Biology Pacing: Scope and Sequence - ~36 weeks to prepare for Keystones (1 week of wiggle-room included)

(accounts for breaks/finals/Keystones, etc.)

Anchor	Time Frame
BIO.A.1 Basic Biological Principles **-Scientific Method/Variables Review** **-Biotic/Abiotic, Characteristics of Life**	1 week (Aug-Sep) (*1st week of school is 3 days) 2 week (Sep)
REVIEW UNIT BIO.B.4 Ecology & BIO.B.3 Theory of Evolution	2 weeks (Sep)
BIO.B.2 Genetics **-DNA Structure/Replication** **-RNA Transcription/Translation/Mutations** **-Mendelian Genetics/Complex Heredity**	2 weeks (Oct) 2 weeks (Oct) 2 weeks (Nov)
BIO.B.1 Cell Growth and Reproduction **--Microscope Use Review** **-Cell Cycle/Interphase** **-Mitosis** **-Meiosis**	1 week (Nov) 1 week (Nov) 2 weeks (Nov-Dec) 2 weeks (Dec)
BIO.A.4 Homeostasis and Transport **-Cell Structure/Organelles** **-Plasma Membrane Structure** **-Types of Membrane Transport**	2 weeks (Jan) 1 week (Jan) (*1 week will be lost for midterms/finals) 3 weeks (Jan-Feb)
BIO.A.3 Bioenergetics **-ATP/ADP Structure and Function** **-Chloroplasts & Photosynthesis** **-Mitochondria & Cellular Respiration**	1 week (Feb) 2 weeks (Feb - Mar) 2 weeks (Mar)
BIO.A.2 The Chemical Basis for Life **-Atomic Structure/Chemistry of Water** **-Carbon/Macromolecules**	2 weeks (Mar) 3 weeks (April)
Keystone Review	2 weeks (April - May)
Keystones	~1 week (Mid-May)
Project Based Learning	~3 weeks (May-June)
Finals	Mid-June

Time Frame: 2.5 weeks (Sep)
Unit/Anchor: Basic Biological Principles
Module A

Anchor Descriptors:

BIO. A 1.1 Explain the characteristics common to all organisms.
BIO.A.1.2 Describe relationships between structure and function at biological levels of organization.
BIO.B Apply scientific thinking, processes, tools and technologies in the study of science

Eligible Content:

BIO.A.1.1.1 Describe the characteristics of life shared by all prokaryotic and eukaryotic organisms.
BIO.A.1.2.2 Describe and interpret relationships between structure and function at various levels of biological organization (i.e.,organelles, cells, tissues, organs, organ systems, and multicellular organisms).

NGSS:

HS-LS1: From Molecules to Organisms: Structures and Processes
HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Objectives:

1. Apply scientific process/nature of science skills to scientific problems
2. Apply knowledge of life characteristics to determine life
3. Describe the interplay between organizational levels of living things
4. Distinguish between prokaryotes and eukaryotes
5. Describe basic cell structures and functions

Learning Events/Activities

1. Scientific scenarios
2. Scientific method lab activity
3. Characteristics of life lab activity
4. Cell diagrams: prokaryote vs. eukaryote with compare/contrast chart
5. Cell diagrams: cell structures & functions
6. Characteristics of Life webquest
7. Graphic organizer (pyramid) for levels of organization
8. Poster/chart comparing living vs non-living according to life characteristics, with rationale
9. Scientific method lab activity
10. Characteristics of life sort-card activity
11. Guided reading/Review handouts

Assessments:

1. Chapter 7 Assessment Questions
2. Teacher-made formative/summative assessment
3. Chapter 7 Standardized Test Prep

Resources:

"Biology" McGraw Hill
McGraw Hill Powerpoint Presentations/Website
Custom made Powerpoint presentations
Discovery Streaming
Teachertube
Internet resources
Laboratory materials

Study guides

Time Frame: 2 weeks (Sep)
Unit/Anchor: Ecology and Evolution Review (Mini-Unit)
Module B

Anchor Descriptors:

BIO.B.4.1 Describe ecological levels of organization in the biosphere.
BIO.B.4.2 Describe interactions and relationships in an ecosystem.
BIO.B.3.1 Explain the mechanisms of evolution.
BIO.B.3.2 Analyze the sources of evidence for biological evolution.
BIO.B.3.3 Apply scientific thinking, processes, tools, and technologies in the study of the theory of evolution.

