ADVANCED PLACEMENT BIOLOGY Curriculum Map

See attached pages for Learning Targets and College Board© Essential Knowledge references (students are also given a complete copy of the AP Biology Course and Exam Description – June 2015, pg. 5-102 https://apcentral.collegeboard.org/courses/ap-biology?course=ap-biology

Approximate course calendar

- Unit 1 – Introduction, Nature of Science, Biochemistry, and Energetics 8-9 weeks
- Unit 2 – Evolution 4-4 ½ weeks
- Unit 3 – Ecology 3 weeks
- Unit 4 – Cells & Introduction to Homeostasis 6 weeks
- Unit 5 – Animal Homeostasis & Cellular Respiration 5 weeks
- Unit 6 – Plant Homeostasis & Photosynthesis 2 weeks
- Unit 7 – Inheritance & Genetics 2 – 2 ½ weeks

Grading/Assessments

1st Semester

Practice/Formative Assessment	35%
Summative Assessment	30%
Lab work	20%
Free Response Writing	15%

2nd Semester

Practice/Formative Assessment	15%
Summative Assessment	50%
Lab work	20%
Free Response Writing	15%

Methods used to determine student understanding may include, but are not limited to the following:

Small group interactions
Whole class discussions
POGILs and other similar activities
Interactive, multimedia activities
Index card assessments & reflections
Laboratory Experiences: guided & inquiry
Free Response writing
Summative exams will be cumulative, approximately one per 4-6 weeks

2018 National Exam Date: Monday May, 14 – students will need to be at school by 7:30 a.m. on test day

Unit 1: INTRODUCTION/NOS/BIOCHEMISTRY/ENERGETICS

1 – The Science of AP Biology

Read all of chapter 1

- → *An understanding of what the Big Ideas are & how they relate to what will be studied in this course*
- → *An understanding of what the 7 Science Practices are & how they relate to what will be studied in this course*
- → *Characteristics of living systems*
- → *Hierarchical organization of living systems*
- → *Structure-function relationships*
- → *Evidence that supports Darwin's theory of evolution by natural selection*
- → *The essential components of a scientific investigation:*
  - ↳ *Observation & question formulation*
  - ↳ *Independent, dependent, & confounding variables*
  - ↳ *Control v. experimental groups*
- → *How to craft a hypothesis as an experimental prediction*

2 – The Nature of Molecules and the Properties of Water

Review chapter 2 – most should be review; determine areas needing further discussion; we will discuss water and acids/bases

- → The relationship between structure & function at the molecular level
- → Interactions between atoms, elements, & molecules
- → Chemical bonds important in biological systems (covalent, hydrogen, ionic, & van der Walls interactions), how they form, & their comparative strength
- → The difference between polar & nonpolar covalent bonds
- → How hydrogen bonds determine the properties of water, & how these properties influence life on Earth
- → How hydrophobic & hydrophilic portions of molecules interact with water
- → How to interpret the pH scale
- → The importance of buffers in stabilizing pH & maintaining homeostasis in biological systems

Framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
28-9	2.A.3.a	Main emphasis on 2.A.3.a.3 *properties of water due to its polarity and bonding*

3 – The Chemical Building Blocks of Life

Review chapter 3 – most should be review; determine areas needing further discussion.
You do not need in-depth understanding of biomolecules (e.g., motifs & domains, chaperone proteins); just read for the big picture

- → The properties of the carbon atom that make it the building block of biological molecules
- → The significance of the CHNOPS elements
- → Categories of the four biological macromolecules (carbohydrates, lipids, proteins, & nucleic acids) and their *representative* structural formulas
- → The biological functions of each of the four categories of macromolecules
- → How the additions of functional groups change the chemical properties of hydrocarbon chains
- → The process of dehydration synthesis in building organic molecules & the process of hydrolysis in breaking down organic molecules
- → The four levels of protein structure & the forces that help maintain each level
- → The denaturing effect of heat & pH on a protein's structure

14 – DNA: THE GENETIC MATERIAL

Read chapter 14 for understanding of the key concepts listed below; much should be a review

- → Historical experiments that provide evidence that DNA is the carrier of genetic information
- → The molecular structure of DNA
- → The importance of complementarity to the structure & function of DNA
- → The process of DNA replication: the major steps, the role of key enzymes, & the semiconservative model

Framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
14-15	1.B.1.a	
20-21	1.D.2.b.1	
50	3.A.1.a.1, 4, 5	Also visit www.dnai.org/timeline
50-51	3.A.1.b (all)	
52-53	3.A.1.d	
81-82	4.A.1 (all)	
89	4.B.1.a	

6 – ENERGY AND METABOLISM

Read all of chapter 6 – we will discuss most of this chapter

- → Forms of energy (potential v. kinetic)
- → Sources of energy in biosphere
- → Oxidation-reduction reactions
- → Laws of thermodynamics
- → Endergonic v. exergonic reactions
- → Enzymes & activation energy
- → Catalytic cycle of an enzyme, i.e., how the enzyme is not permanently altered & how a product is produced from substrate(s)
- → Factors that affect enzyme function, (e.g., temperature, pH, enzyme or substrate concentration, salinity)
- → Regulation of enzymatic activity (e.g., feedback inhibition, competitive v. non-competitive inhibitors, activators)
- → Structure of the ATP (or GTP) molecule
- → How structure of ATP enables it to transfer energy within the cell

Framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
23	2.A.1.a, b	
28	2.a.2h	
89-90	4.B.1.b, c, d	

Unit 2: EVOLUTION

20 – GENES WITHIN POPULATIONS

Read sections 1-6; skim rest of chapter

- → *The difference between Darwin's evolution by natural selection & Lamarck's inheritance of acquired traits*
- → *The connection between genetic variation in a population & evolution*
- → *How evolution can be measured as changes in allele frequencies in a population*
- → *The five conditions that must be met for a population to be in Hardy-Weinberg (H-W) equilibrium*
- → *How to use the H-W equation to calculate genotype frequencies & allele frequencies in a population in order to detect whether a population is evolving*
- → *Agents of evolutionary change, & an example of each*
- → *The principle of heterozygote advantage & an example*
- → *How the fitness of a population is measured by its survival advantage & reproductive success*

Framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
10	1.A.1 (all	
11	1.A.2 a-c	
12	1.A.3 (all)	
12-13	1.A.4.b.3 & 4	
64	3.C.1.d	
94	4.C.1.b.1	
95-96	4.C.3.b & c	

21 – THE EVIDENCE FOR EVOLUTION

Read for types of evidence of evolution & specific examples

- → *Examples of how the fossil record provides evidence for evolution*
- → *Examples of how artificial selection provides evidence for evolution*
- → *Examples of how morphological features/comparative embryology provide evidence for evolution*
- → *The difference between homologous & analogous structures, & what each indicates about evolution*
- → *Examples of how molecular information provides evidence for evolution*
- → *How convergent evolution supports the mechanism of natural selection*
- → *How variation (e.g., Darwin's finches), adaptation, heritability, reproductive success, & time are used to explain evolution by natural selection*

Framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
11	1.A.2.d	
12	1.A.4.a	
12-13	1.A.4.b.1 & 2	
18	1.C.3 (all)	
95	4.C.3.a	

22 – The Origin of Species

Read sections 1-4; main points from 5 & 6

- → *The difference between the biological species concept & the ecological species concept*
- → *How prezygotic & postzygotic isolating mechanisms maintain reproductive isolation, & examples of each*
- → *The distinction between allopatric & sympatric speciation, & the conditions required for each to occur*
- → *The difference between gradualism & punctuated equilibrium with regard to the rate of evolutionary change*
- → *How phenomena such as genetic drift, sexual selection, artificial selection, & human impact on ecosystems can affect speciation*
- → *Examples of factors that affect the rates of speciation & extinction*
- → *Examples of evidence to support the claim that life continues to evolve on Earth*

Framework pg	**ESSENTIAL KNOWLEDGE**	**NOTES/COMMENTS**
17	1.C.1.a	
17-18	1.C.2 (all)	
64	3.C.1.c.1	

