

**Course Title:** Genetics

**Board Approval Date:** 11/18/13

**Credit / Hours:** 0.5 Credit

**Course Description:**

This course focuses on mastery of the PA Academic Standards for Science and Technology. As students' progress through this course they will participate in the systematic study of the fundamentals of Human Genetics. This course encompasses the early history and cytological foundations for Genetics, Mendelian or Transmission Genetics, Quantitative Traits and Polygenic Inheritance, DNA analysis, Genetic mutations/trait analysis, and Genetic engineering.

Within the framework of this course are advanced technological labs that students will encounter in a college level Genetics course. Some of the labs include fruit fly culturing for determination of phenotypes, DNA fingerprinting, DNA extraction, Genetic engineering using plasmids to make glow-in-the-dark bacteria, crime scene analysis, possible GMO and fiber analysis at crime scenes labs and writing a major research paper on a hot topic in Genetics with an oral and power point presentations. Wherever possible, applications of basic principles are correlated to activities or events the student may encounter in their lifetime. This course is intended for college prep students only with an interest in the Human Services/Health fields or any of the Sciences. A pre-requisite of an 85% or higher in both Physical Science and Biology are required.

**Learning Activities / Modes of Assessment:**

Large group instruction  
Laboratory experiments  
Small group work  
Reading assignments  
Computer Research  
Research Analysis

Tests and Quizzes  
Projects with Rubrics  
Lab Reports / Write-ups  
PowerPoint Presentations  
Intensive Day Projects  
Graphic Organizers  
Model Making  
Oral Speeches

**Instructional Resources:**

Textbook: "Human Genetics" ninth edition – Copyright 2010 McGraw-Hill  
Textbook: "Basic Human Genetics" second edition – Copyright 1999 Sinauer Associates Inc.

Computer, Power-point presentations, Study guides, Activboard, Educational videos, Lab-generated Activities/Worksheets, Education Video Library, Wilkes or Susquehanna Science in Motion, and Carolina Biological.

## Course Pacing Guide

Course: **Genetics**

<b>Course Unit (Topic)</b>	<b>Length of Instruction (Days/Periods)</b>
1. History and Chromosomal Basis of Genetics	16 days
2. Classic Mendelian Genetics	18 days
3. Extensions to Mendelian Genetics	12 days
4. Quantitative Traits	14 days
5. Molecular Genetics	15 days
6. Biotechnology	<u>15 days</u>
<b>DAYS TOTAL</b>	<b>90 Days</b>

Topic: 1- History and Chromosomal Basis of Genetics

Days: 16

Subject(s):

Grade(s):

Know:

- The various fields that make-up Genetics.
- The many scientists involved in discovering the field of Genetics, including Gregor Mendel.
- The importance of the Human Genome Project.
- Early and modern form of Eugenics.
- Write a research paper and give oral presentation on findings on a hot topic in Genetics.
- The cell organelles involved in cell reproduction including performing well on a lab practical.
- The steps of mitosis and meiosis in order, including knowing the main differences in each of these nuclear divisions.
- Life cycle of a cell.

Vocabulary:

- Cytogenetics, transmission genetics, quantitative genetics, population genetics, molecular genetics, Human genome project, pangenesis, gemmules, eugenics, nucleus, nucleolus, nuclear envelope, chromatin, chromatid, chromosome, centriole, spindle fiber, cytoplasm, plasma membrane, mitochondria,

Understand:

Biologic molecules are important to the function of all living organisms.

Do:

**3.1.10.B – Essential**

Describe concepts of models as a way to predict and understand science and technology.

- Distinguish between different types of models and modeling techniques and apply their appropriate use in specific applications (e.g., kinetic gas theory, DNA).
- Examine the advantages of using models to demonstrate processes and outcomes (e.g., blue print analysis, structural stability).
- Apply mathematical models to science and technology.

**3.4.10.B – Compact**

Analyze energy sources and transfers of heat.

- Determine the efficiency of chemical systems by applying mathematical formulas.
- Use knowledge of chemical reactions to generate an electrical current.
- Evaluate energy changes in chemical reactions.
- Use knowledge of conservation of energy and momentum to explain common phenomena (e.g., refrigeration system, rocket propulsion).
- Explain resistance, current and electro-motive force (Ohm's Law).

3.1.10.B -

Describe concepts of models as a way to predict and understand science and technology.

- Distinguish between different types of models and modeling techniques and apply their appropriate use in specific applications (e.g., kinetic gas theory, DNA).
- Examine the advantages of using models to demonstrate processes and outcomes (e.g., blue print analysis, structural stability).
- Apply mathematical models to science and technology.

3.4.10.B - Analyze energy sources and transfers of heat

3.1.10.B - Describe concepts of models as a way to predict and understand science and technology.

