The following list and tables summarize the "inquiry standards," sometimes called Science & Engineering Practices, for both ODE's Ohio Revised Science Standards (released 2011), which is paraphrased from the Next Generation Science Standards (NGSS, released 2013).

IN ADDITION TO TEACHING AND IMPLEMENTING THE CURRENT HIGH SCHOOL SCIENCE CURRICULUM, TEACHERS MUST CONSISTENTLY INCORPORATE AND INTEGRATE THE "INQUIRY AND APPLICATION STANDARDS" INTO DAILY CLASSROOM INSTRUCTION.

OVERVIEW OF STANDARDS

The following List and Table summarizes the "inquiry standards," sometimes called Science & Engineering Practices, for both ODE's Ohio Revised Science Standards (released 2011), which is paraphrased from the Next Generation Science Standards (NGSS). THESE STANDARDS MUST BE ACCOUNTED FOR THROUGHOUT THE CURRICULUM!

ODE's Science Inquiry and Application (From Ohio Revised Science Standards)

All students must use the following scientific processes with appropriate laboratory, safety techniques to construct their knowledge and understanding in all science content areas:

- Identify questions and concepts that guide scientific investigations;
- Design and conduct scientific investigations;
- Use technology and mathematics to improve investigations and communications;
- Formulate and revise explanations and models using logic and evidence (critical thinking);
- Recognize and analyze explanations and models; and
- Communicate and support a scientific argument

Next Generation Science Standards

8 SCIENCE AND ENGINEERING PRACTICES (From the May 2012 Draft)

Science and Engineering Practices	Defined as…	Grades 9-12 Condensed Practices
Asking Questions and Defining Problems	A practice of science is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world works and which can be empirically tested. Engineering questions clarify problems to determine criteria for successful solutions and identify constraints to solve problems about the designed world. Both scientists and engineers also ask questions to clarify the ideas of others.	Asking questions and defining problems in grades 9-12 builds from grades K-8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and explanatory models and simulations. □ Ask questions that arise from phenomena, models, theory, or unexpected results. □ Ask questions that require relevant empirical evidence. □ Ask questions to determine quantitative relationships between independent and dependent variables. □Ask questions that challenge the premise of an argument, the interpretation of a data set, or the suitability of a design.

Science and Engineering Practices Developing and using models	Defined as… A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations. Modeling tools are used to develop questions, predictions and explanations; analyze and identify flaws in systems; and communicate ideas. Models are used to build and revise scientific explanations and proposed engineered systems. Measurements and observations are used to revise models and designs.	Grades 9-12 Condensed Practices Modeling in 9-12 builds on K-8 and progresses to using, synthesizing, and constructing models to predict and explain relationships between systems and their components in the natural and designed world. • Use multiple types of models to represent and explain phenomena, and move flexibly between model types based on merits and limitations. • Construct, revise, and use models to predict and explain relationships between systems and their components. • Use models (including mathematical and computational) to generate data to explain and predict phenomena, analyze systems, and solve problems. • Design a test of a model to ascertain its reliability. • Examine merits and limitations of various models in order to select or revise a model that best fits the evidence or the design criteria.

Science and Engineering Practices Planning and carrying out investigations	Defined as… Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters. Engineering investigations identify the effectiveness, efficiency, and durability of designs under different conditions.	Grades 9-12 Condensed Practices Planning and carrying out investigations to answer questions or test solutions to problems in 9-12 builds on K-8 experiences and progresses to include investigations that build, test, and revise conceptual, mathematical, physical, and empirical models. • Plan and carry out investigations individually and collaboratively and test designs as part of building and revising models, explaining phenomena, or testing solutions to problems. Consider possible confounding variables or effects and ensure the investigation's design has controlled for them. • Evaluate various methods of collecting data (e.g., field study, experimental design, simulations) and analyze components of the design in terms of various aspects of the study. Decide types, how much, and accuracy of data needed to produce reliable measurement and consider any limitations on the precision of the data (e.g., number of trials, cost, risk, time). • Select appropriate tools to collect, record, analyze, and evaluate data. • Plan and carry out investigations and test design solutions in a safe and ethical manner including considerations of environmental, social, and personal impacts. • Planning and carrying out investigations may include elements of all of the other practices.