23 – SYSTEMATICS, PHYLOGENIES, AND COMPARATIVE BIOLOGY

Mostly covered through activities; good reference for vocabulary & examples

- → *What a phylogeny represents*
- → *The difference between ancestral & derived characteristics*
- → *How a phylogenetic tree or cladogram is constructed from shared derived characteristics*
- → *How phylogenetic tees are constructed to depict evolutionary relationships based on scientific evidence*
- → *How phylogenetic trees can indicate the timing of species diversification*

Framework pg	**ESSENTIAL KNOWLEDGE**	**NOTES/COMMENTS**
15-16	1.B.2 (all)	

26 – THE ORIGIN AND DIVERSITY OF LIFE

Read for general concepts (additional information can be found in chapter 59)

- → *The approximate age of Earth & the timing of key biological events associated with the three domains of life: Archaea, Bacteria, & Eukarya*
- → *The conditions on primitive Earth and its atmosphere*
- → *How the Miller-Urey experiment tested & supported the spontaneous "organic soup" model of the origin of life hypothesis*
- → *One or two other hypotheses about the origin of life (e.g., RNA World and reactive surface)*
- → *The main categories of the hierarchical taxonomic system, & how they indicate evolutionary relationships among organisms*
- → *The origin of mitochondria & chloroplasts through endosymbiosis*
- → *Examples of shared, conserved core processes*
- → *How phylogenetic trees are constructed from scientific evidence (e.g., fossils, molecular data) to reflect evolutionary relationships among organisms*

Framework pg	**ESSENTIAL KNOWLEDGE**	**NOTES/COMMENTS**
17	1.C.1.b	POGIL (& ch. 59)
19	1.D.1 (all)	
20	1.D.2 (all)	

Unit 3 - ECOLOGY

54 – BEHAVIORAL BIOLOGY

Read sections 1, 4, 5, 7-9, main concepts of 11-12; skim sections 2, 3, 6, 10

- → *The evolutionary importance of animal behavior: behavior is a selectable phenotype that can increase fitness*
- → *Examples of behaviors that increase fitness of both the individual & the population (e.g., courtship rituals, flocking, migration patterns, foraging, predator warning & other avoidance behaviors, maternal behaviors)*
- → *The difference between innate & learned behaviors, examples of each, & the survival advantages of each*
- → *Examples of animal communication*
- → *Examples how animals detect & respond to external (i.e., environmental) signals*
- → *Examples of internal mechanisms that control behavior (e.g., genes, hormones, neurotransmitters, neural circuits, reflex arcs)*
- → *How inclusive fitness is related to kin selection, & under what circumstances it can lead to altruistic behavior*

Framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
36	2.C.2	
43-44	2.E.2.b	
44-45	2.E.3.a	
45	2.E.3.b.3	
73-75	3.E.1 (all)	

55 – ECOLOGY OF INDIVIDUALS AND POPULATIONS

Read: main concepts in all sections

- → Examples of environmental (abiotic) factors that can impact population dynamics
- → The components that can be used to characterize a population: density, dispersion, & demographics
- → The differences between exponential & logistic models of population growth
- → The differences between *r*-selected & *K*-selected life history adaptations
- → How density-dependent & density-independent factors regulate population growth
- → The concept of carrying capacity, & how it can affect population size
- → How to interpret human population pyramids

Framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
37-38	2.D.1. (all)	
86-87	4.A.5.c (all)	
87-88	4.A.6.e	
91	4.B.3.b	
95-96	4.C.3.a-b	

56 – COMMUNITY ECOLOGY

Read: main concepts in all sections

- → The difference between an organism's fundamental niche & its realized niche
- → The effects of interspecific competition, & how it can lead to competitive exclusion or species adaptation
- → The four types of symbiotic relationships (predation, parasitism, mutualism, & commensalism) & an example of each
- → The characteristics of a keystone species, & the impact of a keystone species on community structure, & an example
- → The difference between Batesian & Muellerian mimicry, & an example of each
- → The difference between primary & secondary succession, & an example of each on the community & ecosystem

Framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
37	2.D.1.b	
45	2.E.3.b.4	
73	3.E.1 (all)	
86	4.A.5.b	
91	4.B.3.a (all)	
91	4.B.3.c	
96	4.C.4 (all)	