Topic: 1- History and Chromosomal Basis of Genetics

Days: 16

Subject(s):

Grade(s):

Know:	Understand:	Do:
<p>chloroplasts, ER, centromere, ribosomes, mitosis, meiosis, prophase, metaphase, anaphase, telophase, cell cycle, synapsis, crossing-over, tetrad, homologous chromosomes.</p>		<p>3.4.10.B - Analyze energy sources and transfers of heat.</p> <ul style="list-style-type: none"> <li>• Determine the efficiency of chemical systems by applying mathematical formulas.</li> <li>• Use knowledge of chemical reactions to generate an electrical current.</li> <li>• Evaluate energy changes in chemical reactions.</li> <li>• Use knowledge of conservation of energy and momentum to explain common phenomena (e.g., refrigeration system, rocket propulsion).</li> <li>• Explain resistance, current and electro-motive force (Ohm's Law).</li> </ul> <ul style="list-style-type: none"> <li>• Distinguish between different types of models and modeling techniques and apply their appropriate use in specific applications (e.g., kinetic gas theory, DNA).</li> <li>• Examine the advantages of using models to demonstrate processes and outcomes (e.g., blue print analysis, structural stability).</li> <li>• Apply mathematical models to science and technology.</li> </ul> <ul style="list-style-type: none"> <li>• Determine the efficiency of chemical systems by applying mathematical formulas.</li> <li>• Use knowledge of chemical reactions to generate an electrical current.</li> <li>• Evaluate energy changes in chemical reactions.</li> <li>• Use knowledge of conservation of energy and momentum to explain common phenomena (e.g., refrigeration system, rocket propulsion).</li> <li>• Explain resistance, current and electro-motive force (Ohm's Law).</li> </ul>

Topic: 2- Classic Mendelian Genetics

Days: 18

Subject(s):

Grade(s):

Know:

Know the work of Gregor Mendel and how he discovered the field of Genetics.

State the differences between Mendel's Law of Dominance, Law of Segregation, and Law of Independent Assortment.

Calculate probabilities of Monohybrid and Dihybrid Crosses using Punnett Squares.

Apply the Product Rule, Factorial Law, and Pascal's Triangle in solving genetic probabilities.

Perform lab on probabilities using coins, and Maize corn.

How to perform Fruit fly crosses involving 3 different phenotypic traits and calculate probability of results?

Calculate trihybrid cross probabilities using the Calculation method and Fork-line method.

How to determine generations of genetic disorders after analyzing pedigree worksheets to determine if its a recessive or dominant trait?

Understand:

Gregor Mendel's Laws can explain patterns of inheritance in all living things.

Do:

**3.3.10.C – Essential**

Describe how genetic information is inherited and expressed.

- Compare and contrast the function of mitosis and meiosis.
- Describe mutations' effects on a trait's expression.
- Distinguish different reproductive patterns in living things (e.g., budding, spores, fission).
- Compare random and selective breeding practices and their results (e.g., antibiotic resistant bacteria).
- Explain the relationship among DNA, genes and chromosomes.
- Explain different types of inheritance (e.g., multiple allele, sex-influenced traits).
- Describe the role of DNA in protein synthesis as it relates to gene expression.

**3.1.10.B – Essential**

Describe concepts of models as a way to predict and understand science and technology.

- Distinguish between different types of models and modeling techniques and apply their appropriate use in specific applications (e.g., kinetic gas theory, DNA).
- Examine the advantages of using models to demonstrate processes and outcomes (e.g., blue print analysis, structural stability).
- Apply mathematical models to science and technology.

**3.3.10.A – Essential**

Explain the structural and functional similarities and differences found among living things.

- Identify and characterize major life forms according to their placement in existing classification groups.
- Explain the relationship between structure and function at the molecular and cellular levels.
- Describe organizing schemes of classification keys.
- Identify and characterize major life forms by kingdom, phyla, class and order.

Topic: 2- Classic Mendelian Genetics

Days: 18

Subject(s):

Grade(s):

Know:

Understand:

Do:

**3.3.10.B – Essential**

Describe and explain the chemical and structural basis of living organisms.

- Describe the relationship between the structure of organic molecules and the function they serve in living organisms.
- Identify the specialized structures and regions of the cell and the functions of each.
- Explain how cells store and use information to guide their functions.
- Explain cell functions and processes in terms of chemical reactions and energy changes.

**3.4.10.B – Compact**

Analyze energy sources and transfers of heat.

- Determine the efficiency of chemical systems by applying mathematical formulas.
- Use knowledge of chemical reactions to generate an electrical current.
- Evaluate energy changes in chemical reactions.
- Use knowledge of conservation of energy and momentum to explain common phenomena (e.g., refrigeration system, rocket propulsion).
- Explain resistance, current and electro-motive force (Ohm's Law).

**3.7.10.B – Important**

Apply appropriate instruments and apparatus to examine a variety of objects and processes.

- Describe and use appropriate instruments to gather and analyze data.
- Compare and contrast different scientific measurement systems; select the best measurement system for a specific situation.
- Explain the need to estimate measurements within error of various instruments.
- Apply accurate measurement knowledge to solve everyday problems.
- Describe and demonstrate the operation and use of advanced instrumentation in evaluating material and chemical properties (e.g., scanning electron microscope, nuclear magnetic resonance machines).