Science and Engineering Practices Analyzing and interpreting data	Defined as… Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use arrange of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis. Engineering investigations include analysis of data collected in the tests of designs. This allows comparison of different solutions and determines how well each meets specific design criteria— that is, which design best solves the problem within given constraints? Like scientists, engineers require a range of tools to identify patterns within data and interpret the results. Advances in science make analysis of proposed solutions more efficient and effective.	Grades 9-12 Condensed Practices Analyzing data in 9-12 builds on K- 8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. • Use tools, technologies, and/or models (e.g., computational, mathematical) to generate and analyze data in order to make valid and reliable scientific claims or determine an optimal design solution. • Consider limitations (e.g., measurement error, sample selection) when analyzing and interpreting data. • Determine function fits to data, including slope, intercept, and correlation coefficient for linear fits. • Compare and contrast various types of data sets (e.g., self- generated, archival) to examine consistency of measurements and observations. • Evaluate the impact of new data on a working explanation of a phenomenon or design solution.

Science and Engineering Practices Using mathematics and computational thinking	Defined as… In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; statistically analyzing data; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Statistical methods are frequently used to identify significant patterns and establish correlational relationships.	Grades 9-12 Condensed Practices Mathematical and computational thinking at the 9-12 level builds on K-8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. • Use mathematical or algorithmic representations of phenomena or design solutions to create explanations, computational models, or simulations. • Use mathematical expressions to represent phenomena or design solutions in order to solve algebraically for desired quantities. • Use simple limit cases to test mathematical expressions, computer programs or algorithms, or simulations to see if a model ―makes sense‖ by comparing the outcomes with what is known about the real world. • Use statistical and mathematical techniques and structure data (e.g., displays, tables, graphs) to find regularities, patterns (e.g., fitting mathematical curves to data), and relationships in data. • Used for a range of tasks such as constructing simulations; statistically analyzing data; and recognizing, expressing, and applying quantitative relationships. • Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Statistical methods are frequently used to identify significant patterns and establish correlational relationships.

Science and Engineering Practices Constructing explanations (for science) and designing solutions (for engineering)	Defined as… The products of science are explanations and the products of engineering are solutions. The goal of science is the construction of theories that provide explanatory accounts of the world. A theory becomes accepted when it has multiple lines of empirical evidence and greater explanatory power of phenomena than previous theories. The goal of engineering design is to find a systematic solution to problems that is based on scientific knowledge and models of the material world. Each proposed solution results from a process of balancing competing criteria of desired functions, technical feasibility, cost, safety, aesthetics, and compliance with legal requirements. The optimal choice depends on how well the proposed solutions meet criteria and constraints.	Grades 9-12 Condensed Practices Constructing explanations and designing solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific knowledge, principles, and theories. • Make quantitative claims regarding the relationship between dependent and independent variables. • Apply scientific reasoning, theory, and models to link evidence to claims and show why the data are adequate for the explanation or conclusion. • Construct and revise explanations and arguments based on evidence obtained from a variety of sources (e.g., scientific principles, models, theories) and peer review. • Base casual explanations on valid and reliable empirical evidence from multiple sources and the assumption that natural laws operate today as they did in the past and will continue to do so in the future. • Apply scientific knowledge to solve design problems by taking into account possible unanticipated effects.