57 – DYNAMICS OF ECOSYSTEMS

Read: main concepts in all sections

- → How energy flows through an ecosystem
- → The trophic levels of a food chain – primary producers, primary consumers, secondary consumers, tertiary consumers, & decomposers – and specific examples of terrestrial & marine food chains
- → How nutrients cycle within food chains & food webs, and the specifics for the water, carbon, & nitrogen biogeochemical cycles
- → The difference between gross primary productivity & net primary productivity
- → The relationship between biodiversity & ecosystem stability

Framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
23-24	2.A.1.e-f	
28	2.A.3.a.1-2	
37-38	2.D.1.c	
39	2.D.3.b	
86	4.A.5.a	
87	4.A.6.a-d, f, g	

58 – THE BIOSPHERE

Skim chapter to address the key concepts and essential knowledge statements

- → The effects of abiotic factors in the development of biomes
- → Examples of major terrestrial, marine, & freshwater biomes, & their characteristics

Framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
92	4.B.4 (all)	

59 – CONSERVATION BIOLOGY

Read: 59-1 & 2 (additional examples & reinforcement of importance of biodiversity); rest of chapter as needed for additional examples of the listed EK statements)

Framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
11	1.A.2.d	
17	1.C.1.b	
39	2.D.3.b	
86	4.A.5.a	
92	4.B.4.a	
95-96	4.C.3.a	

Unit 4: Cells & Introduction to Homeostasis

4 – Cell Structure

Review chapter 4 – most should be review; determine areas needing further discussion

- → The differences between prokaryotes & eukaryotes
- → The structure & function of the organelles found in animal & plant cells
- → Interactions between subcellular components
- → Factors that limit cell size, & how cell shape relates to cell function
- → The origin of mitochondria & chloroplasts through endosymbiosis

Framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
14-15	1.B.1.b	
28-29	2.A.3.b	
31	2.B.1.c	
33	2.B.3 (all)	
69	3.D.2 (all)	
82-83	4.A.2 (all)	
90	4.B.2.a.1	

5 – Membranes

Review chapter 5 – much should be review; determine areas needing further discussion

- → Why cell membranes need to be selectively permeable
- → The molecular components of the cell membrane (fluid mosaic model; phospholipids, proteins, carbohydrates, & cholesterol) & the function of each
- → Formation of concentration gradients across membranes (e.g., electron transport systems, Na+/K+ pumps)
- → Passive transport processes (diffusion, osmosis, & facilitated diffusion) & cellular examples of each
- → Active transport & cellular examples
- → Water potential and effects on animal & plant cells placed in hypotonic, hypertonic, & isotonic solutions
- → Bulk transport processes (endocytosis & exocytosis) & cellular examples of each

Framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
31	2.B.1 (all)	
32	2.B.2 (all)	

9 – CELL COMMUNICATION

Read: main concepts in all sections (read for supportive details to the POGIL; focus on the big picture)

- → How cells communicate through a system of complementary-shaped molecules: signal molecules (ligands) & membrane or intracellular protein receptors
- → The three stages of cell signaling: reception, signal transduction, & cellular response
- → How phosphorylation is a common mechanism for activating or deactivating protein function
- → How cell-surface receptor proteins receive chemical signals from hydrophilic ligands which cannot pass through the cell membrane
- → Example(s) of membrane-receptor systems such as neurotransmitters, G protein-coupled or tyrosine receptors
- → How intracellular receptors within the cytosol receive signals from hydrophobic ligands that pass through the cell membrane
- → Example(s) of intracellular receptor systems such as steroid hormones triggering gene expression
- → How membrane receptors trigger secondary messenger systems within the cell & often amplify the signal via a cascade
- → Example(s) of a secondary messenger system such as the glucagon-cAMP cascade that riggers glycogen hydrolysis or the MAP kinase cascade that advances the cell cycle

Framework pg	**ESSENTIAL KNOWLEDGE**	**NOTES/COMMENTS**
68	3.D.1 (all)	
69	3.D.2 (all)	
70-71	3.D.3 (all)	
71-72	3.D.4 (all)	

42 – THE ANIMAL BODY & PRINCIPLES OF REGULATION

Read 42.6 and 42.7 for background on body system communication & feedback mechanisms