Eligible Content:**

BIO.B.4.1.1, .2: (levels of ecological organization; characteristics of biotic/abiotic ecosystem components)
BIO.B.4.2.1, .2, .3, .4, .5: (energy flow through an ecosystem; biotic interactions in an ecosystem; cycles of matter; ecosystems changing due to natural and human disturbances; limiting factors and species extinction).
BIO.B.3.1.1, .2, .3: (natural selection effect on allele frequency; development of new species; genetic mutations producing variations)
BIO.B.3.2.1: (evidence to support evolution)
BIO.B.3.3.1: (distinguish hypothesis, inference, law, theory, principle, fact, and observation)

NGSS:

HS-LS2: Ecosystems: Interactions, Energy, and Dynamics
HS-LS2-1: Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
HS-LS2-2: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
HS-LS2-3: Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
HS-LS2-4: Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
HS-LS2-5: Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
HS-LS2-6: Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
HS-LS2-8: Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
HS-LS3: Heredity: Inheritance and Variation of Traits
HS-LS3-3: Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
HS-LS4: Biological Evolution: Unity and Diversity

**For full description of eligible content, please refer to Units I & II of the 9th grade curriculum.

Concepts:

1. Energy and matter cycle through an ecosystem.
2. Food chains and food webs demonstrate predative interactions between living organisms.
3. Organisms interact symbiotically.
4. Natural disasters, human impact and limiting factors impact ecosystems.
5. The relationship between genetic inheritance and evolution
6. Types of natural selection, speciation and the contributing factors
7. Organisms are organized for study by various physical and physiological features

Objectives:

1. Describe and differentiate between the levels of ecological organization.
2. Describe characteristic biotic and abiotic components of terrestrial and aquatic ecosystems.
3. Explain how energy flows through an ecosystem.
4. Describe biotic interactions within an ecosystem.
5. Describe Darwin's theory of evolution, supported by his observations and research.
6. Relate heredity to natural selection.
7. Support Darwin's theory using various types of observable evidence.
8. Explain natural selection and its components.
9. Explain the process of speciation and differentiate between its various causes.

Learning Events/Activities

1. Modeling food chains
2. Demonstrating natural selection using manipulatives
3. Analyzing and graphic data of observable change in species over time
4. Guided reading/Review handouts
5. Chapter 2/3/4.1/5.1/15/17.1 Assessment Questions
6. Chapter 2/3/4.1/5.1/15/17.1 Standardized Test Prep

Assessments:

1. Chapter Assessment Questions
2. Teacher-made formative/summative assessment
3. Standardized Test Prep

Resources:

"Biology" McGraw Hill
McGraw Hill Powerpoint Presentations/Website
Custom made Powerpoint presentations
Discovery Streaming
Teachertube
Internet resources
Laboratory materials
Study guides

Time Frame: 6 weeks (Oct-Nov)
Unit/Anchor: Genetics
Module B

BIO.B.2.1 Compare Mendelian and non-Mendelian patterns of inheritance.
BIO.B.2.2 Explain the process of protein synthesis (i.e., transcription, translation, and protein modification).
BIO.B.2.3 Explain how genetic information is expressed.
BIO.B.2.4 Apply scientific thinking, processes, tools, and technologies in the study of genetics.

Eligible Content:

BIO.B.2.1.1 Describe and/or predict observed patterns of inheritance (i.e., dominant, recessive, co-dominance, incomplete dominance, sex-linked, polygenic, and multiple alleles).
BIO.B.2.1.2 Describe processes that can alter composition or number of chromosomes (i.e., crossing-over, nondisjunction, duplication, translocation, deletion, insertion, and inversion).
BIO.B.2.2.1 Describe how the processes of transcription and translation are similar in all organisms.
BIO.B.2.2.2 Describe the role of ribosomes, endoplasmic reticulum, Golgi apparatus, and the nucleus in the production of specific types of proteins.
BIO.B.2.3.1 Describe how genetic mutations alter the DNA sequence and may or may not affect phenotype (e.g., silent, nonsense, frameshift).
BIO.B.2.4.1 Explain how genetic engineering has impacted the fields of medicine, forensics, and agriculture (e.g., selective breeding, gene splicing, cloning, genetically modified organisms, gene therapy).