Science and Engineering Practices	Defined as…	Grades 9-12 Condensed Practices
Engaging in argument from evidence	Argumentation is the process by which explanations and solutions are reached. In science and engineering, reasoning and argument based on evidence are essential to identifying the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation to listen to, compare, and evaluate competing ideas and methods based on merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to identify strengths and weaknesses of claims.	Engaging in argument from evidence in 9-12 builds from K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world. Arguments may also come from current scientific or historical episodes in science. • Criticize and evaluate arguments and design solutions in light of new evidence, limitations (e.g., trade-offs), constraints, and ethical issues. • Evaluate the merits of competing arguments, design solutions, and/or models. • Evaluate the claims, evidence, and reasoning of currently accepted explanations or solutions as a basis for the merits of the arguments. • Construct a counter-argument that is based in data and evidence that challenges another proposed argument.

Science and Engineering Practices Obtaining, evaluating, and communicating information	Defined as… Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations as well as orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to acquire information that is used to evaluate the merit and validity of claims, methods, and designs.	Grades 9-12 Condensed Practices Obtaining, evaluating, and communicating information in 9-12 builds on K-8 and progresses to evaluating the validity and reliability of the claims, methods, and designs. • Critically read scientific literature adapted for classroom use to identify key ideas and major points and to evaluate the validity and reliability of the claims, methods, and designs. • Generate, synthesize, communicate, and critique claims, methods, and designs that appear in scientific and technical texts or media reports. • Recognize the major features of scientific and technical writing and speaking and produce written and illustrated texts or oral presentations that communicate ideas and accomplishments.

Note to Teachers:

The following tables summarize the Common Core State Standards of English Language Arts & Literacy in History/Social Studies, Science and Technical Subjects.

IN ADDITION TO TEACHING AND IMPLETMENATING THE CURRENT HIGH SCHOOL SCIENCE CURRICULUM, TEACHERS MUST CONSISTENTLY INCORPORATE AND INTEGRATE THE "COMMON CORE STATE STANDARDS OF ENGLISH LANGUAGE ARTS & LITERACY IN HISTORY/SOCIAL STUDIES, SCIENCE AND TECHNICAL SUBJECTS" INTO DAILY CLASSROOM INSTRUCTION.

Reading Standards for Literacy in Science and Technical Subjects.

Each number 1-10 is a College and Career Readiness Anchor Standard

No. Grades 9-10 Students	*Grades 11-12 students*
Key Ideas and Details	
1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.	Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

Craft and Structure		
4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
5	Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).	Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
6	Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.	Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.

Integration of Knowledge and Ideas	
7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
Range of Reading and Level of Text Complexity	
10 By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.	By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.

Writing Standards *for Literacy in Science and Technical Subjects.*

Each number 1-10 is a College and Career Readiness Anchor Standard

No.	*Grades 9-10 Students*	*Grades 11-12 students*
	Text Types and Purposes	
1	Write arguments focused on discipline-specific content. a. Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence. b. Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns. c. Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.	Write arguments focused on discipline-specific content. a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence. b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases. c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims. d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. e. Provide a concluding statement or section that follows from or supports the argument presented.

	d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. e. Provide a concluding statement or section that follows from or supports the argument presented.	
2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. a. Introduce a topic and organize ideas, concepts, and information to make when include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. b. Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge the topic. manage the c. Use varied transitions and sentence	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. a. Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., important connections and distinctions; headings), graphics (e.g., figures, tables), and multimedia useful to aiding comprehension. b. Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts. d. Use precise language, domain-specific vocabulary and of techniques such as metaphor, simile, and analogy to complexity of the topic; convey a knowledgeable stance in a style

	structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts. d. Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers. e. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. f. Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).	that responds to the discipline and context as well as to the expertise of likely readers. e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).
3	Students' narrative skills continue to grow in these grades. The Standards require that students be able to incorporate narrative elements effectively into arguments and informative/explanatory texts. In history/social studies, students must be able to incorporate narrative accounts into their analyses of individuals or events of historical import. In science and technical subjects, students must be able to write precise enough descriptions of the step-by-step procedures they use in their investigations or technical work that others can replicate them and (possibly) reach the same results.	