- → How vertebrate cells are organized into tissues, organs, & organ systems, & examples of each
- → How negative & positive feedback loops maintain internal homeostasis when external environmental conditions change, & an example of each
- → How body temperature is regulated in vertebrates
- → The relationship between body mass & metabolic rate

52 –THE REPRODUCTIVE SYSTEM

Read 52.3 & 52.4 for hormonal control

- → The role of positive and negative feedback mechanisms in the functioning of the reproductive system

Framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
23-24	2.A.1.d.3-5	
34-35	2.C.1 (all)	
38	2.D.2.a	

43 – THE NERVOUS SYSTEM

44 – SENSORY SYSTEMS

Read: 43.1 – structure of neuron; 43.2-43.3 – nerve impulse transmission & communication; 43.4 & chapter 44 to support 3.E.2.d

- → Structure of the neuron as an example of the major theme of the relationship between structure & function
- → How movement across a cell membrane by diffusion & active transport applies to the function of neurons
- → The detailed mechanism of how a nerve impulse is transmitted along a neuron
- → How the release of a neurotransmitter is triggered at the axon terminal with examples of inhibitory or stimulatory neurotransmitters
- → What happens at the synapse to transmit a nerve impulse across the junction
- → The organization & function of the major parts of the nervous systems: CNS & PNS
- → The general structure of the brain, & examples of functions of each major brain region
- → The organization & function of a reflex arc

Framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
75-77	3.E.2 (all)	

Unit 5: Animal Homeostasis and Cellular Respiration

CHAPTER 7 – HOW CELLS HARVEST ENERGY

Read all; but focus on the major concepts (look at 2.A)

Apply these principles

1. The point is to make ATP
2. In biology, moving hydrogens moves electrons; moving electrons moves energy
3. Oxidation and reduction reactions are coupled

Be sure to review the basics of metabolism, free energy, etc. (ch. 6)

- → *The fundamental differences between fermentation & cellular respiration: the inputs, the conditions that trigger each process, & the products of each process*
- → *That glycolysis is a universal metabolic process in both prokaryotes & eukaryotes*
- → *The summary of each stage of aerobic respiration: the inputs & products of each, where each stage occurs in the cell, & the efficiency of ATP production in each*
- → *That glycolysis oxidizes glucose to produce 2 pyruvate molecules & a net yield of 2 ATP*
- → *How pyruvate is transported from the cytosol to the Krebs cycle in the mitochondria*
- → *The value of the Krebs cycle in the production of electron carriers NADH & $FADH_2$, which will deliver electrons to the electron transport chain, & ultimately, oxygen*
- → *How the electron transport chain harvests electrons from NADH & $FADH_2$ to fuel chemiosmosis*
- → *The enzymatic role of ATP synthase in the synthesis of ATP from ADP and P_i, & how a proton gradient across the mitochondrial membrane is needed to drive this reaction*
- → *How the double-membrane structure of the mitochondria enable their function in chemiosmosis*

Framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
23-24	2.A.1.b, c, d	(ch 42 for endotherm vs. ectotherm)
25-28	2.A.2.b, c, f, g, h	
38-39	2.D.2.b, c	(also see ch 42)
83	4.A.2.d	
85	4.A.4	Connect cell resp. to organs & systems
90	4.B.2.a.2	Connection to organs

45 – THE ENDOCRINE SYSTEM

Skim chapter to address the key concepts and essential knowledge statements

- → How the mechanisms by which hormones transmit messages to cells are an application of the basic principles of cell communication systems (signal transduction)
- → The different action on target cells of fat-soluble & water-soluble hormones
- → Illustrative examples of the function of hormones such as
  - ↳ Trigger for secretion, where hormone is secreted, target cells, hormone action, & regulation
  - ↳ Blood sugar level (insulin & glucagon), blood osmolarity (ADH), blood calcium level (PTH & calcium), metabolism (TSH & thryroxine), & the menstrual cycle (estrogen, FSH, LH, progesterone)
- → How negative feedback works to regulate homeostasis, and some examples
- → How positive feedback works to regulate homeostasis, & some examples
- → From chapter 52: the connection between the reproductive system & the endocrine system in the regulation of the menstrual cycle

Framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
34-35	2.C.1 (all)	
68	3.D.1.d	
69-70	3.D.2.c	