NGSS:

HS-LS1: From Molecules to Organisms: Structures and Processes
HS-LS1-1: Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
HS-LS3: Heredity: Inheritance and Variation of Traits
HS-LS3-1: Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
HS-LS3-2: Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

Concepts:

1. DNA is the basis of life because of three qualities: it holds information, it copies itself, and it changes.
2. DNA sequences are the blueprints of life. Cells must maintain this information, yet also access it to manufacture proteins. RNA acts as the go-between, linking DNA to protein.
3. DNA replication, RNA transcription and RNA translation are separate events in the cell which occur in sequence and bridge the gap between DNA molecules and genetic expression.
4. Mutations provide the variation necessary for life to exist. Usually DNA repair protects against harmful mutations, but some mutations are helpful.
5. Gregor Mendel deduced the basis of inheritance patterns. His two laws brilliantly described how chromosomes behave in meiosis, which had not yet been discovered.
6. Patterns of inheritance can be obscured when genes have many variants, interact with each other or the environment, are in mitochondria, or are linked on the same chromosome

Objectives:

1. Explain how the genetic code (DNA) is translated into physical traits of an organism
2. Compare and contrast Mendelian and non-Mendelian inheritance patterns
3. Describe how mutations can occur and their effect on genotypes/phenotypes
4. Discuss impact of genetic engineering in modern life

Learning Events/Activities

- DNA diagram
- DNA replication practice
- DNA models
- RNA diagram
- DNA-RNA transcription practice
- Protein synthesis pathway diagram
- Translation practice
- Punnett Square practice – Mendelian inheritance
- Punnett Square practice – non-Mendelian inheritance
- Pedigrees
- Mutations & Disorders chart
- Genetic engineering types and purposes chart

Online activities/webquests

- Replication/Transcription/Translation webquest
- Punnett Square practice online
- Online mutations activity
- Genetic mutations & chromosomal abnormalities activity
- Genetic engineering articles & reflections

Laboratory Activities:

- DNA extraction lab
- Protein synthesis modeling activity
- Interpreting PCR results activity

Guided reading/Review handouts
Chapter 12/13/11.1-11.3 Assessment Questions
Chapter 12/13/11 Standardized Test Prep

Assessments:

4. Chapter Assessment Questions
5. Teacher-made formative/summative assessment
6. Chapter Standardized Test Prep

Resources:

"Biology" McGraw Hill
McGraw Hill Powerpoint Presentations/Website
Custom made Powerpoint presentations
Discovery Streaming
Teachertube
Internet resources
Laboratory materials
Study guides

Time Frame: 6 weeks (Nov-Dec)
Unit/Anchor: Cell Growth and Reproduction
Module B

Anchor Descriptors:

BIO.A.1.2 Describe relationships between structure and function at biological levels of organization.
BIO.B.1.1 Describe the three stages of the cell cycle: interphase, nuclear division, cytokinesis.
BIO.B.1.2 Explain how genetic information is inherited.

Eligible Content:

BIO.A.1.2.1 Compare cellular structures and their functions in prokaryotic and eukaryotic cells.
BIO.B.1.1.1 Describe the events that occur during the cell cycle: interphase, nuclear division (i.e., mitosis or meiosis), cytokinesis.
BIO.B.1.1.2 Compare the processes and outcomes of mitotic and meiotic nuclear divisions.
BIO.B.1.2.1 Describe how the process of DNA replication results in the transmission and/ or conservation of genetic information.
BIO.B.1.2.2 Explain the functional relationships between DNA, genes, alleles, and chromosomes and their roles in inheritance.

NGSS:

HS-LS1: From Molecules to Organisms: Structures and Processes
HS-LS1-4: Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

Concepts:

1. Cells reproduce by division after DNA replication. Asexual reproduction (mitosis) produces genetically identical offspring, while sexual reproduction (meiosis & fertilization) produces genetically diverse offspring
2. DNA replication during the cell cycle conserves the genetic code of cells for the new daughter cells
3. Cell cycle controls determine cell division; errors in controls can result in cancer

Objectives:

1. Compare and contrast asexual and sexual reproduction
2. Describe the stages of the cell cycle and possible genetic outcomes
3. Explain cell cycle regulation and results of loss of controls
4. Explain how DNA replication conserves genetic information, and how cell/nuclear divisions can affect genetic outcomes of new organisms

Learning Events/Activities

1. Vocabulary
2. Lecture presentation/notes/discussion
3. Animations/videos
4. Chapters 10/11.4 Section Assessment Questions
5. Cell Cycle diagram
6. Chromosome diagram

7. Mitosis phases diagram & questions
8. Meiosis phases diagram & questions
9. Online activities/webquests
10. Mitosis webquest
11. Meiosis webquest
12. Cell division Virtual Lab
13. Laboratory Activities:
    a. Mitosis Microscope Lab
    b. Meiosis Microscope Lab
    c. Mitosis and meiosis modeling activity
14. Guided reading/Review handouts
15. Chapter 10 Assessment Questions
16. Chapter 10 Standardized Test Prep
17. Chapter 11.4 Assessment Questions