Topic: 2- Classic Mendelian Genetics

Days: 18

Subject(s):

Grade(s):

Know:	Understand:	Do:
		<p>3.3.10.C - Describe how genetic information is inherited and expressed.</p> <p>3.1.10.B - Describe concepts of models as a way to predict and understand science and technology.</p> <p>3.3.10.A - Explain the structural and functional similarities and differences found among living things.</p> <p>3.3.10.B - Describe and explain the chemical and structural basis of living organisms.</p> <p>3.4.10.B - Analyze energy sources and transfers of heat.</p> <p>3.7.10.B - Apply appropriate instruments and apparatus to examine a variety of objects and processes.</p> <p>3.3.10.C - Describe how genetic information is inherited and expressed.</p> <p>3.1.10.B - Describe concepts of models as a way to predict and understand science and technology.</p> <p>3.3.10.A - Explain the structural and functional similarities and differences found among living things.</p> <p>3.3.10.B - Describe and explain the chemical and structural basis of living organisms.</p> <p>3.4.10.B - Analyze energy sources and transfers of heat.</p> <p>3.7.10.B - Apply appropriate instruments and apparatus to examine a variety of objects and processes.</p> <ul style="list-style-type: none"> <li>• Compare and contrast the function of mitosis and meiosis.</li> <li>• Describe mutations' effects on a trait's expression.</li> <li>• Distinguish different reproductive patterns in living things (e.g., budding, spores, fission).</li> <li>• Compare random and selective breeding practices and their results (e.g., antibiotic resistant bacteria).</li> <li>• Explain the relationship among DNA, genes and chromosomes.</li> <li>• Explain different types of inheritance (e.g., multiple allele, sex-influenced traits).</li> </ul>

Topic: 2- Classic Mendelian Genetics

Days: 18

Subject(s):

Grade(s):

Know:	Understand:	Do:
		<ul style="list-style-type: none"> <li>• Describe the role of DNA in protein synthesis as it relates to gene expression.</li> <li>• Distinguish between different types of models and modeling techniques and apply their appropriate use in specific applications (e.g., kinetic gas theory, DNA).</li> <li>• Examine the advantages of using models to demonstrate processes and outcomes (e.g., blue print analysis, structural stability).</li> <li>• Apply mathematical models to science and technology.</li> <li>• Identify and characterize major life forms according to their placement in existing classification groups.</li> <li>• Explain the relationship between structure and function at the molecular and cellular levels.</li> <li>• Describe organizing schemes of classification keys.</li> <li>• Identify and characterize major life forms by kingdom, phyla, class and order.</li> <li>• Describe the relationship between the structure of organic molecules and the function they serve in living organisms.</li> <li>• Identify the specialized structures and regions of the cell and the functions of each.</li> <li>• Explain how cells store and use information to guide their functions.</li> <li>• Explain cell functions and processes in terms of chemical reactions and energy changes.</li> <li>• Determine the efficiency of chemical systems by applying mathematical formulas.</li> <li>• Use knowledge of chemical reactions to generate an electrical current.</li> <li>• Evaluate energy changes in chemical reactions.</li> <li>• Use knowledge of conservation of energy and momentum to explain common phenomena (e.g., refrigeration system, rocket propulsion).</li> </ul>

Topic: 2- Classic Mendelian Genetics

Days: 18

Subject(s):

Grade(s):

Know:	Understand:	Do:
		<ul style="list-style-type: none"> <li>• Explain resistance, current and electro-motive force (Ohm's Law).</li> <li>• Describe and use appropriate instruments to gather and analyze data.</li> <li>• Compare and contrast different scientific measurement systems; select the best measurement system for a specific situation.</li> <li>• Explain the need to estimate measurements within error of various instruments.</li> <li>• Apply accurate measurement knowledge to solve everyday problems.</li> <li>• Describe and demonstrate the operation and use of advanced instrumentation in evaluating material and chemical properties (e.g., scanning electron microscope, nuclear magnetic resonance machines).</li> <li>• Compare and contrast the function of mitosis and meiosis.</li> <li>• Describe mutations' effects on a trait's expression.</li> <li>• Distinguish different reproductive patterns in living things (e.g., budding, spores, fission).</li> <li>• Compare random and selective breeding practices and their results (e.g., antibiotic resistant bacteria).</li> <li>• Explain the relationship among DNA, genes and chromosomes.</li> <li>• Explain different types of inheritance (e.g., multiple allele, sex-influenced traits).</li> <li>• Describe the role of DNA in protein synthesis as it relates to gene expression.</li> <li>• Distinguish between different types of models and modeling techniques and apply their appropriate use in specific applications (e.g., kinetic gas theory, DNA).</li> <li>• Examine the advantages of using models to demonstrate processes and outcomes (e.g., blue print analysis, structural stability).</li> </ul>