CHAPTER 51 –THE IMMUNE SYSTEM

Read sections 1-4; be able to tie this chapter back to cell communication

- → Several elements of an innate immune response
- → The differences between B & T cells relative to their activation & actions
- → How antigens are recognized by immune system cells
- → The differences in humoral & cell-mediated immunity
- → Why helper T cells are central to immune responses

TIPS

- → **B cells** make antibodies, which provide humoral immunity. This helps fight pathogens that are circulating in body fluids
- → **Cytotoxic T cells** destroy body cells that are infected by a pathogen or cancer cells
- → **Helper T cells** activate both B and T cells

Framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
39	2.D.3.a	
40-41	2.D.4. (all)	
94	4.C.1.a	

Unit 6: Plant Homeostasis and Photosynthesis

8 – PHOTOSYNTHESIS

Read all (you don't have to know minute details – use chapter review and key concepts listed below to help you focus as you read the chapter); from 8.7, only general concepts

- → How the photosystems collect light energy & convert it to chemical energy
- → How photosystem II produces ATP by chemiosmosis in the light-dependent reactions
- → How the double-membrane structure of the chloroplasts (thylakoids) enable their function in chemiosmosis
- → How photosystem I produces NADPH in the light-dependent reactions
- → How the Calvin cycle (light-independent or carbon-fixing reactions) uses the product of the light-dependent reactions to synthesize sugar (G3P)
- → The evolutionary origins of photosynthesis in prokaryotes & the production of an oxygenated atmosphere & its consequences
- → The commonalities & distinctions between photosynthesis in chloroplasts & aerobic respiration in mitochondria

Framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
25-28	2.A.2.a, c, d, e, g	
33	2.B.3.a, b	Chloroplast vs. mitochondrion
84	4.A.2.g	
94	4.C.1.a	chlorophylls

36 – PLANT FORM

Read for supporting information to the key concepts listed below; some aspects will be review from earlier in course, some aspects will be re-emphasized in the last unit

- → Structure & function of xylem & phloem as an example of complementarity of structure & function
- → Basic organization of the plant body: shoot system (buds, leaves, stems) & root systems (roots, root hairs)
- → Structure & function of guard cells & stomata
- → Structure of a typical leaf, & how that structure relates to the process of photosynthesis
- → How the apical meristem of roots reflects areas of active mitosis
- → How the regulation of gene expression relates to tissue specialization in plants

37 – TRANSPORT IN PLANTS

Read for supporting information to the key concepts listed below; many of the concepts should serve to review & reinforce earlier content (illustrative examples)

- → How the mechanisms of transport in plants are applications of the basic concept of movement across cell membranes by diffusion, osmosis, & active transport
- → How cohesion, adhesion, & evaporation produce transpirational pull on water in the xylem of a plant
- → The mechanisms of transport between cells in a plant, such as active transport proton pumps, passive symport (cotransport) channels, passive transport ion channels, osmosis through aquaporins, & flow through plasmodesmata
- → The roles of diffusion, active transport, & bulk flow in the movement of water, minerals, & organic molecules through xylem & phloem
- → How root hairs & symbiosis with mycorrhizal fungi serve as adaptations to increase water absorption by roots
- → How stomata provide homeostatic regulation of water, carbon dioxide & water
- → The turgor mechanism that regulates the opening & closing of stomata
- → Examples of environmental factors that affect rate of transpiration
- → Adaptations in plants that allow them to withstand drought, flooding, & high-salt environments

Framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
28-29	2.A.3.a	36
29	2.A.3.b.1	36 (revisit)
32	2.B.2.a, b	(Revisit homeostasis & cell transport mechanisms)
34	2.C.1	Stomata (feedback mechanism)
37	2.D.1	37
38	2.D.2.b	36 & 37
85	4.A.4	36 & 37

39 – PLANT DEFENSE RESPONSES

Read for supporting information to the key concepts listed below; many of the concepts should serve to review & reinforce earlier content

- → A few examples of physical & biochemical adaptations in plants that protect them from herbivores & parasites, including induced responses
- → A few examples of symbiotic relationships between plants & animals that protect plants from predation
- → A few examples of toxins that humans are susceptible to and/or have medicinal value

