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 & $FADH_2$) + 2 ATP + CO_2 (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. O_2 = final electron acceptor

b. anaerobic respiration: glycolysis, fermentation
   - low ATP production (~2 ATP)
   - alcohol fermentation
     a. yeast
     b. produce alcohol (2C) + CO_2 + 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 CO_2
      - 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 CO_2 in bundle sheath cells to feed CO_2 to RuBisCo
        e. keep O_2 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 CO_2 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 CO_2 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