Production and Distribution of Writing	
4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.	Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
Research to Build and Present Knowledge	
7 Conduct short as well as more sustained research projects to answer a question (including a self- generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.	Conduct short as well as more sustained research projects to answer a question (including a self- generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research and question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
9 Draw evidence from informational texts to support analysis, reflection, and research.	Draw evidence from informational texts to support analysis, reflection, and research.
Range of Reading and Level of Text Complexity	
10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames or a day or two) for a range of discipline-specific tasks, purposes, and audiences.	Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) (a single sitting for a range of discipline-specific tasks, purposes, and audiences.

GRADING PERIOD 4

Unit One: Structure and Function of Cell — **23 Days**

Academic Learning Targets

The students will be able to…

- describe how temperature influences reaction rates
- describe how enzymes enable chemical reactions in living systems
- explain how pH can effect protein structure
- evaluate how the structure of water makes it a good solvent
- identify the basic elements of life
- explain why carbon is the basis of life
- explain how water, carbohydrates, proteins, nucleic acids and lipids are essential to cell structure and functions
- describe the structure of a protein
- describe what influences protein shape and function
- describe how a cell can act as a single system
- use the fossil record to develop a timeline from the first types of cells to multicellular organisms
- describe how a cell can act as part of a multicellular organism
- explain how a cell conducts functions associated with life
- describe the function and structure of the cell membrane
- describe the structure and function of the cellular structures that deal with transport of materials
- describe the structure and functions of the cellular structures that deals with energy transformation
- describe the structure and function of cellular structures that deal with protein building
- describe the structure and function of cellular structures that deal with waste disposal
- describe the structure and function of cellular structures that deal with information feedback
- describe the structure and function of cellular structures that deal with movement
- describe how cellular organelles function as a system

Required Lab Themes/ Intervention/ Extension

Required Lab Themes:

- Microscope
- Comparison of cells

Intervention:

- Cell Structure and Function -- Major Concepts and Learning Activities: http://serendip.brynmawr.edu/exchange/files/cell%20structure%20function.pdf;
- Animal Cell/Plant Cell virtual labs, http://www.biologycorner.com/worksheets/cheekcell-virtual.html;
- Cells Alive! Internet lesson: http://www.biologycorner.com/worksheets/cellsalive.html:
- Concepts in Biochemistry: Interactive Cell Structure Module: http://www.wiley.com/legacy/college/boyer/0470003790/animations/cell_structure/cell_structure.htm;

Extension:

- Enrichment: Group Project, Just One of the Family; Unit 2 Resources p. 11
- Chemistry Tutorial from The Biology Project: http://www.biology.arizona.edu/biochemistry/tutorials/chemistry/problems.html;

Textbook: Prentice Hall -Biology

This pacing guide is based on days. A day is a 50 minute period and should be adjusted to fit alternative schedules.

GRADING PERIOD 4

Unit Two: Cellular Processes

22 Days

Academic Learning Targets

The students will be able to…

- compare and contrast how autotrophs and heterotrophs obtain energy
- describe how ATP works
- describe the light and dark reactions of photosynthesis
- explain the process of cellular respiration
- explain cell differentiation as a functional modification within a multicellular organism
- compare cellular division in eukaryotes and prokaryotes
- describe the steps of cellular division
- describe how cellular interactions regulate the cell cycle

Required Lab Themes/ Intervention/ Extension

Required Lab Themes:

- Animal/plant cell division
- Photosynthesis
- Cellular Respiration

Intervention:

- How do biological organisms use energy? http://serendip.brynmawr.edu/exchange/bioactivities/energy
- Illuminating Photosynthesis Interactive: http://www.pbs.org/wgbh/nova/nature/photosynthesis.html;
- CellsALIVE! Interactive: http://www.cellsalive.com/mitosis.htm;
- Chromosome Shuffle: http://www.accessexcellence.org/AE/AEC/AEF/1996/meyer_chromosome.php;

Extension:

- Mitosis and Meiosis Resource List: http://www.nclark.net/MitosisMeiosis
- Cellular respiration and Photosynthesis resource list: http://www.nclark.net/PhotoRespiration
- SePUP Cell Cycle Game: http://sepuplhs.org/high/sgi/teachers/cell_sim.html

Textbook: Prentice Hall - Biology

This pacing guide is based on days. A day is a 50 minute period and should be adjusted to fit alternative schedules.