Topic: 2- Classic Mendelian Genetics

Days: 18

Subject(s):

Grade(s):

Know:	Understand:	Do:
		<ul style="list-style-type: none"> <li>• Apply mathematical models to science and technology.</li> <li>• Identify and characterize major life forms according to their placement in existing classification groups.</li> <li>• Explain the relationship between structure and function at the molecular and cellular levels.</li> <li>• Describe organizing schemes of classification keys.</li> <li>• Identify and characterize major life forms by kingdom, phyla, class and order.</li> <li>• Describe the relationship between the structure of organic molecules and the function they serve in living organisms.</li> <li>• Identify the specialized structures and regions of the cell and the functions of each.</li> <li>• Explain how cells store and use information to guide their functions.</li> <li>• Explain cell functions and processes in terms of chemical reactions and energy changes.</li> <li>• Determine the efficiency of chemical systems by applying mathematical formulas.</li> <li>• Use knowledge of chemical reactions to generate an electrical current.</li> <li>• Evaluate energy changes in chemical reactions.</li> <li>• Use knowledge of conservation of energy and momentum to explain common phenomena (e.g., refrigeration system, rocket propulsion).</li> <li>• Explain resistance, current and electro-motive force (Ohm's Law).</li> <li>• Describe and use appropriate instruments to gather and analyze data.</li> <li>• Compare and contrast different scientific measurement systems; select the best measurement system for a specific situation.</li> <li>• Explain the need to estimate measurements within error of various instruments.</li> <li>• Apply accurate measurement knowledge to solve everyday problems.</li> </ul>

Topic: 2- Classic Mendelian Genetics

Days: 18

Subject(s):

Grade(s):

Know:

Understand:

Do:

- Describe and demonstrate the operation and use of advanced instrumentation in evaluating material and chemical properties (e.g., scanning electron microscope, nuclear magnetic resonance machines).

Topic: 3- Extensions to Mendelian Genetics

Days: 12

Subject(s):

Grade(s):

Know:	Understand:	Do:
<p>Distinguish between gene-linkage and crossing-over.</p> <p>How extra-nuclear genes operate and control traits such as mitochondria and chloroplasts?</p> <p>The various disorders attributed to mutations in the mitochondria.</p> <p>Various multiple allele traits such as blood type and how to predict crosses with different blood type individuals?</p> <p>Distinguish between sex-linked, sex-limited, and sex-influenced traits.</p> <p>Non-disjunctions effect on chromosomal disorders.</p> <p>Explain the difference between incomplete dominance and co-dominance.</p> <p>Vocabulary: Gene linkage, crossing-over, extra-nuclear genes, variegation, oxidative phosphorylation, multiple alleles, antigens, agglutination, Rh factor, sex-linked traits, sex-limited traits, sex-influenced traits, nondisjunction, incomplete dominance, and codominance.</p>	<p>Hereditary information is inherited and expressed; the gene is the functional unit of heredity.</p>	<div data-bbox="846 346 1455 968"> <p><b>3.3.10.C – Essential</b> Describe how genetic information is inherited and expressed.</p> <ul style="list-style-type: none"> <li>• Compare and contrast the function of mitosis and meiosis.</li> <li>• Describe mutations' effects on a trait's expression.</li> <li>• Distinguish different reproductive patterns in living things (e.g., budding, spores, fission).</li> <li>• Compare random and selective breeding practices and their results (e.g., antibiotic resistant bacteria).</li> <li>• Explain the relationship among DNA, genes and chromosomes.</li> <li>• Explain different types of inheritance (e.g., multiple allele, sex-influenced traits).</li> <li>• Describe the role of DNA in protein synthesis as it relates to gene expression.</li> </ul> </div> <div data-bbox="846 982 1455 1436"> <p><b>3.1.10.B – Essential</b> Describe concepts of models as a way to predict and understand science and technology.</p> <ul style="list-style-type: none"> <li>• Distinguish between different types of models and modeling techniques and apply their appropriate use in specific applications (e.g., kinetic gas theory, DNA).</li> <li>• Examine the advantages of using models to demonstrate processes and outcomes (e.g., blue print analysis, structural stability).</li> <li>• Apply mathematical models to science and technology.</li> </ul> </div> <p>3.3.10.C - Describe how genetic information is inherited and expressed. 3.1.10.B - Describe concepts of models as a way to predict and understand science and technology. 3.3.10.C - Describe how genetic information is inherited and expressed. 3.1.10.B - Describe concepts of models as a way to predict and understand science and technology.</p> <ul style="list-style-type: none"> <li>• Compare and contrast the function of mitosis and meiosis.</li> </ul>

Topic: 3- Extensions to Mendelian Genetics

Days: 12

Subject(s):

Grade(s):