Assessments:

1. Chapter Assessment Questions
2. Teacher-made formative/summative assessment
3. Chapter Standardized Test Prep

Resources:

"Biology" McGraw Hill
McGraw Hill Powerpoint Presentations/Website
Custom made Powerpoint presentations
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Teachertube
Internet resources
Laboratory materials
Study guides

Time Frame: 6 weeks (Jan - Feb)
Unit/Anchor: Homeostasis and Transport
Module A

Anchor Descriptors:

BIO.A.1.2 Describe relationships between structure and function at biological levels of organization.
BIO.A.4.1 Identify and describe the cell structures involved in transport of materials into, out of, and throughout a cell.
BIO.A.4.2 Explain mechanisms that permit organisms to maintain biological balance between their internal and external environments.

Eligible Content

BIO.A.1.2.1 Compare cellular structures and their functions in prokaryotic and eukaryotic cells.
BIO.A.4.1.1 Describe how the structure of the plasma membrane allows it to function as a regulatory structure and/or protective barrier for a cell.
BIO.A.4.1.2 Compare the mechanisms that transport materials across the plasma membrane (i.e., passive transport—diffusion, osmosis, facilitated diffusion; and active transport—pumps, endocytosis, exocytosis)
BIO.A.4.1.3 Describe how membrane-bound cellular organelles (e.g., endoplasmic reticulum, Golgi apparatus) facilitate the transport of materials within a cell.
BIO.A.4.2.1 Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation).

NGSS:

HS-LS1: From Molecules to Organisms: Structures and Processes
HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

Concepts:

1. Cell structures (cell membrane, Golgi complex, endoplasmic reticulum) and their functions in transport and homeostasis
2. Passive transport versus active transport within and between cells
3. Homeostasis maintenance within cells and whole organism

Objectives:

1. Describe how the structure of the plasma membrane allows it to function as a regulatory structure and/or protective barrier for a cell.
2. Compare and contrast active vs. passive transport mechanisms.
3. Describe how membrane-bound cellular organelles facilitate intracellular transport of materials.
4. Discuss how the membrane can perform both active and passive passport.
5. Explain mechanisms organisms use to maintain homeostasis

Learning Events/Activities

1. Vocabulary
   Lecture presentation/notes/discussion
   Animations/videos
   Chapters 7.3/7.4 Section Assessment Questions
   Cell diagrams

2. Cell membrane diagrams
3. Cell membranes & transport chart
4. Online activities/webquests
5. Cell Transport webquest
6. Cell Transport Virtual Lab
7. Laboratory Activities:

8. Osmosis in Cells Microscope Lab
9. Osmosis & Diffusion Lab
10. Cell size and Diffusion lab
11. Guided reading/Review handouts

Assessments:

1. Chapter Assessment Questions
2. Teacher-made formative/summative assessment
3. Chapter Standardized Test Prep

Resources:

"Biology" McGraw Hill
McGraw Hill Powerpoint Presentations/Website
Custom made Powerpoint presentations
Discovery Streaming
Teachertube
Internet resources
Laboratory materials
Study guides

Time Frame: 5 weeks (Feb-Mar)
Unit/Anchor: Bioenergetics
Module A

Anchor Descriptors:

BIO.A.1.2 Describe relationships between structure and function at biological levels of organization.
BIO.A.3.1 Identify and describe the cell structures involved in processing energy.
BIO.A.3.2 Identify and describe how organisms obtain and transform energy for their life processes.

Eligible Content:

BIO.A.1.2.1 Compare cellular structures and their functions in prokaryotic and eukaryotic cells.
BIO.A.3.1.1 Describe the fundamental roles of plastids (e.g., chloroplasts) and mitochondria in energy transformations.
BIO.A.3.2.1 Compare the basic transformation of energy during photosynthesis and cellular respiration.
BIO.A.3.2.2 Describe the role of ATP in biochemical reactions

NGSS:

HS-LS1: From Molecules to Organisms: Structures and Processes
HS-LS1-5: Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
HS-LS1-7: Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
HS-LS2: Ecosystems: Interactions, Energy, and Dynamics
HS-LS2-3: Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

Concepts:

1. Cells, therefore all living things, must obtain and use energy. Energy transformations such as photosynthesis and cellular respiration convert energy into usable forms.
2. Photosynthesis is a multi-phased biochemical reaction that converts sunlight into chemical energy
3. Cellular respiration is a multi-phased biochemical reaction that converts chemical energy into another form, ATP
4. Fermentation is another process that can convert one form of chemical energy into another

Objectives:

1. Describe the structure of mitochondria and chloroplasts in eukaryotic cells.
2. Describe the fundamental roles of plastids (e.g., chloroplasts) and mitochondria in energy transformations.
3. Identify the stages of photosynthesis, and the reactants & products of each stage
4. Identify the stages of cellular respiration, and the reactants and products of each stage.

