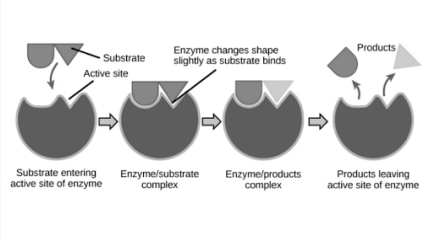
Enzymes



- **enzyme:** macromolecule that acts as a biological catalyst to speed up reactions by lowering E_A
- **substrate:** molecule that can interact with an enzyme
- **active site:** spot to specially interact with the substrate
- **cofactor:** non-protein bound to the active site to allow for the substrate to properly bind
- *coenzyme:* organic molecule serving as a cofactor

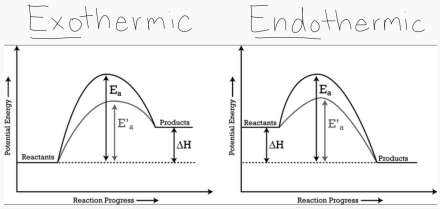
enzymes are reusable

Enzyme Lowers Activation Energy

1. Proper Alignment~	active site allows place for reactants (substrates) to come together
2. Pulls Reactants~	breaks chemical bonds before reaction
3. More Conducive~	chemical/physical properties better than those in surrounding environment
4. Form Temporary Bonds~	amino acids in active site bond with the substrate molecule

- catalyze either the forward or reverse reaction --- depends on the concentration of reactants/products

Enzyme Reaction Graphs



Enzyme Structure

- same as structure of proteins:	primary, secondary, tertiary, & quaternary
- shape denatures at...	
1. high temperature~	(thermal agitation) bonds disrupted
ideal at:	35-40 degrees
graph:	wide parabola
2. low pH~	(too acidic) hydrogen bonds disrupted
ideal at:	pH 6-8
graph:	steep parabola (log scale)
(3.) substrate concentration~	determine rate of collision
ideal at:	below saturation level
graph:	logistic growth (levels off)

Enzyme Activity

- competitive inhibitors:	enter the active site in place of the substrate
- noncompetitive inhibitors:	bind to a location that isn't the active site (allosteric site), change enzyme shape, & block substrate
- allosteric regulation:	binding of a regulatory molecule at a site that affects the function at a different site
	ex) allosteric deactivation & allosteric activation
- feedback inhibition:	end product of metabolic pathway acts as an inhibitor of an enzyme within the pathway

ATP Background

main 3 kinds of work performed:	1. chemical work- start reactions
	2. transport work- moving substances
	3. mechanical work- movement of cilia, contract muscles, etc.
ATP synthesis 2 ways:	1. substrate level phosphorylation
	↳ phosphate group removed from substrate & added to ADP to form ATP
	2. chemiosmosis (electron transport chain)
	↳ H+ ions move across membrane moving e- & uses that energy for ATP synthesis
- uncouplers:	chemical in liquid membrane that moves H^+ across the membrane (blocks ATP synthesis)

Energy

- metabolic pathway:	series of chemical reactions that has a starting molecule and results in a product
- catabolic pathway:	pathway that breaks down complex molecules/polymers into simpler molecules/monomers (releases energy)
- anabolic pathway:	pathway that uses simple molecules/monomers to form complex molecules/polymers (consumes energy)

Energy (cont)

- 1st Law of Thermodynamics~	conservation of energy
	↳ energy can be transferred/transformed, but can't be created or destroyed
2nd Law of Thermodynamics~	increases entropy/disorder (heat)
	↳ usable forms of energy are changed to useless forms

Free Energy

- free energy (ΔG):	portion of a system's energy that can perform work
	↳ must be *negative* for reaction to be spontaneous

	gravitational position	**solutes in solvent**	**molecules (size & #)**
higher ΔG	high altitude	clustered	large, few
lower ΔG	low altitude	dispersed	small, many

define	**how ΔG changes**	**example**

Free Energy (cont)

exergonic reaction:	spontaneous reaction with a net release of free energy	- ΔG	cellular respiration
endergonic reaction:	nonspontaneous reaction with free energy absorbed	+ ΔG	photosynthesis