Know:	Understand:	Do:
		<ul style="list-style-type: none"> <li>• Describe mutations' effects on a trait's expression.</li> <li>• Distinguish different reproductive patterns in living things (e.g., budding, spores, fission).</li> <li>• Compare random and selective breeding practices and their results (e.g., antibiotic resistant bacteria).</li> <li>• Explain the relationship among DNA, genes and chromosomes.</li> <li>• Explain different types of inheritance (e.g., multiple allele, sex-influenced traits).</li> <li>• Describe the role of DNA in protein synthesis as it relates to gene expression.</li> <li>• Distinguish between different types of models and modeling techniques and apply their appropriate use in specific applications (e.g., kinetic gas theory, DNA).</li> <li>• Examine the advantages of using models to demonstrate processes and outcomes (e.g., blue print analysis, structural stability).</li> <li>• Apply mathematical models to science and technology.</li> <li>• Compare and contrast the function of mitosis and meiosis.</li> <li>• Describe mutations' effects on a trait's expression.</li> <li>• Distinguish different reproductive patterns in living things (e.g., budding, spores, fission).</li> <li>• Compare random and selective breeding practices and their results (e.g., antibiotic resistant bacteria).</li> <li>• Explain the relationship among DNA, genes and chromosomes.</li> <li>• Explain different types of inheritance (e.g., multiple allele, sex-influenced traits).</li> <li>• Describe the role of DNA in protein synthesis as it relates to gene expression.</li> <li>• Distinguish between different types of models and modeling techniques and apply their appropriate use in specific applications (e.g., kinetic gas theory, DNA).</li> </ul>

Topic: 3- Extensions to Mendelian Genetics

Days: 12

Subject(s):

Grade(s):

Know:

Understand:

Do:

- Examine the advantages of using models to demonstrate processes and outcomes (e.g., blue print analysis, structural stability).
- Apply mathematical models to science and technology.

Topic: 4- Quantitative Traits

Days: 14

Subject(s):

Grade(s):

Know:	Understand:	Do:
<p>The effect environment has on gene expressions (quantitative traits).</p> <p>Distinguish between continuous variation and discontinuous variation.</p> <p>The mechanisms in play behind developing diabetes.</p> <p>Nature vs nurture on homosexuality debate.</p> <p>Effects of genes and environment on alcoholism, skin color, and intelligence.</p> <p>Radiation effects on genes and chromosomes and expressions attributed with them.</p> <p>Carcinogen effects on genes and chromosomes and the expressions attributed with them.</p>	<p>Quantitative traits are determined by the cumulative effects of many genes and whose action can be very sensitive to environmental factors.</p>	<p><b>3.1.10.B – Essential</b> Describe concepts of models as a way to predict and understand science and technology.</p> <ul style="list-style-type: none"> <li>Distinguish between different types of models and modeling techniques and apply their appropriate use in specific applications (e.g., kinetic gas theory, DNA).</li> <li>Examine the advantages of using models to demonstrate processes and outcomes (e.g., blue print analysis, structural stability).</li> <li>Apply mathematical models to science and technology.</li> </ul> <p><b>3.1.B.B1.a – Essential</b> HEREDITY - Explain that the information passed from parents to offspring is transmitted by means of genes which are coded in DNA molecules.</p> <p><b>3.1.B.B5.a – Essential</b> UNIFYING THEMES - PATTERNS Describe how Mendel's laws of segregation and independent assortment can be observed through patterns of inheritance.</p> <p><b>3.1.B.B5.b – Essential</b> UNIFYING THEMES - Distinguish among observed inheritance patterns caused by several types of genetic traits (dominant, recessive, codominant, sex-linked, polygenic, incomplete dominance, multiple alleles)</p> <p><b>3.1.B.B5.d – Essential</b> UNIFYING THEMES - Explain how gene actions, patterns of heredity, and reproduction of cells and organisms account for the continuity of life.</p> <p><b>3.4.12.B1. – Essential</b> EFFECTS OF TECHNOLOGY - Analyze ethical, social, economic, and cultural considerations as related to the development, selection, and use of technologies.</p> <p><b>3.1.10.B -</b>  Describe concepts of models as a way to predict and understand science and technology.</p>

Topic: 4- Quantitative Traits

Days: 14

Subject(s):

Grade(s):

Know:	Understand:	Do:
		<ul style="list-style-type: none"> <li>• Distinguish between different types of models and modeling techniques and apply their appropriate use in specific applications (e.g., kinetic gas theory, DNA).</li> <li>• Examine the advantages of using models to demonstrate processes and outcomes (e.g., blue print analysis, structural stability).</li> <li>• Apply mathematical models to science and technology.</li> </ul> <p>3.1.10.B - Describe concepts of models as a way to predict and understand science and technology.</p> <p>3.1.B.B1.a - HEREDITY - Explain that the information passed from parents to offspring is transmitted by means of genes which are coded in DNA molecules.</p> <p>3.1.B.B5.a - UNIFYING THEMES - PATTERNS Describe how Mendel's laws of segregation and independent assortment can be observed through patterns of inheritance.</p> <p>3.1.B.B5.b - UNIFYING THEMES - Distinguish among observed inheritance patterns caused by several types of genetic traits (dominant, recessive, codominant, sex-linked, polygenic, incomplete dominance, multiple alleles)</p> <p>3.1.B.B5.d - UNIFYING THEMES - Explain how gene actions, patterns of heredity, and reproduction of cells and organisms account for the continuity of life.</p> <p>3.4.12.B1. - EFFECTS OF TECHNOLOGY - Analyze ethical, social, economic, and cultural considerations as related to the development, selection, and use of technologies.</p> <ul style="list-style-type: none"> <li>• Distinguish between different types of models and modeling techniques and apply their appropriate use in specific applications (e.g., kinetic gas theory, DNA).</li> <li>• Examine the advantages of using models to demonstrate processes and outcomes (e.g., blue print analysis, structural stability).</li> <li>• Apply mathematical models to science and technology.</li> </ul>