GRADING PERIOD 1

Unit Three: Modern Genetics — **20 Days**

Academic Learning Targets

The students will be able to…

- identify and summarize the stages of meiosis
- summarize how the process of meiosis produces genetic recombination
- explain how DNA and chromosomes structure intertwine with Mendel's Laws of Inheritance
- explain the concept of polygenic traits using an example
- explain the concept of linked genes and use a Dihybrid cross to explore linked groups.
- describe and analyze problems dealing with incomplete dominance
- describe and analyze problems dealing with sex-linked traits
- describe and analyze problems dealing with dihybrid crosses
- explain how a Chi Square test can be used as a validity test for genetic crosses
- describe pleiotropy using an example (sickle cell anemia)
- describe epistasis using an example
- describe how technological developments led to current knowledge of heredity

Required Lab Themes/ Intervention/ Extension

Required Lab Themes:

- Pedigrees
- Meiosis
- Chi Square/goodness of fit

Intervention:

- Enlivening Genetics Education!: http://www2.edc.org/weblabs/
- The American Society of Human Genetics (ASHG) - Curriculum Content Review: http://www.ashg.org/education/pdf/Resources_CCRC.pdf;
- The Chi-Square is a ―Ratio-Ruling‖: http://www.synapses.co.uk/genetics/chisqr.html;
- Chi-Square Tests: http://inspire.stat.ucla.edu/unit_13/index.php;

Extension:

- Enrichment, Unit 3 Resources, pp. 11, 47, 121

Textbook: Prentice Hall - Biology
This pacing guide is based on days. A day is a 50 minute period and should be adjusted to fit alternative schedules.

GRADING PERIOD 1

Unit Four: Structure and Function of DNA **15 Days**

Academic Learning Targets

The students will be able to…

- summarize the experiments that led to the discovery of DNA.
- **diagram/label the basic structure of DNA & chromosomes**
- **summarize the role of the enzymes in DNA replication and how leading and lagging strands are synthesized differently**

Required Lab Themes/ Intervention/ Extension

Required Lab Themes:

- Models of DNA/RNA

Intervention:

- The Biology Corner: DNA resources: http://www.biologycorner.com/bio2/index2.html#DNA
- Molecular Biology Overview: http://serendip.brynmawr.edu/exchange/bioactivities/MolBio
- Genetics Resource List: http://www.nclark.net/Genetics

Extension:

Enrichment, Unit 3 Resources p. 83

Textbook: Prentice Hall - Biology

This pacing guide is based on days. A day is a 50 minute period and should be adjusted to fit alternative schedules.

Unit Five: Genetic Mechanisms and Inheritance 5

GRADING PERIOD 1

Academic Learning Targets	Required Lab Themes/ Intervention/ Extension
The students will be able to… □ describe how DNA bases code for amino acids and proteins □ **explain how mRNA, rRNA, and tRNA are involved in the transcription and translation of genes** □ summarize the role of RNA polymerase and DNA in the synthesis and translation of mRNA into a protein	**Required Lab Themes:** □ Model tRNA/rRNA/protein synthesis **Intervention:** *See previous page* **Extension:** □ Enrichment, Unit 3 Resources, p.83

Textbook: Prentice Hall - Biology
This pacing guide is based on days. A day is a 50 minute period and should be adjusted to fit alternative schedules.