Photosynthesis Background

equation:	**$6CO_2+6H_2O$ (+energy) → $C_6H_{12}O_6+6O_2$**
two processes:	1. light dependent reaction (light reaction)
	2. light independent reaction (dark reaction)
light reaction	**dark reaction**
- pigments trap light energy to transform into chemical energy	-forms glucose from CO_2, ATP, & $NADPH^+$
- breaks down H_2O to release O_2 ($2H_2O$ → O_2+4H^++4e-)	- light energy stored in bonds of glucose
- produces ATP from ADP	
- unites H^+ with $NADPH^+$	

Chloroplast Structure

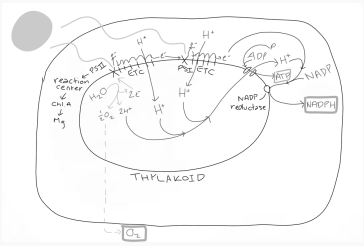
- light & dark reactions occur in chloroplasts
- inner membrane organized into structures that photosynthesis reactions are located
↳ *light* reactions occur in the *thylakoid*
↳ *dark* reactions occur in the *stroma*

Pigments

pigments absorb certain light wavelengths and reflect others

↳ *blue/violet:*	shortest & more energy
↳ *red:*	longest & less energy
- chlorophyll appears green due to reflecting green and absorbing red/blue	
- chlorophyll has at least 5 forms that vary:	
Chlorophyll type~	*Found in~*
1. Chl. A	all plants & algae
2. Chl B	all plants & green algae
3. Chl. C	brown algae
4. Chl. D	red algae
5. bacteriochlorophyll	some bacteria
- accessory pigments trap light wavelengths different from chlorophyll	(increase the amount of light used)
carotenoids~	*phycobilin~*
↳ carotene & xanthophylls	↳ in red algae & blue-green bacteria
↳ yellow, brown, orange colors	↳ absorb violet, blue, and green light
	↳ allow red algae to live deeper than other types

Light Dependent Reaction

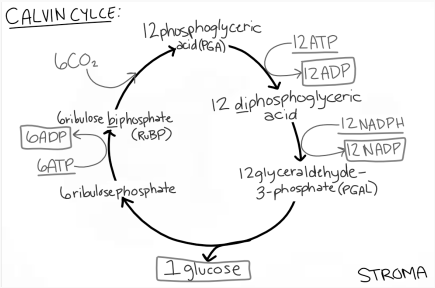


- scaffolds to reaction center → chlorophyll molecules → excited element e- (higher energy level) → e- out of photosystem II
- H_2O breakdown only PS II
- 2e- replaces lost e- in PS II
- e- lost by PS I is replaced by e- from PS II
- ETC taking steps to keep releasing energy for H^+ to pass through
- **products**: O_2, NADPH, & ATP

AP Biology: Unit 3 Cheat Sheet

by kmz_2022 via cheatography.com/145729/cs/31574/

Light Independent Reaction



- *RuBP carboxylase:**
↳ a.k.a. rubisco
↳ enzyme changes inorganic to organic
↳ 6 diphosphate (6C) -- split in half -- 12 phosphate (3C)

- ATP equivalents:
↳ 18 ATP (total) = 18 (1 each)
↳ 12 NADPH = 36 (3 each)
↳ TOTAL = 54 ATP used

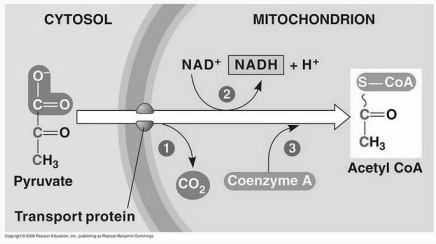
- ADP & NADPH used from light dependent reaction
- products: ADP, NADP, & glucose

Cellular Respiration Background

equation:	$C_6H_{12}O_6+6O_2 \rightarrow 6H_2O+6CO_2$ (+energy)
three stages (w/ O_2):	1. glycolysis
	(pyruvate processing)
	2. krebs cycle
	3. electron transport chain
two stages (w/o O_2):	1. gylcolysis
	2. fermentation