Topic: 5- Molecular Genetics

Days: 15

Subject(s):

Grade(s):

Know:

Understand:

Do:

Various different types of proteins and their functions within our body.

Amino acids are the monomer units of polypeptides or proteins.

One gene- one enzyme hypothesis (Lock and key hypothesis).

History and discovery of DNA as the chemical of inheritance.

Structure of DNA and components that make up a DNA nucleotide.

Chargaff's rule.

Processes that take place in DNA replication.

Role of DNA in making proteins by Transcription and Translation.

Difference between a frameshift and point mutation.

Vocabulary:

Polypeptide, enzymes, amino acid, peptide bond, Lock and key hypothesis, active site, substrate, nucleic acid, DNA, plasmid, adenine, guanine, cytosine, thymine, uracil, nucleotide, purine,

DNA directs the production of proteins necessary for the growth and function of cells.

### 3.1.10.B – Essential

Describe concepts of models as a way to predict and understand science and technology.

- Distinguish between different types of models and modeling techniques and apply their appropriate use in specific applications (e.g., kinetic gas theory, DNA).
- Examine the advantages of using models to demonstrate processes and outcomes (e.g., blue print analysis, structural stability).
- Apply mathematical models to science and technology.

### 3.3.10.C – Essential

Describe how genetic information is inherited and expressed.

- Compare and contrast the function of mitosis and meiosis.
- Describe mutations' effects on a trait's expression.
- Distinguish different reproductive patterns in living things (e.g., budding, spores, fission).
- Compare random and selective breeding practices and their results (e.g., antibiotic resistant bacteria).
- Explain the relationship among DNA, genes and chromosomes.
- Explain different types of inheritance (e.g., multiple allele, sex-influenced traits).
- Describe the role of DNA in protein synthesis as it relates to gene expression.

3.1.10.B - Describe concepts of models as a way to predict and understand science and technology.

3.3.10.C - Describe how genetic information is inherited and expressed.

3.1.10.B - Describe concepts of models as a way to predict and understand science and technology.

3.3.10.C - Describe how genetic information is inherited and expressed.

- Distinguish between different types of models and modeling techniques and apply their

Topic: 5- Molecular Genetics

Days: 15

Subject(s):

Grade(s):

Know:	Understand:	Do:
<p>pyrimidines, DNA polymerase, leading strand, lagging strand, mRNA, tRNA, transcription, translation, template strand, frameshift, point mutation.</p>		<p>appropriate use in specific applications (e.g., kinetic gas theory, DNA).</p> <ul style="list-style-type: none"> <li>• Examine the advantages of using models to demonstrate processes and outcomes (e.g., blue print analysis, structural stability).</li> <li>• Apply mathematical models to science and technology.</li> <li>• Compare and contrast the function of mitosis and meiosis.</li> <li>• Describe mutations' effects on a trait's expression.</li> <li>• Distinguish different reproductive patterns in living things (e.g., budding, spores, fission).</li> <li>• Compare random and selective breeding practices and their results (e.g., antibiotic resistant bacteria).</li> <li>• Explain the relationship among DNA, genes and chromosomes.</li> <li>• Explain different types of inheritance (e.g., multiple allele, sex-influenced traits).</li> <li>• Describe the role of DNA in protein synthesis as it relates to gene expression.</li> <li>• Distinguish between different types of models and modeling techniques and apply their appropriate use in specific applications (e.g., kinetic gas theory, DNA).</li> <li>• Examine the advantages of using models to demonstrate processes and outcomes (e.g., blue print analysis, structural stability).</li> <li>• Apply mathematical models to science and technology.</li> <li>• Compare and contrast the function of mitosis and meiosis.</li> <li>• Describe mutations' effects on a trait's expression.</li> <li>• Distinguish different reproductive patterns in living things (e.g., budding, spores, fission).</li> <li>• Compare random and selective breeding practices and their results (e.g., antibiotic resistant bacteria).</li> <li>• Explain the relationship among DNA, genes and chromosomes.</li> </ul>

Topic: 5- Molecular Genetics

Days: 15

Subject(s):

Grade(s):

Know:

Understand:

Do:

- Explain different types of inheritance (e.g., multiple allele, sex-influenced traits).
- Describe the role of DNA in protein synthesis as it relates to gene expression.