40 – SENSORY SYSTEMS IN PLANTS

Read for supporting information to the key concepts listed below; many of the concepts should serve to review & reinforce earlier content

- → The three stages of the signal transduction pathway as the mechanism of the plant sensory systems & response: reception, signal transduction, & cellular response
- → The adaptive value of phototropism & photoperiodism
- → Examples of how plants detect & respond to changes in environmental factors such as light, length of day, & water availability
- → An example of a plant negative feedback mechanism & an example of a plant positive feedback mechanism in the regulation of sensory processes
- → Chapter 41: How day length (photoperiod) triggers flowering

Framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
35	2.C.1.b	40 Feedback/hormones
36	2.C.2	40 Photoperiodism and phototropism
40	2.D.4.a	39
43	2.E.2.a	40
45	2.E.3.b.1 & 2	40
69	3.D.2.a, b	39
70-71	3.D.3	40 (apply signal transduction pathway to plants)
91	4.B.3.a	39 (revisit population interactions)

Unit 7A – Inheritance

11 – SEXUAL REPRODUCTION AND MEIOSIS

Read to review the following concepts; determine areas needing further discussion

- → The difference between asexual & sexual reproduction
- → Key differences between mitosis & meiosis
- → The function of meiosis & fertilization in sexual reproduction
- → How chromosome number is reduced from diploid (2n) to haploid (1n) in the process of meiosis
- → The role of homologous chromosomes in meiosis
- → The genetic consequences of the phenomenon of crossing over
- → How crossing over, independent assortment, & random fertilization increase genetic variation

52 – THE REPRODUCTIVE SYSTEM

Read to for additional support of the essential knowledge statements (mainly 52.1)

- → Differences between the processes of oogenesis & spermatogenesis, & how these processes connect to meiosis
- → How fertilization in sexually reproducing organisms increases genetic diversity in the offspring & population
- → Sex can be determined genetically or by environmental conditions

Framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
55-56	3.A.2.c	
56-57	3.A.3.b.1 & 2	
63-64	3.C.1	Mutations
65	3.C.2.c	

CHAPTER 12 – PATTERNS OF INHERITANCE

Read to review the following concepts; determine areas needing further discussion

- → Mendel's two principles of inheritance: the Law of Segregation & the Law of Independent Assortment
- → The difference between a gene & an allele
- → The vocabulary of genetic crosses: P, F1, F2, dominant, recessive, homozygous, heterozygous, genotype, & phenotype
- → How to set up a cross to solve a genetics problem, establishing the correct gametes & using the rules of probability to predict possible outcomes of genetic crosses
- → How to interpret a Punnett square
- → The application of statistics (chi-square) to analyze patterns of inheritance provided by data sets
- → How to interpret a pedigree
- → Examples of recessive & dominant genetic disorders in humans
- → Examples of ethical, social, & medical issues surrounding human genetic disorders (also see chapter 13)

13 – CHROMOSOMES, MAPPING, AND THE MEIOSIS-INHERITANCE CONNECTION

Read for information on the following concepts; we will cover most of this with practice genetics problems

- → The relationship between the chromosomal theory of inheritance, the behavior of chromosomes during meiosis, & Mendel's principles (laws) of inheritance
- → The inheritance pattern of many traits cannot be explained by simple Mendelian genetics
- → The relationship between sex chromosomes & sex determination
- → How to use a Punnett square to solve for a genetics cross involving a sex-linked trait
- → How the phenomenon of crossing over during meiosis increases genetic variation
- → How mutations can cause genetic diseases, & an example
- → How alterations in chromosome number can cause genetic disorders, & an example
- → How statistics (chi-square) can be applied to analyze patterns of inheritance provided by data sets that suggest non-Mendelian inheritance patterns
- → An example of non-nuclear inheritance such as mitochondrial DNA

Framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
56-57	3.A.3	
57-58	3.A.4	
63-64	3.C.1	Mutations
94-95	4.C.2	

