Biology Metabolism Quick Reference

Version 0.5

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http://firmitas.org/

Glucose $C_6H_{12}O_6$

Food energy = H bonds

ATP energy = P bonds

Metabolism = sum of all chem. reactions.
Catabolism = breakdown of compounds.
Anabolism = building of compounds.
REDOX = reduction + oxidation.
Reduction= gain of e^-, H, ATP; loss of Oxy
Oxidation= loss of e^-, H, ATP; gain of Oxy
ATP = adenosine triphosphate
= adenine + ribose + phosphates
ADP = double P, AMP = monophosphate
Catabolism example is cell respiration =
$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_20 + ATP$
Anabolism example is photosynthesis =
$6CO_2 + 6H_20 + ATP \rightarrow C_6H_{12}O_6 + 6O_2$
Left side = reactants, right side = products

Enzymes= proteins that modify a *substrate*
They catalyze reactions without changing.
However they do degrade over time.
Most have 1 active site, some have 2 or 3.
Vitamins= cofactors, minerals= coenzymes
Inhibitors = competitive (blocks active site)
or not (uses allosteric site, changes active site).
Activation energy of enzymes is low.
Enzymes like certain pH & temp.
Acid kills enzymes; high temp denatures them.

Fermentation= glycolysis (O_2 lacking)
∃ ~20 kinds; humans use lactic acid type.
After exercise our muscles have lactic acid.
Terminal electron accepter is pyruvate.
ETC regenerates NAD+ from NADH.
1 glucose → 2 ATP, 2 NADH.
Non-cyclic phosphorylation=PSII, PS1
Cyclic phosphorylation: PS1 only
Substrate-level phosphorylation = ATP made during glycolysis.
Autotroph= organism makes its own food
Heterotroph= it consumes food

Cell Respiration = glucose → ATP.
~100 enzymes used (e.g. dehydrogenase).
ATP's last phosphate bond is high-energy.
Respiration= glycolysis + Krebs + ETC.
ADP bond only used in starvation situation.
NAD+ & e^- = NADH; FAD & e^- = $FADH_2$
O_2 *is terminal accepter* of glucose's H.
Mitochondrion= 2 bilayers, cristae, matrix
Glycolysis happens in cytoplasm.
Krebs (i.e. citric acid) cycle in matrix.
e^- Transp. Chain in cristae/inner membrane.
Oxidative phosphorylation = transfer of e^-
Substrate-level phosphorylation = xfer of P
Glycolysis→ 2 pyruvate, 2 ATP, 2 NADH
Pyruvates enter the mitochondrion, then…
Pyruvates→ 2 acetyl-CoA, 2 NADH, $2CO_2$
Acetyl-CoA is a 2-carbon molecule.
CoA is like a pass to enter the Krebs cycle.
Krebs→ 3 NADH, 1 $FADH_2$, 1 ATP, $2CO_2$
Krebs turns twice for each input glucose.
ETC→ 3 ATP per NADH, 2 per $FADH_2$
Net = 38 ATP per glucose.
Chemiosmosis= Protons pumped into inner membrane across *proton gradient*, then come out via ATP synthase to make ATP.

Plants (roots, shoots(stem, leaves, branch))
Leaf = mesophyll [, parenchyma].
Lower epidermis=stomata (2 guard cells).
Upper epidermis=cuticle, blocks H_20+CO_2
Chloroplasts= thylakoids(grana), stroma.
Thylakoids have chlorophyll in bilayer.
Tail of chlorophyll is hydrophobic.
Xylem carry water.
Phloem carry glucose.

Photosynthesis=Light reactions+Calvin cycle.
Visible spectrum is 390 nm to 760 nm.
Light reactions = Photosystem II, then I;
& occurs in thylakoids →ATP NADPH O_2
Light R. takes H_20 & light as input.
PSII uses P680 chlorophyll, PS1 uses P700
Calvin: ATP, NADPH & $3CO_2$ →1 G3P.
Calvin sends ADP & NADP+ to Light R.
Phase I carbon fixation RuBP+CO_2
via Rubisco → two 3-phosphoglycerates
Phase II reduction → **2 G3P**, NADP+ ADP
Phase III regeneration 1 G3P → (5C)RuBP
Two Calvin turns (=2 G3P) → glucose.
Chemiosmosis = *photophosphorylation*