EAST PENN SCHOOL DISTRICT

Genetics
July 14, 2025

Genetics Unit 1 - DNA and Chromosomes

STAGE 1 | DESIRED RESULTS

Standards

3.1.9-12.A 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.

3.1.9-12.P. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

3.1.9-12.Q. 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.

Transfer

Students will be able to independently use their learning to...

- ❑ DNA sequences are the blueprints of life

Meaning

UNDERSTANDINGS

Students will understand that...

- ☐ Mutations provide the variation necessary for life to persist.
- ☐ As an organism grows and develops, carefully orchestrated chemical reactions activate and deactivate parts of the genome at strategic times and in specific locations.

ESSENTIAL QUESTIONS

Students will keep considering...

- ☐ What controls the expression of our genes?
- ☐ How does the structure of nucleic acids, genes and chromosomes relate to their function?
- ☐ What is the relationship between the processes of replication, transcription, and translation?
- ☐ What are the ultimate causes of genetic errors?

Acquisition

Students will know...

- ☐ DNA structure and function.
- ☐ Central dogma of life.
- ☐ Processes of DNA replication, transcription, and translation
- ☐ Protein processing.
- ☐ History of the discovery of DNA and relevant experiments .
- ☐ Role of RNA.
- ☐ Types of mutations.
- ☐ Effects of atypical chromosome number and structure.
- ☐ Mechanisms of control in gene expression.
- ☐ Relevance of the epigenome.

Students will be skilled at...

- ☐ Relate the structure of DNA to its function.
- ☐ Explain the relationship of DNA, genes, and chromosomes.
- ☐ Demonstrate the processes of DNA replication and protein synthesis.
- ☐ Identify regulatory factors in the processes of DNA replication, transcription, translation, and protein processing.
- ☐ Investigate the role of the environment in gene expression.
- ☐ Describe how genetic mutations alter DNA and their effect on phenotype.
- ☐ Research genetic disorders resulting from mutations.
- ☐ Discuss current topics in the field of genomics.

Genetics Unit 2 - Genetic Engineering

STAGE 1 | DESIRED RESULTS

Standards

3.1.9-12.A 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.

Transfer

Students will be able to independently use their learning to understand...

- ❏ DNA is the code of life.
- ❏ Technology allows for the analysis and modification of genetic information.
- ❏ Individuals and society must consider the benefits and ramifications of using biotechnology.

Meaning

UNDERSTANDINGS

Students will understand that...

- ☐ Scientific research often leads to technological advances that can have positive and/or negative impacts upon society as a whole.
- ☐ Modern biotechnologies manipulate DNA providing new ways to study, monitor, treat diseases and alter the environment.

ESSENTIAL QUESTIONS

Students will keep considering...

- ☐ How will genetic technologies contribute to our understanding and treatment of common human genetic diseases?
- ☐ What regulations should be enacted on these technologies?
- ☐ What legal and ethical problems have arisen from new DNA technologies?
- ☐ Just because we can should we (use these technologies)?

Acquisition

Students will know...

- ☐ Genetic Engineering
- ☐ Restriction enzymes.
- ☐ Gel Electrophoresis
- ☐ PCR
- ☐ Bioethics
- ☐ CRISPR technology
- ☐ DNA microchip analysis
- ☐ Genetic Testing
- ☐ DNA fingerprinting
- ☐ New Terminology- genomics, proteomics, metagenomics.

Students will be skilled at...

- ☐ Define Genetic Engineering and describe its subcategories and aims in various biological fields.
- ☐ Explain the properties of DNA that lend to its manipulation in the laboratory.
- ☐ Evaluate current research techniques in treating genetic diseases.
- ☐ Summarize the major methods of analyzing DNA and their results.
- ☐ Perform and analyze DNA gel electrophoresis patterns.
- ☐ Explain how restriction enzymes are used in mapping.
- ☐ Explain how linkage studies led to sequencing of the human genome.
- ☐ Describe the technology behind identifying,

		sequencing, synthesizing, and amplifying DNA. ☐ Discuss moral and ethical considerations of gene therapy. ☐ Describe several applications of DNA fingerprinting and microarray analysis.

Genetics Unit 3 - Cell Growth and Reproduction

STAGE 1 | DESIRED RESULTS

Standards

3.1.9-12.D
Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

Transfer

Students will be able to independently use their learning to understand...

- ☐ Genetic information is transferred during cell division of preexisting cells to newly formed cells
- ☐ Cells differentiate down cell lineages by differential gene expression.

Meaning

UNDERSTANDINGS
Students will understand that...

