

Name _____

Period _____

AP Biology

Date _____

REVIEW UNIT 3: METABOLISM (RESPIRATION & PHOTOSYNTHESIS)
“TOP TEN”

A. Top “10” — If you learned anything from this unit, you should have learned:

1. Overarching Concept: Energy production through chemiosmosis
 - a. pumping of H⁺ ions onto one side of a membrane through protein pumps in an Electron Transport Chain (ETC)
 - b. flow of H⁺ ions across the membrane down the concentration gradient through ATP synthase
 - c. drives the synthesis of ATP from ADP + P_i
2. Coupled reactions get the work done
 - a. oxidation & reduction reactions: Krebs & Calvin cycles
 - b. ETC & pumping of H⁺ (protons): light-dependent reactions & ETC of mitochondria
3. Cellular Respiration
 - a. aerobic respiration
 - glycolysis
 - a. cytoplasm
 - b. glucose(6C) → 2 pyruvate (3C)
 - c. produce 2 ATP & 2 NADH
 - d. substrate-level phosphorylation
 - Krebs cycle
 - a. mitochondrial matrix
 - b. pyruvate → acetyl CoA → Krebs
 - c. produce electron carriers (NADH & FADH₂) + 2 ATP + CO₂ (waste product)
 - ETC
 - a. mitochondrial inner membrane: cristae increase surface area
 - b. protein pumps embedded in membrane: cytochromes
 - i. remember cytochrome C
 - c. establish H⁺ gradient in intermembrane space, so they flow into matrix through ATP synthase
 - d. produce ~40 ATP
 - e. oxidative phosphorylation
 - i. O₂ = final electron acceptor

- b. anaerobic respiration: glycolysis, fermentation
 - low ATP production (~2 ATP)
 - alcohol fermentation
 - a. yeast
 - b. produce alcohol (2C) + CO₂ + NAD: not reversible, alcohol kills yeast
 - c. recycle NAD back to glycolysis so 2ATP can be produced
 - lactic acid fermentation
 - a. bacteria (yogurt & cheese) & animals
 - b. produce lactic acid (3C) + NAD: reversible
 - i. therefore animals can convert lactic acid back to pyruvate → Krebs cycle
 - c. recycle NAD back to glycolysis so 2ATP can be produced
- 4. Photosynthesis
 - a. light-dependent reactions
 - Photosystem II (ETC produces ATP) & Photosystem I (ETC produces NADPH)
 - light energy + splitting of water to donate electrons to chlorophyll reaction center
 - H⁺ gradient built up in inner thylakoid space & flows out into stroma
 - chloroplast: thylakoids, grana, stroma
 - photophosphorylation
 - b. Calvin cycle
 - light independent reaction
 - carbon fixation through RuBisCo enzyme
 - use ATP & NADPH from light reactions to produce of 3C sugars
 - c. C4 & CAM plants
 - adaptation in hot, dry ecosystems because stomates closed a lot
 - reduce photorespiration: low carbon fixation in a high oxygen/low CO₂
 - C4
 - a. physically separate carbon fixation from Calvin Cycle
 - b. new enzyme (PEP carboxylase) for carbon fixation
 - c. different anatomy
 - i. bulls eye: vascular bundle, bundle sheath cells, mesophyll cells, stomates
 - d. store carbon as 4 carbon sugars convert back to CO₂ in bundle sheath cells to feed CO₂ to RuBisCo
 - e. keep O₂ away from RuBisCo
 - f. grasses

- CAM
 - a. separate carbon fixation from Calvin Cycle by time
 - b. fix carbon at night when stomates open
 - c. store carbon as 4 carbon sugars convert back to CO₂ in day when stomates closed
 - d. cactus, succulents, pineapple
5. Regulation of metabolism is through negative feedback of enzyme pathways

B. Labs

1. Respiration

Be sure to review the procedures and the conclusions, and understand:

- a. Factors that affect rate of respiration
- b. How to set up a similar experiment
 - What was being measured?
 - How was generated CO₂ dealt with
- c. Controls vs. Experimental

2. Photosynthesis

Be sure to review the procedures and the conclusions, and understand:

- a. Factors that affect rate of photosynthesis
- b. How to set up a similar experiment
 - What was being measured?
 - What was DPIP's role?
- c. Controls vs. Experimental

3. Dissolved Oxygen

Be sure to review the procedures and the conclusions, and understand:

- a. Factors that affect primary productivity
- b. How to set up a similar experiment
 - What was being measured?
 - How was respiration measured?
 - How was photosynthesis measured?
 - How was gross productivity calculated?
 - How was net productivity calculated?
- c. How does this relate to health/stability of ecosystems?
- d. Controls vs. Experimental