BIOL 110: Dr. Staples's **MT2 Review** sheet – **Major Terms & Concepts** (this is NOT an exhaustive list!!) 3/9/2005

Starr Chapter:

4. Metabolism: potential (includes chemical) & kinetic energy, 1st law: total energy = constant; 2nd law: tendency toward disorder (*entropy*). **Endergonic, exergonic reactions, energetic coupling**, ATP/phosphorylation, electron transfers – Oxidation-reduction reactions, electron transport systems, **aerobic respiration** = NADH, $FADH_2$; **photosynthesis** = NADPH. ***Controlled energy release and harvesting (small packets)!!*** Concentration gradient, diffusion, metabolic pathways, **ENZYMES**, activation energy, catalysis, **active site/induced-fit** model. ***Allosteric control***, feedback inhibition, selective permeability – Passive transport, Active transport; Exocytosis, **Endocytosis**, Phagocytosis. **Osmosis: hypotonic, hypertonic, isotonic solutions**.

5. **Autotrophs**, **heterotrophs**, Photosynthesis (violet and red light) – ATP and or NADPH for **Carbon-fixation**. Chloroplasts, thylakoids, stroma→ make glucose→ sucrose, starch, cellulose. Pigments: chlorophylls, carotenoids, Photosystem II (P680)→ PSI (P700), Light-Dependent Rxns: Light splits $H_2O \rightarrow O_2$ + electrons and H, ATP synthesized from ETS *H+ gradient* (thru **ATP synthase**); PSI also makes ***NADPH*** electon carriers to drive **CO_2 fixation of C** into glucose. [controlled release/capture of energy in ATP& NADPH]. Light-Independent Rxns. (**Calvin-Benson Cycle**): *CO_2 + 5C (RuBP) →6C→ 2x 3C (PGA), + ATP + NADPH → 2x 3C PGAL → Glucose (+* regenerate *RuBP).*

6. Respiration – releasing stored energy. **ATP** = universal energy currency of cell; "**energetic coupler"**! (*exergonic to endergonic*). Glycolysis (invest 2, harvest 4 ATP): glucose→2x 3C Pyruvate (2 net ATP); Twice per Glucose: Pyr Oxid'n/Krebs Cycle/ETC (36 net ATP). NAD+, FAD+ Coenzymes, Acetyl-CoA, ETC electrons pump protons (stored Energy) = **Chemiosmotic Mechanism** of ATP synthesis at **ATP Synthase** enzyme → lots of ATP from electron transport (ETC) phosphorylation (ADP + Pi → ATP). **Anaerobic Fermentation** (alcoholic or lactate) regenerates NAD for glycolysis to repeat (only 2 ATP/glucose).

7. Reproduction: establishes the continuity of life. Asexual: ***MITOSIS*** → ***identical****/exact copies, diploid→diploid; identical daughter cells to mother.* **Nuclear divisions = mitosis & meiosis**! ***Somatic cells*** = mitosis; ***Germ cells*** = meiosis. Chromosomes, Chromatin, Chromatids. **Histones**, Nucleosome, Centromere, diploid, haploid. Cell cycle: **Interphase** (G1, S, G2) & mitosis (prophase, metaphase, anaphase, telophase). Spindle apparatus/ microtubules. Centrioles. Kinetochores, Microtubule Spindle, Centrioles/ Centrosomes. **Cytoplasmic Division/ CYTOKINESIS**: plant **cell plate**; animal **cleavage furrow** – contractile ring.

- Sexual Reproduction: **MEIOSIS**: Germ cells (eg: gonads - testes, ovaries) → gametes (eggs, sperm; haploid)→ Fertilization (zygote). *Generate **diversity/variation**: meiotic crossing over and random assortment (unique gametic combinations, unlike either original parent), random combination of alleles from two parents.* Diploid = 2n; Haploid = n. Meiosis I= ***reduction division***, 2n→n; Meiosis II (~mitosis), but n→n. Homologous chromosomes/homologs pair (prophase I); Sister chromatids separate, Ana. II. Fertilization: sperm (n) + egg (n) → zygote (2n).

8. **GENETICS**: **Mendel's** pea plants; *Genes, alleles, traits, true-breeding (homozygous), hybrid offspring (heterozygous),* ***Dominant, Recessive, Genotype, Phenotype***. P, F1, F2. Punnet Square, test cross; Law of **Segregation** (monohybrid cross), law of **Independent Assortment** (dihybrid cross). *Incomplete dominance, Codominance*. Temperature sensitive allele (Himalayan rabbits, Siamese cats); Environmental effects on phenotype; Continuous Variation of Traits.

Principles of Biology Midterm 2 (Spring 2005): STUDY QUESTIONS

Possible Short Essay Topics (be prepared to draw diagrams as well!):

1. Define exergonic and endergonic chemical reactions, and give an example of each. Define "energetic coupling", and diagram/explain how the endergonic and exergonic reactions can be coupled by the "Universal Energy Currency" of the cell (what is this "currency").
2. Describe how an enzyme binds a substrate. What is Activation Energy, and how does an enzyme speed-up a chemical reaction? *Use diagrams to illustrate your explanations.*
3. Describe and distinguish between the two types of Passive Transport, and Active Transport across biological membranes. *Draw diagrams to illustrate each process.*

4. Where do the electrons and energy for photophosphorylation come from? What type of energy is produced, and how can it be used to complete the Synthesis phase of photosynthesis?
5. Describe how chemiosmosis produces ATP in chloroplasts and mitochondria, and where it happens within these organelles. Where does the electron energy come from in photosynthesis, and in aerobic respiration?
6. Compare the ATP inputs and outputs of Glycolysis alone with those by Aerobic Respiration. How many ATP are consumed, and how many are produced in each process from start to finish? Where where are the most ATP produced during Aerobic Respiration? *Use diagrams to illustrate your explanations.*
7. *How many carbons enter and leave each of the 4 phases of Aerobic Respiration (Glycolysis, Preparatory step/Pyruvate Oxidation, Kreb's Cycle, and Electron Transport chain)?* In what form do all of the carbons leave? *Use diagrams to illustrate your explanations.*

8. Using diagrams, compare and contrast Mitosis and Meiosis I. What is the purpose of Mitosis, and of Meiosis? How do the differences between these two types of nuclear divisions serve this biological purpose?
9. Describe the three characteristics of Meiosis and Sexual Reproduction that contribute to the diversity of life on earth.

10. Describe the theory of Blending Inheritance. How did Mendel's first set of experiments disprove this theory?
11. Distinguish between Codominance and Incomplete Dominance, and give an example of each in nature.
12. What were the advantages to Mendel's experimental methods, and to using pea plants? Name two ways in which Mendel's experiments and results were "lucky".

**** NOTES on Problem-Solving:**

- Be able to recognize and distinguish each phase of Mitosis, Meiosis I, and Meiosis II.
- Be familiar with constructing Punnett Squares for Monohybrid and Dihybrid Crosses to predict Genotypic and Phenotypic outcomes of genetic Crosses.
- Be able to calculate probabilities for specific genotypic or phenotypic outcomes. (Work on the Genetics problems, and bring questions to lab and class!).
- Be familiar with the Monohybrid and Dihybrid phenotypic ratios, and what they tell us about patterns of inheritance.