Topic: 6 - Biotechnology

Days: 15

Subject(s):

Grade(s):

Know:

Process of conducting DNA fingerprinting by gel electrophoresis.

GMO or genetically modified plants and animals. (How they are created, benefits, concerns, etc.)

Gene therapy successes in the medical field..

The process of mammal cloning. (How they are created, benefits, concerns, etc.)

Distinguish between chromosomal mutations and gene mutations and the disorders associated with each.

Disorders associated with polygenic inheritance.

Vocabulary:

DNA fingerprinting, gel-electrophoresis, thermal cycler, TAQ polymerase, restriction enzymes, recombinant DNA, genetic engineering, gene therapy, cloning, aneuploidy, polyploidy, amniocentesis, chorionic villa sampling, karyotype, genomic imprinting,

Understand:

Advances in Biotechnology has improved the world in which we live in.

Do:

### 3.1.10.C – Essential

Apply patterns as repeated processes or recurring elements in science and technology.

- Examine and describe recurring patterns that form the basis of biological classification, chemical periodicity, geological order and astronomical order.
- Examine and describe stationary physical patterns.
- Examine and describe physical patterns in motion.

### 3.3.10.D – Essential

Explain the mechanisms of the theory of evolution.

- Analyze data from fossil records, similarities in anatomy and physiology, embryological studies and DNA studies that are relevant to the theory of evolution.
- Explain the role of mutations and gene recombination in changing a population of organisms.
- Compare modern day descendants of extinct species and propose possible scientific accounts for their present appearance.
- Describe the factors (e.g., isolation, differential reproduction) affecting gene frequency in a population over time and their consequences.
- Describe and differentiate between the roles of natural selection and genetic drift.
- Describe changes that illustrate major events in the earth's development based on a time line.
- Explain why natural selection can act only on inherited traits.
- Apply the concept of natural selection to illustrate and account for a species' survival, extinction or change over time.

(Ecosystem Standards are in the Environment and Ecology Standard Category (4.6).)

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Subject(s):

Grade(s):

Know:

Understand:

Do:

**3.3.10.A – Essential**

Explain the structural and functional similarities and differences found among living things.

- Identify and characterize major life forms according to their placement in existing classification groups.
- Explain the relationship between structure and function at the molecular and cellular levels.
- Describe organizing schemes of classification keys.
- Identify and characterize major life forms by kingdom, phyla, class and order.

**3.3.10.C – Essential**

Describe how genetic information is inherited and expressed.

- Compare and contrast the function of mitosis and meiosis.
- Describe mutations' effects on a trait's expression.
- Distinguish different reproductive patterns in living things (e.g., budding, spores, fission).
- Compare random and selective breeding practices and their results (e.g., antibiotic resistant bacteria).
- Explain the relationship among DNA, genes and chromosomes.
- Explain different types of inheritance (e.g., multiple allele, sex-influenced traits).
- Describe the role of DNA in protein synthesis as it relates to gene expression.

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Subject(s):

Grade(s):

Know:

Understand:

Do:

**3.8.12.A – Important**

Evaluate the consequences and impacts of scientific and technological solutions.

- Propose solutions to specific scientific and technological applications, identifying possible financial considerations.
- Analyze scientific and technological solutions through the use of risk/benefit analysis.
- Analyze and communicate the positive or negative impacts that a recent technological invention had on society.
- Evaluate and describe potential impacts from emerging technologies and the consequences of not keeping abreast of technological advancements (e.g., assessment alternatives, risks, benefits, costs, economic impacts, constraints).

**3.6.4.A – Unranked**

Know that biotechnologies relate to propagating, growing, maintaining, adapting, treating and converting.

- Identify agricultural and industrial production processes that involve plants and animals.
- Identify waste management treatment processes.
- Describe how knowledge of the human body influences or impacts ergonomic design.
- Describe how biotechnology has impacted various aspects of daily life (e.g., health care, agriculture, waste treatment).

3.1.10.C - Apply patterns as repeated processes or recurring elements in science and technology.  
 3.3.10.D - Explain the mechanisms of the theory of evolution.(Ecosystem Standards are in the Environment and Ecology Standard Category (4.6).)  
 3.3.10.A - Explain the structural and functional similarities and differences found among living things.  
 3.3.10.C - Describe how genetic information is inherited and expressed.  
 3.1.10.C - Apply patterns as repeated processes or recurring elements in science and technology.  
 3.3.10.D - Explain the mechanisms of the theory of

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Subject(s):

Grade(s):

