Biology Curriculum Map and Pacing Guide 2024 - 2025

Unit 1: Energy - Ecosystems: Interactions, Energy, and Dynamics

Duration: 7 days (Fall) and 7 days (Spring)

Topic(s)	Required Labs	Possible Labs/Activities	Tennessee Biology Academic Standards (DCIs)	End of Unit Summative Assessment
Energy Transfer Relationships Disruptions	Energy Transfer Lab	Water Lab (Energy) Animal Ecosystem Project Energy Transfer Activity	**BIO1.LS2: Ecosystems: Interactions, Energy, and Dynamics** 1) Analyze mathematical and/or computational representations of population data that support explanations of factors that affect population size and carrying capacities of populations within an ecosystem. Examine a representative ecosystem and, based on interdependent relationships present, predict population size effects due to a given disturbance. 3) Analyze through research the cycling of matter in our biosphere and explain how biogeochemical cycles are critical for ecosystem function. 4) Analyze data demonstrating the decrease in biomass observed in each successive trophic level. Construct an explanation considering the laws of conservation of energy and matter and represent this phenomenon in a mathematical model to describe the transfer of energy and matter between trophic levels. 5) Analyze examples of ecological succession, identifying and explaining the order of events responsible for the formation of a new ecosystem in response to extreme fluctuations in environmental conditions or catastrophic events. **BIO1.LS4: Biological Change: Unity and Diversity** 3) Identify ecosystem services and assess the role of biodiversity in support of these services. Analyze the role human activities have on disruption of these services.	Common Assessment (30 question **test** via MasteryConnect)
Population Dynamics	Population Dynamics (Carrying Capacity) Lab	Yeast Lab (round 2)		**Specific Examples from Standards Reference Guide** - population size is a balance between reproductive rates, death rates, immigration, and emigration - population affecting factors: new species introduction, population crash due to disease, abiotic resource depletion - “fixing” elements - ecosystems (terrestrial and aquatic) - how and where energy is transferred from organic pools in each trophic level, 10% rule - ecosystems remain in a condition of dynamic equilibrium - primary succession examples such as a glacial retreat in Alaska, volcanism in Hawaii, or wetland development in Florida everglades - secondary succession examples such as the conversion of natural areas of agricultural land before subsequent abandonment, or forest fire devastation - analysis of human activities may include habitat fragmentation, introduction of non-native species or invasive species, overharvesting, pollution, eutrophication, and climate change
Ecological Succession		Succession Lab		
Properties of Water / Hydrologic Cycle Nitrogen Cycle Phosphorus Cycle	Properties of Water Lab			
Ecosystem Services Human Impact on Biodiversity				

Unit 2: Anabolism of Carbohydrates

Duration: 7 days (Fall) and 7 days (Spring)

Organelles: chloroplast, cell wall

Topic(s)	Required Labs	Possible Labs/Activities	Tennessee Biology Academic Standards (DCIs)	End of Unit Summative Assessment
Organic vs Inorganic Molecules Carbohydrates	Building Carbohydrates Indicator Labs - Carbohydrates		**BIO1.LS1: From Molecules to Organisms: Structures and Processes** 2) Evaluate comparative models of various cell types with a focus on organic molecules that make up cellular structures. 5) Research examples that demonstrate the functional variety of proteins and construct an argument based on evidence for the importance of the molecular structure to its function. Plan and carry out a controlled investigation to test predictions about factors, which should cause an effect on the structure and function of a protein. 8) Create a model of photosynthesis demonstrating the net flow of matter and energy into a cell. Use the model to explain energy transfer from light energy into stored chemical energy in the product.	Common Assessment (30 question **test** via MasteryConnect) **Specific Examples from Standards Reference Guide** - parenchyma cells have a large number of chloroplasts - the effect of amylase activity on a starch substrate as function of varying temperature or another independent variable
pH and Enzymes	ph Lab Enzyme Lab	Toothpickase Lab Pineapple and Jello Lab Liver Lab Yeast Lab Potato Lab Pineapple and Laundry Soap		
Photosynthesis Chemosynthesis ATP	Photosynthesis Lab	Water Weed Lab Elodea Lab Floating Disk Lab Phenol Red Photosynthesis Lab		

Unit 3: Catabolism of Carbohydrates

Duration: 6 days (Fall) and 6 days (Spring)