GRADING PERIOD 1

Unit Six: Mutations

5 Days

Academic Learning Targets

The students will be able to…

- explain how a genome is encoded in DNA
- describe the structure of a protein
- describe what influences protein shape and function
- explain the concept of a gene in terms of DNA
- describe cell differentiation as related to gene regulation and control
- explain how different genes can be active/inactive in different cells
- compare how deletions, insertions, and substitutions in DNA alter genes
- explain possible results of an altered gene
- describe how gene mutations can be passed on to offspring

Required Lab Themes/ Intervention/ Extension

Required Lab Themes:

- Model mutations (causes/changes/results)

Extension:

- PBS forensic science resource list: http://www.pbs.org/teachers/thismonth/forensics/index3.html; A listing of resources for teaching genetics thematically.
- Genetic Engineering Lesson Plan: http://www.discoveryeducation.com/teachers/free-lesson-plans/genetic-engineering.cfm; A high school level lesson plan from Discovery education focusing on ethics of genetic engineering

Textbook: Prentice Hall - Biology

This pacing guide is based on days. A day is a 50 minute period and should be adjusted to fit alternative schedules.

Unit Seven: Mechanisms of Evolution **22 Days**

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GRADING PERIOD 2

Academic Learning Targets

The students will be able to…

- use the fossil record to explain the diversity of life on Earth
- describe historical perspectives of evolution
- explain how natural selection is influenced by the environment
- define the process of natural selection, speciation, and homologous structures
- design and conduct an experiment using natural selection
- use molecular-sequence data and morphological comparisons to support or reject lineages of organisms
- use modern molecular evidence to explain evolution and the diversity of life on Earth
- state and defend four interactions that explain how populations evolve over time (increase population, gene variability, finite resources, survival and reproduction rates)
- use Hardy-Weinberg's law to explain gene frequency in populations
- explain evolution in terms of changing proportions of a trait in populations
- explain and use examples of speciation
- explain genetic drift using an example
- explain and use an example of gene flow
- apply the concept of mutation and genetic drift to real world examples
- explain the concept of sexual selection and give examples
- formulate and revise explanations for gene flow and sexual selection based on real-world problems
- explain the concept of descent with modification
- describe the basic concept of biological evolution

Required Lab Themes/ Intervention/ Extension

Required Lab Themes:

- Natural Selection
- Hardy-Weinberg Laws

Interventions:

- Getting into the Fossil Record - http://teacherweb.com/ME/Deering/LeGage/On-Line-Fossil-Lab-1.pdf -
- PBS Evolution Website: http://www.pbs.org/wgbh/evolution/educators/lessons/index.html
- AAAS Introduction to Natural Selection: http://sciencenetlinks.com/lessons/introduction-to-natural-selection/;
- Investigating Natural Selection: http://www.nap.edu/openbook.php?record_id=5787&page=78;
- Making Cladograms: http://www.indiana.edu/~ensiweb/lessons/mclad.html;
- The ―Cytochrome-C‖ Lab: http://www.indiana.edu/~ensiweb/lessons/mol.bio.html;
- The Shape of Life: http://www.pbs.org/kcet/shapeoflife/;

Extension:

- Fossil Hunt: http://www.accessexcellence.org/AE/AEC/AEF/1996/coleman_fossil.php; This Access Excellence lesson plan
- Evolution: Natural and Artificial Selection: www.**e**xplorelearning.com:
- Evolution: Mutation and Selection: www.explorelearning.com;
- Hardy-Weinberg Equilibrium: www.Explorelearning.com;

Textbook: Prentice Hall - Biology

This pacing guide is based on days. A day is a 50 minute period and should be adjusted to fit alternative schedules.