- ☐ Cells maintain a balance between cell division and cell death.
- ☐ Cancer is uncontrolled cell growth.
- ☐ Scientific research often leads to technological advances that can have positive and negative impacts on society.
- ☐ Sexual reproduction results in genetic variation of species.

ESSENTIAL QUESTIONS
Students will keep considering...

- ☐ Why is regulation of the cell cycle important?
- ☐ How are cancer cells different from other cells?
- ☐ What is the importance of stem cells?
- ☐ How does sexual reproduction result in genetic variation?
- ☐ What causes birth defects?

Acquisition

Students will know...

- ☐ Stages of the cell cycle.
- ☐ Events that occur in the stages of mitosis.
- ☐ Control/ regulatory factors of the cell cycle.
- ☐ Events that occur in the stages of meiosis.
- ☐ The differences between mitosis and meiosis.
- ☐ Role of Apoptosis.
- ☐ Role of stem cells in cell proliferation.
- ☐ Process for cell differentiation.
- ☐ Crossing over and independent assortment in meiosis.
- ☐ Occurrence of identical and fraternal twins.
- ☐ Role of genes in aging process.
- ☐ Genetics of cancer.-
- ☐ Relationship of genes to cancer.
- ☐ Characteristics of cancer cells.
- ☐ Detection.
- ☐ Current treatments.

Students will be skilled at...

- ☐ Identify stages of mitosis in onion root tips utilizing the microscope.
- ☐ Discuss various regulatory factors in the control of the cell cycle.
- ☐ Prepare a comparison chart between mitosis and meiosis.
- ☐ Prepare a concept map describing cell differentiation/ cell lineages.
- ☐ Provide examples of apoptosis in human health.
- ☐ Research current applications for stem cell technology.
- ☐ Research new technologies in cancer treatment and detection.

Genetics Unit 4 - Transmission Genetics

STAGE 1 | DESIRED RESULTS

Standards

3.1.9-12.R
Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

Transfer

Students will be able to independently use their learning to understand...

- ☐ Genetics is the study of DNA and the transfer of information from one generation to the next.
- ☐ Genetics touches our everyday lives.
- ☐ In sexually reproducing organisms, each offspring contains a mix of characteristics inherited from both parents.

Meaning

UNDERSTANDINGS
Students will understand that...

- ☐ Mendel's Laws of Genetics can be used to study and predict inheritance patterns.
- ☐ Patterns of inheritance can be obscured when genes have many variants, interact with each other and the environment, are in mitochondria, or are linked on the same chromosome.
- ☐ Most human traits are multifactorial.
- ☐ Our sex chromosomes at conception set the developmental program for maleness or femaleness, but gene expression before and after birth greatly influences what unfolds.

ESSENTIAL QUESTIONS
Students will keep considering...

- ☐ What are common patterns of inheritance?
- ☐ What are the exceptions to Mendel's Laws?
- ☐ How can we predict the transmission of traits to future generations?
- ☐ What models are used to study inheritance patterns?
- ☐ What determines our sexual identity?
- ☐ How does the environment influence genetic traits in populations?

Acquisition

Students will know...

- ☐ Mendel's Laws of Genetics
- ☐ Single gene inheritance
- ☐ Multiple alleles
- ☐ Polygenic Inheritance
- ☐ Punnett Squares
- ☐ Inheritance patterns and pedigree analysis
- ☐ Mitochondrial Genes
- ☐ Linkage
- ☐ Probability

Students will be skilled at...

- ☐ Explain how Mendel's Law of Segregation reflects the events of meiosis.
- ☐ Explain how Mendel's Law of Independent Assortment follows the transmission of two or more genes on different chromosomes.
- ☐ Analyze case studies that appear to alter expected mendelian ratios.
- ☐ Solve probability problems utilizing binomial expansion equations and factorial equation method.

	☐ Sex chromosomes ☐ Traits inherited on sex chromosomes. ☐ Sex-limited and sex influenced traits ☐ X inactivation ☐ Genomic imprinting ☐ Multifactorial traits ☐ Identical twin studies ☐ Influence of genes on behavior	☐ Perform monohybrid, dihybrid and sex-linked crosses utilizing Drosophila melanogaster and analyze outcome via Chi Square. ☐ Analyze pedigrees to determine inheritance patterns. ☐ Explain how linked traits are inherited differently from Mendelian traits. ☐ Solve linkage problems and correlate how linkage is utilized in determining gene location and genetic mapping. ☐ Produce a concept map on the scope of genomic imprinting. ☐ Discuss issues and experiments in sexual identity. ☐ Research behavioral disorders analyzing the role of genes and environmental influences.