**AP Biology Review Topics**

**Evolution**

**Natural Selection**

 Sickle Cell Anemia – heterozygote advantage

 Directional, Stabilizing, Disruptive and graphs

 Species definition

 Hybrid zones

**Hardy Weinberg Equilibrium**

 p,q = allele frequency; p2,q2, 2pq = population frequency (% of population with genotypes)

 practice problem

 Conditions for H-W equilibrium to be met:

 - no natural selection, no gene flow, large population size, mating is random, no mutation

**Evidence for evolution**

 Biogeography

 Fossils – oldest are deepest, sedimentary rock

 Anatomy

 Homologous – features evolved from same ancestor

 Analogous – similar use, different ancestral origin

 Embryology – early embryo forms resemble each other

 Vestigial – features that have lost their use over time but evidence of or structure remains

 Molecular Similarities – genes/proteins conserves across phyla, gene flow

**Conserved characteristics**

 Life, genetic code, metabolism, central dogma (dna🡪rna🡪proteins), eukaryotic /prokaryotic cell

**Phylogeny**

Convergent Evolution

Confuses evolutionary relationships – similar solutions to similar problems, diff. ancestral origins

Homology vs. analogy

Cladograms

**Genetic Drift**

 Founder effect, Bottleneck effect 🡪 reduce genetic diversity

**Speciation**

 Adaptive radiation (finches) – (diff. species evolved from one finch due to diff. environments)

 Barriers to reproduction – postzygotic and prezygotic

 Allopatric Speciation – caused by geographic isolation

 Sympatric Speciation – in a common range/area

**Abiogenesis/Miller Urey experiment**

 Organic molecules possible from inorganic ones

 Experiment proved it – shot electricity through a soup and formed essential organic compounds

**Ribozymes**

RNA as an enzyme – showed mechanism for reproduction of nucleic acids and RNA possible first genetic material

**Origin of Life**

Prokaryotic cells, Eukaryotic cells, Multicellular organisms, Horizontal Gene Transfer (confuses evolutionary relationships

 rRNA is used to examine relationships between bacteria, archae, eukarya

**Energy**

**Exergonic vs Endergonic**

 Exergonic – releases energy, catabolic/breaks down (cell respiration)

 Endergonic – absorbing energy, building/anabolic (photosynthesis)

**Cellular Respiration**

 Redox Reaction

 Glycolysis – glucose 🡪 2 pyruvate + 2 NADH + 2 ATP net (cytoplasm)

 Krebs/Citric Acid Cycle – Acetyl CoA 🡪 citrate (1st product) 🡪 2 ATP + CO2 + 2FADH2 + 6NADH

 Electron Transport Chain – Chemiosmosis/Phosphorylative Oxidation to make 34 ATP

Chemiosmosis –

H+ stripped from electron carriers (NADH and FADH2), pumped across membrane to make a high gradient so they can flow back through the ATP Synthase to make ATP



**Photosynthesis**

 Light Reaction – H2O split and O released, 2 ETCs -ATP and NADPH made for use in dark reaction

 Photosystems – absorb light and pass electrons/energy, protein complexes

 Calvin Cycle – carbon fixation, happens in stroma of chloroplast

 uses Rubisco (enzyme) to fix carbon

 converts CO2 to sugar (form of G3P)

 uses ATP and NADPH

 also known as the C3 cycle

**C4 and CAM plants**

 Adaptations for dry environments (prevent

 water loss)

 CAM – fix carbon at night

 C4 – use different enzyme (PEP carboxylase)

 to fix carbon, do Calvin cycle in bundle

 sheath cells instead of mesophyll

**Environmental matter exchange**

 Carbon Cycle – Photosynthesis and Respiration

 Nitrogen Cycle – Nitrogen fixing bacteria, nitrification and denitrification

 Phosphorous Cycle – rocks

**Biological Molecules and Cells**

**Macromolecules**

 Proteins – NCHO, amine group, carboxyl group, amino acids building blocks, peptide bonds

 Functions – enzymes, structure (hair/nails), defense (antibodies), receptors, O2 transport

