ \_\_\_\_\_\_\_\_ (empty electron carrier) removes electrons from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)
		- Becomes \_\_\_\_\_\_\_\_\_\_\_\_\_ (full electron carrier)
	+ \_\_\_\_\_\_\_\_\_\_ takes electrons to their final destination

*The pathway*

* Requires 2 \_\_\_\_\_\_\_ to get started
* \_\_\_\_\_\_\_\_\_ is \_\_\_\_\_\_\_\_\_\_ to \_\_\_\_\_\_\_\_\_\_\_\_
* Overall \_\_\_\_\_\_\_\_\_ produced by glycolysis

Glycolysis \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ require oxygen

*Alternatives to glycolysis*

* Pentose-phosphate pathway
	+ Uses \_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_ (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)
	+ Operates \_\_\_\_\_\_\_\_\_\_\_\_ with glycolysis
* Entner-Doudoroff pathway
	+ Produces \_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_
	+ Does \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ glycolysis

*Intermediate Step*

* Pyruvic acid (from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_) is \_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_ is produced
* \_\_\_\_\_\_\_\_ waste

*The Krebs Cycle*

* Aka \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or citric acid cycle
* A series of 8 reaction steps
* Completely catabolizes organic molecule to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Main products are \_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_, 1 ATP
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_ carriers
* Final end-product is same as starting reactant; a cycle

*The pathway*

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ enters Krebs cycle
* Generates \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* 1 ATP produced by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_ generated as waste

*The Electron Transport Chain*

* A series of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ pass electrons to ETC
	+ Become \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Return to glycolysis, Krebs cycle
* Energy released from \_\_\_\_\_\_\_\_\_\_\_\_\_ used to drive \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from inside cell to \_\_\_\_\_\_\_\_\_\_\_\_ cell
	+ Produced \_\_\_\_\_\_\_\_ concentration gradient – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Electrons end up on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ -
* ETC generates \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ gradient
* \_\_\_ gradient favors \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ into cell
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ diffuse across membrane freely
* \_\_\_\_\_\_\_ re-enters cell via \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Through transporter called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ captures energy in gradient
	+ Produces \_\_\_\_\_\_\_\_\_ 🡪 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Summary of Respiration**

* Aerobic respiration: the final electron acceptor in ETC is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Organism is an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Oxygen is converted to \_\_\_\_\_\_\_\_\_\_\_\_\_\_ 🡪 \_\_\_\_\_\_\_\_\_\_\_\_\_
* Anaerobic respiration: the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the ETC is \_\_\_\_\_\_\_\_\_
	+ Usually an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Yields \_\_\_\_\_\_\_\_\_\_\_\_ than aerobic respiration because only part of the Krebs cycle operates under \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ conditions
* \_\_\_\_\_\_\_\_\_\_\_\_\_ sources can be used
	+ Eg, can oxidize lipids, \_\_\_\_\_\_\_\_\_\_\_\_\_
* Polymers broken down by enzymes
* Smaller subunits enter catabolism at various points of glycolysis, Krebs cycle

**Fermentation**

* Scientific definition:
	+ Releases energy from \_\_\_\_\_\_\_\_\_\_\_\_\_ of \_\_\_\_\_\_\_\_\_\_\_\_ molecules (food)
	+ Does \_\_\_\_\_\_\_\_\_\_\_\_\_ oxygen
	+ Does not use the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Uses an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ as the final electron acceptor
* ATP generated only via \_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_ converted into organic molecule end-product 🡪 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Main purpose is to regenerate \_\_\_\_\_\_\_\_\_\_ (from \_\_\_\_\_\_\_\_\_\_\_) for \_\_\_\_\_\_\_\_\_\_\_\_\_
	+ \_\_\_\_\_\_\_\_\_\_ can participate in \_\_\_\_\_\_\_\_\_\_\_\_ again
* Produces \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of energy - \_\_\_\_\_\_\_\_\_\_\_\_ left in end-product

*The Pathway*

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ produces \_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ glucose during glycolysis
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_ produced during glycolysis
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ pyruvic acid; regenerates \_\_\_\_\_\_\_\_\_\_\_\_
* Lactic Acid fermentation produces \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Ethanol fermentation produces \_\_\_\_\_\_\_\_\_\_\_\_\_

**Chemotherapy**

* \_\_\_\_\_\_\_\_\_\_\_ 🡪 highly toxic
	+ Inhibit Cytochrome c Oxidase, enzyme in \_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_ ETC
	+ Cell cannot \_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Cell cannot \_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Cell \_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ not affected by cyanide

**Photosynthesis**

* Photo: conversion of \_\_\_\_\_\_\_\_\_\_ energy into \_\_\_\_\_\_\_\_\_\_\_ energy (\_\_\_\_\_)
	+ **\_\_\_\_\_\_\_\_\_\_\_\_-dependent (light) reactions**
* Synthesis:
	+ **Carbon \_\_\_\_\_\_\_\_\_\_\_\_\_**: fixing carbon into \_\_\_\_\_\_\_\_\_\_ molecules
* Light energy is absorbed by \_\_\_\_\_\_\_\_\_\_\_\_\_
	+ In \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of chloroplasts in eukaryotes
	+ In \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of prokaryotes
* Light energizes or “\_\_\_\_\_\_\_\_\_\_” \_\_\_\_\_\_\_\_\_\_\_ in \_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Excited electrons are passed on to \_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ ATP is generated
* Occurs in two ways:
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_ (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_ (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)

*Cyclic photophosphorylation*

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrons
* \_\_\_\_\_\_\_\_\_\_\_\_ passed on to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* ATP generated by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Electrons \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Noncyclic photophosphorylation*

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrons
* \_\_\_\_\_\_\_\_\_\_\_\_ passed on to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* ATP generated by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ - Electrons placed on \_\_\_\_\_\_\_\_\_\_\_\_ 🡪 forms \_\_\_\_\_\_\_\_\_\_\_\_\_\_
		- Electrons in chlorophyll replaced by electrons from \_\_\_\_\_\_\_\_\_\_\_\_\_ 🡪 \_\_\_\_\_\_\_\_ produced as waste

*Light-independent (Dark) reactions*

* + Aka The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cycle
	+ Uses ATP, NADPH produced by noncyclic photophosphorylation to “\_\_\_\_\_\_\_\_” \_\_\_\_\_\_\_\_\_\_
	+ \_\_\_\_\_\_\_\_\_ from \_\_\_\_\_\_\_\_\_\_
	+ Process requires lots of \_\_\_\_\_\_\_\_\_\_\_
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ produced

**Metabolic diversity among organisms**

* Organisms classified according to \_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Specifically, look at basic requirements to sustain life
* Two classifications based on \_\_\_\_\_\_\_\_\_\_\_ sources
	+ Phototrophs –
	+ Chemotrophs –
* Two classifications based on \_\_\_\_\_\_\_\_\_\_\_ sources
	+ Autotrophs –
		- Aka \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ Heterotrophs –
		- Aka \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Classification can be combined

* Photoautotroph
* Photoheterotroph
* Chemoautotrophs
* Chemoheterotrophs

**Chemoheterotrophs**

* Heterotrophs classified according to their source of organic molecule
	+ Saprophytes –
	+ Parasites –
* Metabolic diversity of great interest
	+ Can cause problems, provide potential solutions
		- Rubber degrading bacteria can destroy gaskets in machinery
		- BUT, can be used to degrade discarded tires
		- *Rhodococcus erythropolis* can cause disease in humans, animals
		- BUT, can remove sulfur from petroleum