5. Compare the basic transformations of energy during photosynthesis and cellular respiration.
6. Describe the relationship between photosynthesis and cellular respiration
7. Describe the structure of ATP.
8. Describe the role of ATP in biochemical reactions

Learning Events/Activities

1. Vocabulary
2. Lecture presentation/notes/discussion
3. Animations/videos
4. Chapters 8 & 9 Section Assessment Questions
5. ATP diagrams and questions
6. Photosynthesis diagrams & question
7. Cellular respiration diagrams & questions
8. Photosynthesis poster
9. Cellular respiration poster
10. Online activities/webquests
11. Photosynthesis vs. Cellular respiration webquest
12. Laboratory Activities:
13. Photosynthesis & Cellular Respiration lab
14. Guided reading/Review handouts
15. Chapter 8 & 9 Assessment Questions
16. Chapter 8 & 9 Standardized Test Prep

Assessments:

1. Chapter Assessment Questions
2. Teacher-made formative/summative assessment
3. Chapter Standardized Test Prep

Resources:

"Biology" McGraw Hill
McGraw Hill Powerpoint Presentations/Website
Custom made Powerpoint presentations
Discovery Streaming
Teachertube
Internet resources
Laboratory materials
Study guides

Time Frame: 5 weeks (March-April)
Unit/Anchor: Chemical Basis of Life
Module A

Anchor Descriptors

BIO.A.2.1 Describe how the unique properties of water support life on Earth.
BIO.A.2.2 Describe and interpret relationships between structure and function at various levels of biochemical organization (i.e, atoms, molecules, and macromolecules).
BIO.A.2.3 Explain how enzymes regulate biochemical reactions within a cell.

Eligible Content:

BIO.A.2.1.1 Describe the unique properties of water and how these properties support life on Earth (e.g., freezing point, high specific heat, cohesion).
BIO.A.2.2.1 Explain how carbon is uniquely suited to form biological macromolecules
BIO.A.2.2.2 Describe how biological macromolecules form from monomers.
BIO.A.2.2.3 Compare the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms.
BIO.A.2.3.1 Describe the role of an enzyme as a catalyst in regulating a specific biochemical reaction.
BIO.A.2.3.2 Explain how factors such as pH, temperature, and concentration levels can affect enzyme function.

NGSS:

HS-LS1: <u>From Molecules to Organisms: Structures and Processes</u>
HS-LS1-6: Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

Concepts:

1. Water, while not a biotic factor, is essential to the continued existence of life on earth. Water's properties support the functions of organisms.
2. Carbon compounds (carbohydrates, lipids, proteins, nucleic acids) have specific structures and roles within the cell and increasing levels of organismal complexity. Insufficient quantities of these macromolecules can disrupt cellular functions and structures.
3. Enzymes catalyze biochemical reactions within the cell, necessary to continue optimal cellular function

Objectives:

1. Describe the unique properties of water.
2. Explain how the unique properties of water make life on earth possible.
3. Describe the structure of a carbon atom.
4. Explain how carbon atoms bond to form biological macromolecules.
5. Describe how biological macromolecules form from monomers.

6. Compare the structural and function of carbohydrates, lipids, proteins, and nucleic acids in organisms.
7. Explain how enzymes act as catalysts to regulate biochemical reactions.
8. Explain how environmental factors affect the function and reaction rate of the enzyme.
9. Interpret graphs to analyze enzyme catalyzed reactions.

Learning Events/Activities

1. Vocabulary
2. Lecture presentation/notes/discussion
3. Animations/videos
4. Chapter 2 Section Assessment Questions
5. Exercises:

6. Matter Review handout
7. Water diagrams
8. Macromolecule diagrams and questions
9. Macromolecules models and analysis questions
10. Online activities/webquests
11. Macromolecules webquest
12. Online Enzyme simulation
13. Laboratory Activities:
    a. Water properties lab
    b. Biomacromolecules lab
    c. Enzyme lab
14. Guided reading/Review handouts
15. Chapter 2 Assessment Questions
16. Chapter 2 Standardized Test Prep

Assessments:

1. Chapter Assessment Questions
2. Teacher-made formative/summative assessment
3. Chapter Standardized Test Prep

Resources:

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