Organelles: mitochondria, cilia, flagella, pseudopodia

Topic(s)	Required Labs	Possible Labs/Activities	Tennessee Biology Academic Standards (DCIs)	End of Unit Summative Assessment
Endosymbiotic Theory Cell Types	Cell Labs (microscopes)	Prokaryotes vs Eukaryotes Protist Lab Animal Cell Lab Plant Cell Lab	**BIO1.LS1: From Molecules to Organisms: Structures and Processes** 1) Compare and contrast existing models, identify patterns, and use structural and functional evidence to analyze the characteristics of life. Engage in argument about the designation of viruses as non-living based on these characteristics. 2) Evaluate comparative models of various cell types with a focus on organic molecules that make up cellular structures. 9) Create a model of aerobic respiration demonstrating flow of matter and energy out of a cell. Use the model to explain energy transfer mechanisms. Compare aerobic respiration to alternative processes of glucose metabolism. **BIO1.LS2: Ecosystems: Interactions, Energy, and Dynamics** 2) Create a model tracking carbon atoms between inorganic and organic molecules in an ecosystem. Explain human impacts on climate based on this model. 3) Analyze through research the cycling of matter in our biosphere and explain how biogeochemical cycles are critical for ecosystem function.	Common Assessment (40 question **cumulative benchmark** (units 1-3) via MasteryConnect)
Characteristics of Life Viruses Cell Theory				**Specific Examples from Standards Reference Guide** - viral cycles (lytic and lysogenic) - engage in an argument regarding the classification of a viral particle as either living or nonliving - enucleation of the nucleus in red blood cells in mammals providing for increased levels of oxygen transport in organisms - lack of centrioles in most neurons - muscles cells contain the most mitochondria due to their ATP requirements - differences in efficiencies of the processes of glucose metabolism - pools/stores of carbon - carbon sinks vs sources - “fixing” elements
Cellular Respiration	Anaerobic Respiration Lab Aerobic Respiration Lab	Yeast Lab (round 1) BTB Lab		
Carbon Cycle	Carbon Cycle Lab			

Unit 4: Lipids, Plasma Membrane Structure and Cellular Transport

Duration: 7 days (Fall) and 7 days (Spring)

Organelles: cell membrane, rough ER, smooth ER, golgi body, lysosome, vesicle, cytoplasm, cytosol

Topic(s)	Required Labs	Possible Labs/Activities	Tennessee Biology Academic Standards (DCIs)	End of Unit Summative Assessment
Lipid Structure and Function	Building Lipids Indicator Lab - Lipids	Build cell membrane	**BIO1.LS1: From Molecules to Organisms: Structures and Processes** 2) Evaluate comparative models of various cell types with a focus on organic molecules that make up cellular structures. 7) Utilize a model of a cell plasma membrane to compare the various types of cellular transport and test predictions about the movement of molecules into or out of a cell based on the homeostasis of energy and matter in cells.	Common Assessment (35 question **test** via MasteryConnect)
Endomembrane System		Tay Sachs, Heart Disease, Stroke Project CFTR / Cholera Project		**Specific Examples from Standards Reference Guide**
Cellular Transport	Osmosis Lab Diffusion Lab	Balloon Lab Baggie Lab Egg Lab Sugar Dialysis Lab		

Unit 5: Nucleic Acids and the Regulation of the Cell Cycle

Duration: 7 days (Fall) and 7 days (Spring) Organelles: centriole, cytoskeleton, nucleus

Topic(s)	Required Labs	Possible Labs/Activities	Tennessee Biology Academic Standards (DCIs)	End of Unit Summative Assessment
Chromosome Structure			**BIO1.LS1: From Molecules to Organisms: Structures and Processes** 2) Evaluate comparative models of various cell types with a focus on organic molecules that make up cellular structures. 3) Integrate evidence to develop a structural model of a DNA molecule. Using the model, develop and communicate an explanation for how DNA serves as a template for self-replication and encodes biological information. 5) Research examples that demonstrate the functional variety of proteins and construct an argument based on evidence for the importance of the molecular structure to its function. Plan and carry out a controlled investigation to test predictions about factors, which should cause an effect on the structure and function of a protein. 6) Create a model for the major events of the eukaryotic cell cycle, including mitosis. Compare and contrast the rates of cell division in various eukaryotic cell types in multicellular organisms.	Common Assessment (35 question **test** via MasteryConnect)
Mitotic Cell Cycle Varying Rates of Mitotic Division Cellular Regulation		Cancer Project Hands on Cell Cycle Activities: Foamies, Shaving Cream		**Specific Examples from Standards Reference Guide** - not all segments of DNA are transcribed into proteins - portions of DNA are involved in regulating the expression of genes or affect the structure of the chromosomes (replication origin, centromeres, and telomeres) -connect gene expression and protein function with the process of mitosis to explore the differentiation of cell types from identical daughter cells -discussions on varying rates of mitotic divisions and the relationship between these rates of division and the function of specific cell types within eukaryotic organisms - neurons limited use due to their interconnectedness within neural networks - rapid rates of mitosis with growing root tips - cellular regulation (cyclins, MPFs) - cell signaling (GF, chemical messengers
Cell Signaling				
DNA: Structure and Function Chargaff's Rule	DNA Extraction Lab	Nucleotide Build DNA History Project Build Models		
DNA Replication		Build Models		