Unit 7B – Molecular Genetics

FOCUS ON THE FOLLOWING ESSENTIAL KNOWLEDGE STATEMENTS AS YOU READ THESE CHAPTERS

framework pg	ESSENTIAL KNOWLEDGE	NOTES/COMMENTS
14-15	1.B.1.a	(revisit); 15
42	2.E.1 (all)	15, 16, **19, 52, 53**
49-53	3.A.1	10, 27, 15, 16
54-55	3.A.2.a, b	10
60-61	3.B.1	16
61-62	3.B.2	10, **52**
63-64	3.C.1	Mutations: 15
65	3.C.2	27, 15
66-67	3.C.3	Viral reproduction/replication: 27

CHAPTER 10 – HOW CELLS DIVIDE

Read for information on the following concepts (chapter review can also help you focus your reading of the chapter); some aspects should be review from general biology

- → The biological purpose of mitosis: the production of cells with the same genetic composition; differentiate processes between bacteria & eukaryotes
- → The structure of the eukaryotic chromosome
- → The relationship between homologous chromosomes
- → The structure of the replicated eukaryotic chromosome following interphase
- → The phases of the cell cycle (interphase, M, & cytokinesis); know generalities rather than minute details of each step within the M phase)
- → The distinctions between the process of cytokinesis in animal cells & plant cells
- → The role of cyclins & kinases in the control of the cell cycle
- → The connections between cell-signaling pathways, gene regulation, & control of the cell cycle
- → The correlation between the loss of cell-cycle control and cancer
- → The effect(s) of errors in mitosis on subsequent cells produced from the abnormal cell

CHAPTER 27 - VIRUSES

Read 27.1-27.3 for information on the following concepts

- → How viruses lack characteristics associated with cells & deviate from the cell theory
- → The basic structure of a virus
- → The differences between the lytic & lysogenic reproductive cycles of viruses
- → How the replicative capabilities of viruses allow for rapid evolution & acquisition of new phenotypes
- → How retroviruses deviate from the Central Dogma of biology (DNA→RNA→protein), e.g., HIV
- → How viruses can facilitate transfer of genetic information & introduce genetic variation into host cells

15 – GENES AND HOW THEY WORK

Read for information on the following concepts; some aspects should be review from general biology

- → The difference between replication, transcription, & translation
- → The process of transcription, its machinery, & end products
- → The difference between exons & introns
- → How eukaryotic cells modify mRNA after transcription
- → The process of translation, its machinery, & end products
- → How mutations can alter the amino acid sequence of a protein
- → How changes in genotype can result in changes in phenotype that are subject to natural selection & evolution

16 – CONTROL OF GENE EXPRESSION

Read for information on the following concepts and to support the POGIL

- → General understanding of the relationship between DNA regulatory sequences, regulatory proteins, & small regulatory RNAs in gene expression, & an example of each
- → Functions of the three parts of a bacterial operon: operator, promoter, structural genes
- → The lac & trp (tryp) operons as examples of the control of gene expression in bacteria
- → The impact of chromatin modifications (e.g., DNA methylation) on gene expression in eukaryotes
- → The role of transcription factors in control of gene expression in eukaryotes
- → Post-transcriptional processing (exons & introns)
- → Genetic regulation by microRNAs plays an important role in the development of organisms & the control of cellular functions. Also see ch. 53
- → Chapter 41: The role of internal & external signals (e.g., temperature, sunlight) in the activation of genes in flower formation

17 – BIOTECHNOLOGY

Read for information on the following concepts (and, hopefully, in support of lab & activities)

- → Understanding of *at least two* basic biotechnology tools & their application, such as restriction enzyme analysis of DNA, plasmid-based transformation, & PCR
- → Understanding of an example of genetic engineering products, such as genetically modified foods or pharmaceuticals
- → The process of gene cloning & its application
- → The basic principles & the value of DNA sequencing

19 – CELLULAR MECHANISMS OF DEVELOPMENT

Read for information to support 2.E.1

- → Identification of the sub-processes of development: cell division, differentiation, pattern formation, & morphogenesis
- → The importance of cell division (mitosis) to early development
- → Differences between differentiation & determination
- → Examples of applications of stem cells (e.g., treatment of disease or tissue injury)
- → The role(s) of homeobox-containing (e.g., Hox) genes in development
- → How programmed cell death (apoptosis) can contribute to morphogenesis, & one example (e.g., development of digits, immune function). Also see ch. 53