 Lipids – CHO, long C-H tails that store a lot of energy, triglyceride building blocks (fatty acids +

glycerol), methyl functional groups

 Functions – long term energy storage, cushion, insulation, cell membranes (phospholipids)

 Carbohydrates – CHO in 1:2:1 ration, monosaccharide building blocks, glycosidic linkages,

glycogen, starch, glucose, cellulose

 Functions – energy, structure

 Nucleic Acids – CHONP, RNA/DNA, nucleotide building blocks

 Functions – instructions for protein building, genetic information

**Enzymes**

 Substrate, Active Site, Enzyme-Substrate Complex, Products

 Factors affecting enzyme reaction rates – temperature, pH, salinity, concentration

 Allosteric Inhibition – binding of molecule at site away from active site

 Competitive Inhibition – molecule blocks active site

 Activation energy – energy needed to start a reaction, enzymes LOWer activation energy

**Membranes**

 Fluid Mosaic model

 Phospholipids – hydrophilic head, hydrophobic tail, double layer, small nonpolar can pass thru

 Cholesterol – stabilizes membrane

 Proteins – peripheral, channel, glycoproteins (aid in recognition)

 Aquaporins – allow for quick passage of water

**Transport**

 Diffusion – high 🡪 low concentration, passive (no energy required), moves down conc. gradient

 Osmosis – diffusion of water

Active transport – low 🡪 high concentration, moves up conc. Gradient, endocytosis (taking in

Materials, phagocytosis) and exocytosis (getting rid of), Na/K pumps

**Cells**

 Organelles – ER (smooth and rough), Golgi, Membrane, Ribosomes, Lysosomes, Mitochondria,

Chloroplast, Vacuoles, Peroxisomes, Nucleus, Nucleolus, Chromatin

 Path of a protein in a cell 🡪 endomembrane system – nucleus->ER->Golgi->vesicles->membrane

Organization – cell – tissue – organ – organ system – organism

 Stem Cells – pluripotent

 Specialization – fated during gastrulation (3 germ layers – endoderm, ectoderm, mesoderm)

 Compartmentalization – increased efficiency

**Cell Communication**

 Short Distance - neurotransmitters

 Long Distance – hormones

 Receptors – receive information

 Bacteria – quorum sensing

**Signal Transduction Pathways**

 Reception - Transduction – Response

 Ligand – molecule that binds

 Phosphorylation Cascade, G protein coupled receptors, Secondary messengers, protein kinase

**Molecular Genetics and Heredity (DNA/RNA)**

**Structure of DNA (deoxyribonucleic acid) - Double stranded helix**

 Phosphate/Sugar (deoxyribose) backbone

 4 nitrogenous bases – adenine, thymine, guanine, cytosine

 Carries hereditary information

 Packaging – chromatin wound around histones 🡪 nucleosomes 🡪 looping/coiling🡪 chromosome

**Replication of DNA**

 Semi-conservative model – one new strand one old

 Unzips down middle (helicase), base pairing grows new strand (DNA Polymerase III)

 Leading and Lagging strand (only can copy in one direction)

 Ligase – glues Okazaki fragments (created by lagging strand) back together

 Proofreading (DNA Polymerase I) – finds mistakes and repairs them

 RNA Primer – attaches to parent strand to initiate DNA replication

**RNA (ribonucleic acid) – single stranded**

 Structure – same as DNA except single stranded, no thymine

 Uracil – instead of thymine as a base

 Involved in protein synthesis

 mRNA – messenger RNA

 tRNA – transfers amino acids

 rRNA – in ribosomes

 Modifications – alternative splicing, 5’ cap, polyA tail

 Introns and Exons – exons=expressed regions, introns=non-coding regions

 Methylation (turn genes off) and Acetylation (on)