Unit 6: Proteins

Duration: 7 days (Fall) and 7 days (Spring)

Organelles: nucleolus and ribosomes

Topic(s)	Required Labs	Possible Labs/Activities	Tennessee Biology Academic Standards (DCIs)	End of Unit Summative Assessment
Protein Structure and Shape	Indicator Lab - Proteins	Sickle Cell Explore Amino Acid Build Vinegar and Milk	**BIO1.LS1: From Molecules to Organisms: Structures and Processes** 2) Evaluate comparative models of various cell types with a focus on organic molecules that make up cellular structures. 3) Integrate evidence to develop a structural model of a DNA molecule. Using the model, develop and communicate an explanation for how DNA serves as a template for self-replication and encodes biological information. 4) Demonstrate how DNA sequence information is decoded through transcriptional and translational processes within the cell in order to synthesize proteins. Examine the relationship of structure and function of various types of RNA and the importance of this relationship in these processes. 5) Research examples that demonstrate the functional variety of proteins and construct an argument based on evidence for the importance of the molecular structure to its function. Plan and carry out a controlled investigation to test predictions about factors, which should cause an effect on the structure and function of a protein. **BIO1.LS3: Heredity: Inheritance and Variation of Traits** 2) Explain how protein formation results in phenotypic variation and discuss how changes in DNA can lead to somatic or germline mutations.	Common Assessment (35 question **test** via MasteryConnect) **MasteryConnect Checkpoint (units 1-6)**
Enzymes	Enzyme Lab	Toothpickase Lab Pineapple and Jello Lab Liver Lab Yeast Lab Potato Lab Pineapple and Laundry Soap		**Specific Examples from Standards Reference Guide** - connection between genotypes and phenotypes resulting from expression of the genes - relate monogenic inheritance to phenotype; examples include pathways for melanin and lactase production - roles of proteins include cellular regulation, cell signaling, enzymatic function, and structural components - the effect of amylase activity on a starch substrate as function of varying temperature or another independent variable
RNA and Protein Synthesis		Cookie Lab		
Mutations		Modeling		

Unit 7: Reproduction and Chromosome Mutations

Duration: 10 days (Fall) and 7 days (Spring)

Topic(s)	Required Labs	Possible Labs/Activities	Tennessee Biology Academic Standards (DCIs)	End of Unit Summative Assessment Common Assessment (35 question **test** via MasteryConnect)
Meiotic Cell Cycle			**BIO1.LS1: From Molecules to Organisms: Structures and Processes** 6) Create a model for the major events of the eukaryotic cell cycle, including mitosis. Compare and contrast the rates of cell division in various eukaryotic cell types in multicellular organisms. **BIO1.LS3: Heredity: Inheritance and Variation of Traits** 1) Model chromosome progression through meiosis and fertilization in order to argue how the processes of sexual reproduction lead to both genetic similarities and variation in diploid organisms. Compare and contrast the processes of sexual and asexual reproduction, identifying the advantages and disadvantages of each. 2) Explain how protein formation results in phenotypic variation and discuss how changes in DNA can lead to somatic or germline mutations. **BIO1.ETS2: Links Among Engineering, Technology, Science, and Society** 1) Obtain, evaluate, and communicate information on how molecular biotechnology may be used in a variety of fields. 2) Investigate the means by which karyotypes are utilized in diagnostic medicine 3) Analyze scientific and ethical arguments to support the pros and cons of application of a specific biotechnology technique such as stem cell usage, in vitro fertilization, or genetically modified organisms.	**Specific Examples from Standards Reference Guide** - mutations are passed to sexually reproduced offspring only when they are present in gametes - events that lead to genetic differences (mutations, crossing over, and random segregation) as well as events that generate similarities in parent and offspring (DNA replication and transmission) - models may be used to demonstrate how chromosomal abnormalities (nondisjunction - Down, Turner, Patau, Edward, and Klinefelter syndromes) and/or how sterile hybrids (mules, seedless watermelons) cannot complete meiosis due non-homologous chromosomes from different species - molecular techniques: PCR, gel electrophoresis, restriction enzyme digestion of DNA, DNA sequencing, plasmid-based transformation, transfection; techniques used in the fields of medicine, agriculture, biomedical engineering, and forensics
Compare and Contrast Sexual and Asexual Reproduction				
Chromosome Mutations		Chromosome Mutations - “Syndromes” Project Modeling		
Karyotypes, Moleculecular Biotechnologies	molecular biotechnologies assignment - ACT day			

Unit 8: Genetics

Duration: 12 days (Fall) and 8 days (Spring)