GRADING PERIOD 2

Unit Eight: Diversity of Life

23 Days

Academic Learning Targets

The students will be able to…

- use cladograms to explain biodiversity. (Focusing on morphological comparisons and molecular evidence)
- relate how recent molecular-sequence data generally support earlier hypotheses regarding lineages of organisms based upon morphological comparisons
- explain that variation of organisms with a species is due to population genetics and gene frequency

Required Lab Themes/ Intervention/ Extension

Required Lab Themes:

- Dichotomous Keys
- Cladograms

Intervention

- Cladistics is a Zip...baggie: http://www.indiana.edu/~ensiweb/lessons/clad.bag.html;
- The Missing Link: http://www.pbs.org/wgbh/nova/education/activities/2905_link.html; *NOVA*'s "Hardware Organism"

Extension

- Microevolution: **www.e**xplorelearning.com;

Textbook: Prentice Hall - Biology

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GRADING PERIOD 3

Unit Nine: Diversity and Interdependence of Life 22 Days

Academic Learning Targets	Required Lab Themes/ Intervention/ Extension
The students will be able to… • classify organisms using various classification systems • compare methods of classifying organisms & the categories used • write a scientific name using binomial nomenclature • compare/contrast species concepts • describe methods used to reveal phylogeny & cladogram construction • classify organisms using the currently accepted system	**Required Lab Themes:** • Dichotomous Keys • Cladograms **Intervention** **Extension** • Develop a Classification System: http://www.sciencelearn.org.nz/Contexts/Life-in-the-Sea/Teaching-and-Learning-Approaches/Develop-a-classification-system; • Interpreting Graphics - Taxonomy: http://www.biologycorner.com/worksheets/taxonomy_interpret.html ; • Primate Classification: http://www.indiana.edu/~ensiweb/lessons/primclas.html#anchor980882;

Textbook: Prentice Hall - Biology
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GRADING PERIOD 3

Unit Ten: Ecosystems 23 Days

Academic Learning Targets

The students will be able to…

- explain interspecies and intra-species competition in terms of an ecological niche
- explain the effects of intraspecies and interspecies competition
- explain how ecosystems can have cyclic fluctuations around a rough equilibrium
- describe the flow of energy and cycles of matter as organism survive and reproduce
- explain the concept of energy flow as unidirectional in an ecosystem
- describe how geological and biological conditions can change ecosystems
- demonstrate how even though ecosystems have cyclical fluctuations around a state of equilibrium they can remain relatively consistent over hundreds or thousands of years.
- determine the factors that limit the number of organisms that an ecosystem can support
- \describe population growth capacity
- use real-time data to compare exponential and logistic growth models.
- use technology to access authentic data to study population changes and growth
- use mathematical graphing and algebraic knowledge to explain concepts of carrying capacity and homeostasis in biomes
- describe the effects of immigration and emigration on an ecosystem
- use food webs/chains to explain relationships or events within an ecosystem (biomagnification; habitat destruction)

Required Lab Themes/ Intervention/ Extension

Required Lab Themes:

- Population Growth/Limitations

Intervention:

- Biome and Ecology Unit: http://www.accessexcellence.org/AE/AEC/AEF/1996/tomlinson_ecology.php;
- Focus on Air Quality: http://www.pbs.org/now/classroom/airquality.html;
- Skeeter Populations and Exponential Growth: http://www.learner.org/workshops/algebra/workshop8/lessonplan2b.html;

Extension

- Intraspecific Competition Lab: http://www.faculty.virginia.edu/evolutionlabs/GSUEvoLab5.htm; This lab explores the effect overplanting an area has on plant growth
- Prairie Ecosystem: www.explorelearning.com; investigate feeding relationships to determine the food chain. Bar graphs and line graphs show changes in populations over time.
- Estimating Population Size: www.Explorelearning.com; Students use the capture/recapture method to estimate the population of fish in a simulated pond.
- Rabbit Population by Season: www.Explorelearning.com; Students observe the population of rabbits in an environment over many years; conditions can be adjusted
- Great Gravidity: http://insected.arizona.edu/gg/default.html; A 4 week observation based project that investigates pressures on an aphid colony.
- Nature's Pharmacy: Killing the Cure; http://www.actionbioscience.org/biodiversity/lessons/plotkinlessons.pdf; This lesson provides students with an opportunity to explore ethnobotany within the realm of pharmaceutical development.

Textbook: Prentice Hall - Biology

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