**Mutations – permanent change in DNA**

 Point (Addition, Deletion, Substitution) Sense, Nonsense, Frameshift

 Underlying mechanism of evolution

 Cause variation in populations

 In cell cycle regulation – cancer

 Happen during cell division – mispairings or falty division

**Protein Synthesis**

 Central Dogma – DNA 🡪 RNA 🡪 amino acids 🡪 proteins

 Transcription – DNA copied into mRNA template

 Translation – mRNA translated into amino acids, tRNA delivers amino acids to growing chain

 Peptide bond – between amino acids

 Chaperonins – help fold proteins into their complex 3D shape

 Shape = function

**Gene Regulation**

 Operons (prokaryote) – only turn on when need to use/shut off when don’t need – energy efficient

* promoter, repressor, operator, genes (repressor binds to operator)
* Inducible – off until turned on (lac) and Repressible – on until turned off (trp)

Enhancers (eukaryotic)

Transcription factors (euk)

Methylation and Acetylation (euk)

 Epigenetics (euk) – expression of the genome as a result of methylation (turns off genes)

**Cell Cycle and Division**

4 phases of cell cycle – G1(growth), S (DNA copied), G2(growth),

M (mitosis/meiosis)

 Interphase – G1, S , G2, - cell spends most of time here

 G0 – non-diving acquiescent state of cell – nervous system

cells, liver

 Checkpoints – ensure everything going correctly

* Checkpoints ignored 🡪 cancer

 Mitosis – growth and repair, asexual reproduction

one cell division, makes identical copies

 4 phases – prophase, metaphase, anaphase,

telophase/cytokinesis

 Meiosis – formation of gametes (egg and sperm), sexual reproduction

 Two cell divisions, 4 different daughter cells formed

 8 phases – prophase I and II, metaphase I and II, anaphase I and II, telophase I and II

 1st division – homologous pairs line up across from each other and one set goes to each cell

 2nd division – chromosomes line up on equator and chromatids split at centromere

 Increases variation

 Spermatogenesis (makes 4 sperm) and Oogenesis (1 egg and 3 polar bodies)

**Genetics**

 Mendelian Inheritance – dominance and recessive

 Monohybrid cross (Bb x Bb) – 3:1 phenotype ratio

 Dihybrid cross ( BbCc x BbCc) – 9:3:3:1 phenotype ratio

 Probability rules – do small punnett squares and multiply the chances of the traits together

 Sex-linked – either on X or Y – don’t follow 3:1 ratio

 Incomplete Dominance – think PINKcomplete – white x red flower makes pink flowers – blend

 Codominance – neither allele is dominant over the other – ABO blood groups (AB)

 Chi-squared – tests the statistical significance of the results obtained through genetic crosses

* Figure out the expected by doing a punnett square using your assumed relationship
* Observed is the actual amount observed in the cross
* Degrees of freedom are possible outcomes minus 1
* Use .05 column



**Viral Replication**

 Lytic Cycle and Lysogenic cycle 🡪

 Reverse Transcriptase

 Lysis – cell ruptures

 Vaccines – help defend

**Ecology and Plants**

**Transpiration**

 Pull of water from leaves to shoots

 Moves from high water potential 🡪 low water potential

Water potential = solute potential + pressure potential

Factors that increase evaporation will increase transpiration

Xylem – carries water, moves upward; Phloem – carries sap, moves downward

**Stomates**

 Help regulate water loss in plants – open and close to let in/out water and gases

 K+ ions help to regulate their opening and closing through guard cells

**Plant Adaptations for water loss**

 CAM/C4 plants, waxy cuticle, stomata position on leaves (ie. none on top to be shaded from sun)

**Dissolved Oxygen**

 Temperature, Photosynthetic activity, Decomposition, Mixing/Turbulence, Salinity have effects

 Respiration uses up oxygen in aquatic systems, photosynthesis supplies it

 Primary Productivity – rate at which plants produce organic compounds in an ecosystem

**Populations**

 Predator-Prey interactions

 Competition – Interspecific (between species) and Intraspecific (within species)

**Plant Hormones**

 Auxins – stimulate phototropism (growth towards light)

 Tropisms – gravitropism, thigmoidtropism, photropism

**Plant Defenses**

**Invasive Species**