Topic(s)	Required Labs	Possible Labs/Activities	Tennessee Biology Academic Standards (DCIs)	End of Unit Summative Assessment Common Assessment (45 question cumulative **benchmark** (units 5-8) via MasteryConnect)
Molecular Biotechnologies	Gel Electrophoresis Lab		**BIO1.LS3: Heredity: Inheritance and Variation of Traits** 3) Through pedigree analysis, identify patterns of trait inheritance to predict family member genotypes. Use mathematical thinking to predict the likelihood of various types of trait transmission. **BIO1.ETS2: Links Among Engineering, Technology, Science, and Society** 1) Obtain, evaluate, and communicate information on how molecular biotechnology may be used in a variety of fields. 2) Investigate the means by which karyotypes are utilized in diagnostic medicine 3) Analyze scientific and ethical arguments to support the pros and cons of application of a specific biotechnology technique such as stem cell usage, in vitro fertilization, or genetically modified organisms.	**Specific Examples from Standards Reference Guide** - modes of inheritance - autosomal and sex-linked genes that are dominant/recessive, codominant, or incompletely dominant - practice deductive reasoning using basic set of criteria (successive generation transmission and male/female ratio) to predict mode of inheritance for a trait - define alleles for a trait - assign genotypes to the family members of a given pedigree - use probability-based mathematics to predict offspring genotypes and phenotypes based on parental set - classic examples: brown/blue base eye color due to melanin protein, PTC tasting due to a taste receptor on tongue cells, sickle cell anemia due to hemoglobin protein, PKU due to the enzyme that breaks down amino acids phenylalanine, hemophilia due to a clotting factor protein, ABO blood type due to an enzyme that attaches carbohydrates A, B, or nothing to the red blood cell - molecular techniques: PCR, gel electrophoresis, restriction enzyme digestion of DNA, DNA sequencing, plasmid-based transformation, transfection; techniques used in the fields of medicine, agriculture, biomedical engineering, and forensics
Punnett Squares		Baby Monsters Cookie Lab		
Pedigrees	Pedigree Lab (Indicator Lab)	Albinism Alkaptonuria		

Unit 9: Biological Change: Unity and Diversity

Duration: 14 days (Fall) and 10 days (Spring)

Topic(s)	Required Labs	Possible Labs/Activities	Tennessee Biology Academic Standards (DCIs)	Assessments
History of Biological Change			**BIO1.LS3: Heredity: Inheritance and Variation of Traits** 1) Model chromosome progression through meiosis and fertilization in order to argue how the processes of sexual reproduction lead to both genetic similarities and variation in diploid organisms. Compare and contrast the processes of sexual and asexual reproduction, identifying the advantages and disadvantages of each. 2) Explain how protein formation results in phenotypic variation and discuss how changes in DNA can lead to somatic or germline mutations. **BIO1.LS4: Biological Change: Unity and Diversity** 1) Evaluate scientific data collected from analysis of molecular sequences, fossil records, biogeography, and embryology. Identify chronological patterns of change and communicate that biological evolution is supported by multiple lines of empirical evidence that identify similarities inherited from a common ancestor (homologies). 2) Using a model that demonstrates the change in allele frequencies resulting in evolution of a population over many generations, identify causative agents of change.	**End of Unit Summative Assessment** Common Assessment (35 question **test** via MasteryConnect)
Scientific Evidence of Biological Change				**Specific Examples from Standards Reference Guide** - models may be used to demonstrate how chromosomal abnormalities such as how sterile hybrids (mules, seedless watermelons) cannot complete meiosis due non-homologous chromosomes from different species → postzygotic barrier - phenotypic variation arises not only from genetic variation, but also from gene expression; this may be result of environmental influences - environmental influences that may cause a variation in gene expression: temperature regulates sex organ development in some fish species or fur color expression in some rabbits species, light regulates butterfly wing development, exercise increases muscle protein expression, and isolation rearing in social animals alters brain gene expression - investigate mechanism of isolation (reproductive, geographical, temporal) can lead to evolutionary change - other agents of change are genetic drift (population bottleneck and founder effect) - common examples of adaptations: bird beaks, insect mimicry, antibacterial resistance strains of bacteria - species overspecialization (cheetah, pandas, koalas) increased chance of going extinct - suboptimal traits and vestigial structures - molecular data demonstrating that all life shares the same genetic code; comparative DNA and protein sequence data demonstrating conservation of ubiquitous genes/proteins such as ribosomal protein or cytochrome c
Causative Agents of Allele Frequency Changes	Allele Frequency Lab	Sickle Cell Sea Urchin Lab Malaria		
Molecular Relatedness				
Speciation Cladograms Classification				

The following Crosscutting Concepts (CCC) and Science and Engineering Practices (SEP) are addressed throughout the course.

Crosscutting Concepts

1. Patterns
2. Cause and effect: Mechanism and explanation
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter: Flows, cycles, and conservation
6. Structure and function
7. Stability and change

Science and Engineering Practices

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out controlled investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information