03 DNA & Inheritance

Content Area: **Science**
Course(s): **Biology CP**
Time Period: **Semester 2**
Length: **10 weeks**
Status: **Published**

Standards

	Analyzing and Interpreting Data
	Cause and Effect
	Asking Questions and Defining Problems
	Engaging in Argument from Evidence
HS-LS1-1	Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
	Constructing Explanations and Designing Solutions
LS1.A	Structure and Function
	Structure and Function
HS-LS3-1	Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
LS3.A	Inheritance of Traits
HS-LS3-2	Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.
LS3.B	Variation of Traits
HS-LS3-3	Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
	Scale, Proportion, and Quantity
SCI.HS-LS1-4	Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

Enduring Understandings

1. In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells.

2. As successive subdivisions of an embryo's cells occur, programmed genetic instructions and small differences in their immediate environments activate or inactivate different genes, which cause the cells to develop differently—a process called differentiation.

3. All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells.

4. In all organisms the genetic instructions for forming species' characteristics are carried in the

chromosomes. Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA.

5. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function.

6. The information passed from parents to offspring is coded in the DNA molecules that form the chromosomes. In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation.

7. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depend on both genetic and environmental factors.

Essential Questions

1. How do multicellular organisms which begin as one, single cell, multiply into multicellular organisms made of trillions of specialized cells?

2. How does the body repair when cell tissue is damaged?

3. How are characteristics of one generation passed to the next?

4. How can individuals of the same species and even siblings have different characteristics?

5. How does the cellular process of asexual reproduction compare to the cellular process of making gametes for sexual reproduction?
6. How is genetic variation introduced in sexual reproduction?

7. How are the characteristics of one generation related to the previous generation?

8. Why do individuals of the same species vary in how they look, function, and behave?

9. How is the information present in a gene interpreted to produce a protein?

10. How can an alteration of the DNA nucleotide sequence affect the protein produced?

11. How has our understanding of genetics changed through time?

12. What ethical issues are raised related to biotechnology?

Knowledge and Skills

Knowledge:

1. Students will know that in multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. (DCI LS1.B Growth and Development of Organisms).

2. Students will know that systems of specialized cells within organisms help them perform the essential functions of life. (DCI LS1.A Structure and Function)

3. Students will know that all cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (DCI LS1.A Structure and Function)

4. Students will know that each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. (DCI LS3.A)

5. Students will know that in sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. (DCI LS3.B Variation of Traits)

6. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. (DCI LS3.B Variation of Traits)

7. Students will know that environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors. (DCI LS3.B Variation of Traits)

Skills:

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

2. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out these essential functions of life through systems of specialized cells.

3. Ask questions to clarify relationships about the role of DNA and chromosomes in coding instructions for characteristics traits passed from parents to offspring.

4. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable error occurring during replication, and/or (3) mutations caused by environmental factors.

5. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits

in a population.

Resources

Core Resource:

Modern Biology by Holt, Rinehart & Winston

Supplemental Resources:

Unit 3: DNA & Inheritance

- mitosis under the microscope
- What are stem cells? TedEd
- Learn Genetics Utah
- Dragon Genetics
- The Cell Cycle & Cancer HHMI
- Analyzing Karyotypes
- CSI Wildlife
- DNA, Plasmid Cloning
- Protein Synthesis Walkthrough
- Protein Synthesis and sickle cell anemia

Assessments

https://docs.google.com/document/d/1wR7bQF-8AQoRrt0g4C3hKja0yjwDjC9_BiAmONWbTcI/edit?usp=sharing

Modifications

https://docs.google.com/document/d/1ODqaPP69YkcFiyG72fIT8XsUIe3K1VSG7nxuc4CpCec/edit?usp=shar

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