Know:	Understand:	Do:
		<p>evolution. (Ecosystem Standards are in the Environment and Ecology Standard Category (4.6).)</p> <p>3.3.10.A - Explain the structural and functional similarities and differences found among living things.</p> <p>3.3.10.C - Describe how genetic information is inherited and expressed.</p> <p>3.8.12.A - Evaluate the consequences and impacts of scientific and technological solutions.</p> <p>3.6.4.A - Know that biotechnologies relate to propagating, growing, maintaining, adapting, treating and converting.</p> <ul style="list-style-type: none"> <li>• Examine and describe recurring patterns that form the basis of biological classification, chemical periodicity, geological order and astronomical order.</li> <li>• Examine and describe stationary physical patterns.</li> <li>• Examine and describe physical patterns in motion.</li> <li>• Analyze data from fossil records, similarities in anatomy and physiology, embryological studies and DNA studies that are relevant to the theory of evolution.</li> <li>• Explain the role of mutations and gene recombination in changing a population of organisms.</li> <li>• Compare modern day descendants of extinct species and propose possible scientific accounts for their present appearance.</li> <li>• Describe the factors (e.g., isolation, differential reproduction) affecting gene frequency in a population over time and their consequences.</li> <li>• Describe and differentiate between the roles of natural selection and genetic drift.</li> <li>• Describe changes that illustrate major events in the earth's development based on a time line.</li> <li>• Explain why natural selection can act only on inherited traits.</li> </ul>

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Days: 15

Subject(s):

Grade(s):

Know:	Understand:	Do:
		<ul style="list-style-type: none"> <li>• Apply the concept of natural selection to illustrate and account for a species' survival, extinction or change over time.</li> <li>• Identify and characterize major life forms according to their placement in existing classification groups.</li> <li>• Explain the relationship between structure and function at the molecular and cellular levels.</li> <li>• Describe organizing schemes of classification keys.</li> <li>• Identify and characterize major life forms by kingdom, phyla, class and order.</li> <li>• Compare and contrast the function of mitosis and meiosis.</li> <li>• Describe mutations' effects on a trait's expression.</li> <li>• Distinguish different reproductive patterns in living things (e.g., budding, spores, fission).</li> <li>• Compare random and selective breeding practices and their results (e.g., antibiotic resistant bacteria).</li> <li>• Explain the relationship among DNA, genes and chromosomes.</li> <li>• Explain different types of inheritance (e.g., multiple allele, sex-influenced traits).</li> <li>• Describe the role of DNA in protein synthesis as it relates to gene expression.</li> <li>• Examine and describe recurring patterns that form the basis of biological classification, chemical periodicity, geological order and astronomical order.</li> <li>• Examine and describe stationary physical patterns.</li> <li>• Examine and describe physical patterns in motion.</li> <li>• Analyze data from fossil records, similarities in anatomy and physiology, embryological studies and DNA studies that are relevant to the theory of evolution.</li> </ul>

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Subject(s):

Grade(s):

Know:	Understand:	Do:
		<ul style="list-style-type: none"> <li>• Explain the role of mutations and gene recombination in changing a population of organisms.</li> <li>• Compare modern day descendants of extinct species and propose possible scientific accounts for their present appearance.</li> <li>• Describe the factors (e.g., isolation, differential reproduction) affecting gene frequency in a population over time and their consequences.</li> <li>• Describe and differentiate between the roles of natural selection and genetic drift.</li> <li>• Describe changes that illustrate major events in the earth's development based on a time line.</li> <li>• Explain why natural selection can act only on inherited traits.</li> <li>• Apply the concept of natural selection to illustrate and account for a species' survival, extinction or change over time.</li> <li>• Identify and characterize major life forms according to their placement in existing classification groups.</li> <li>• Explain the relationship between structure and function at the molecular and cellular levels.</li> <li>• Describe organizing schemes of classification keys.</li> <li>• Identify and characterize major life forms by kingdom, phyla, class and order.</li> <li>• Compare and contrast the function of mitosis and meiosis.</li> <li>• Describe mutations' effects on a trait's expression.</li> <li>• Distinguish different reproductive patterns in living things (e.g., budding, spores, fission).</li> <li>• Compare random and selective breeding practices and their results (e.g., antibiotic resistant bacteria).</li> <li>• Explain the relationship among DNA, genes and chromosomes.</li> <li>• Explain different types of inheritance (e.g., multiple allele, sex-influenced traits).</li> </ul>

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Subject(s):

Grade(s):

Know:	Understand:	Do:
		<ul style="list-style-type: none"><li>• Describe the role of DNA in protein synthesis as it relates to gene expression.</li><li>• Propose solutions to specific scientific and technological applications, identifying possible financial considerations.</li><li>• Analyze scientific and technological solutions through the use of risk/benefit analysis.</li><li>• Analyze and communicate the positive or negative impacts that a recent technological invention had on society.</li><li>• Evaluate and describe potential impacts from emerging technologies and the consequences of not keeping abreast of technological advancements (e.g., assessment alternatives, risks, benefits, costs, economic impacts, constraints).</li><li>• Identify agricultural and industrial production processes that involve plants and animals.</li><li>• Identify waste management treatment processes.</li><li>• Describe how knowledge of the human body influences or impacts ergonomic design.</li><li>• Describe how biotechnology has impacted various aspects of daily life (e.g., health care, agriculture, waste treatment).</li></ul>