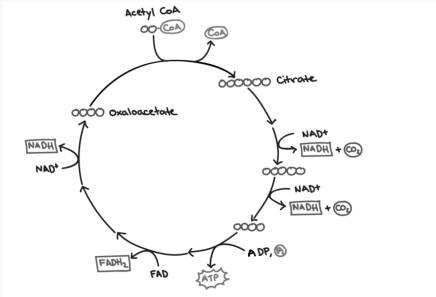
Glycolysis

Pyruvate Processing



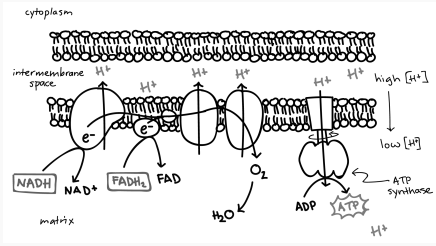
* occurs twice (once per pyruvate)
- location: mitochondria
- reactants: pyruvic acid, NAD^+, & coenzyme A
- products: CO_2, NADH, & aceytyl CoA

Krebs Cycle

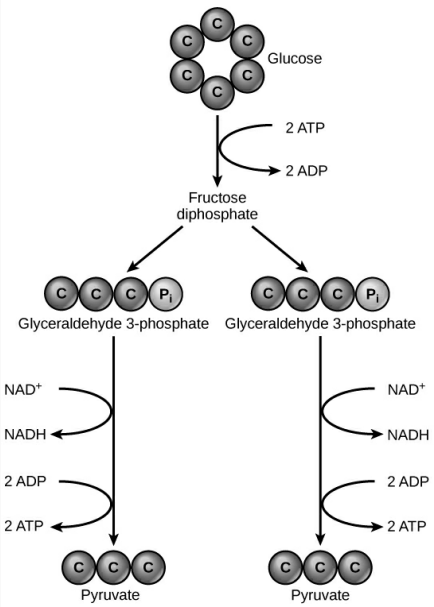


* occurs twice
* a.k.a. citric acid cycle
- location: mitochondria
**- reactants: pyruvic acid, FAD, NAD^+, & ADP
- products: CO_2, NADH, $FADH_2$, & ATP

Electron Transport Chain



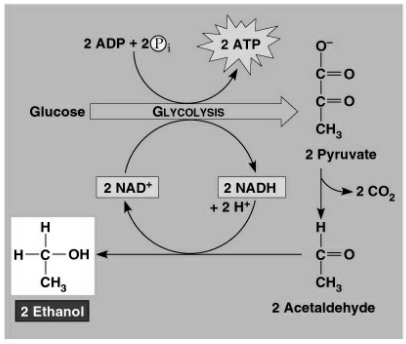
* occurs constantly
* a.k.a. oxidative phosphorylation
- e- from NADH & $FADH_2$ passed along chain = release energy every step
- H^+ moves through channel (energy released)
↳ ADP+P ➜ ATP
- e- combine with O = O_2
↳ O_2+ $2H^+$ ➜ $2H_2O$
- makes 32 ATP from 1 glucose
- location: inner membrane of mitochondria
- reactants: NADH, $FADH_2$, O_2, & ADP
- products: ATP, H_2O, NAD, & FAD



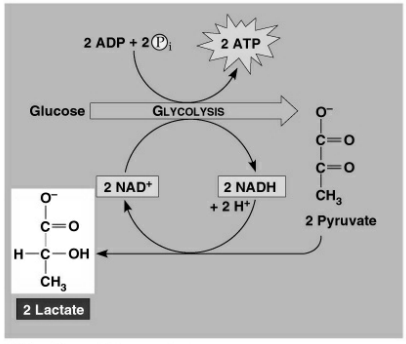
* occurs once
* all cells do this
* does NOT require O_2

- **location:** cytoplasm
- **reactants:** glucose, 2 ATP, 2 NAD^+, & 4 ADP
- **products:** 2 pyruvic acids, 2 NADH, & 4 ATP (*net gain 2*)

Fermentation



(a) Alcohol fermentation



(b) Lactic acid fermentation

* NO O2
* a.k.a. anaerobic cellular respiration
* no ATP production
* recycles NAD for glycolysis

- location: cytoplasm

Alcoholic Fermentation

- reaction: pyruvic acid+NADH ➜ ethanol+CO2+NAD

Lactic Acid Fermentation

- reaction: pyruvic acid+NADH ➜ lactic acid +NAD