

Chapter Six: Genes and DNA

Teacher Notes

Lesson One: What Does DNA Look Like?

- The Pieces of the Puzzle-Scientists knew genes must be able to do two things
 - 1) must be able to give instructions for building and maintaining cells.
 - 2) It must be able to be copied each time a cell divides so each cell must contain identical genes.
- Nucleotides: The Subunits of DNA
 - DNA is made of subunits called nucleotides-a subunit that consists of a sugar, a phosphate, and a nitrogen base.
 - There are 4 different bases-adenine, thymine, guanine, and cytosine
 - each base has a different shape
 - adenine connects to thymine; guanine connects to cytosine
- Chargaff's Rule-amount of adenine always equals thymine; the amount of guanine always equals cytosine.
 - this later helped scientists understand DNA
- Franklin's Discovery-Rosalind Franklin used X-ray diffraction to make images of DNA molecules. X rays are aimed at the DNA molecule. When an X ray hits a part of the molecule the ray bounces off. They saw it was spiral shaped.
- Watson and Crick's Model-After seeing Franklin's images they decided it must look like a long, twisted ladder. They built a model of DNA which explained how it functions in the cell.
- DNA's Double Structure-Known as a double helix; sides always alternate between sugar and phosphate; the rungs of the ladder are always made of two bases.
- Making Copies of DNA-pairing of the bases allows cell to replicate
 - How Copies are Made
 - DNA splits down the middle where the bases meet
 - bases on each side of the molecule are used as a pattern for a new strand
 - as bases are exposed; complementary nucleotides are added to each side of the ladder.
 - 2 DNA molecules are formed (half of each molecule is old and half is new)
 - When Copies Are Made
 - DNA is copied every time a cell divides
 - Each gets a complete set of DNA
 - Unwinding, copying, and rewinding is done by proteins

Lesson Two: How DNA Works

- Unraveling DNA
 - A) each cell codes for proteins that determine traits such as skin color
 - B) DNA in the nucleus is part of a material call Chromatin; long strands are usually bundled loosely within the nucleus.
 - C) A single strand of Chromatin is made up of a long strand of DNA that is coiled around proteins.

D) Each strand of DNA contains 2 halves that are connected in the middle and twisted in a double helix

E) When a cell is ready to divide it packages the chromatin into chromatids; two identical chromatids make up a chromosome that is ready to divide

F) Before division, each human cell contains 46 chromosomes. Chromosomes contain two identical copies of all of the cell's genetic material.

-Genes and Proteins

-DNA is read from one end to the other end and in only one direction

-Proteins and Traits

-Proteins are found throughout cells and cause most of the differences that you can see among organisms.

-Proteins act as chemical triggers and messengers for many of the processes within cells.

-determine how tall you are, colors you see, whether hair is curly or straight.

-Help from RNA-a molecule that is present in all living cells and that plays a role in protein production.

-temporary copy of DNA

-The Making of a Protein

1) copy one side of the segment of DNA containing a gene.

2) Copy is called messenger RNA.

3) each base codes for one amino acid.

4) the mRNA segment is fed through the ribosome.

5) Molecules of transfer RNA deliver amino acids from the cytoplasm to the ribosome.

6) Amino acids are dropped off at the ribosome.

7) Amino acids are joined to make a protein. Usually one protein is produced for each gene.

-Changes in Genes

-Mutations-a change in the nucleotide-base sequence of a gene or DNA molecule

-deletion-a base is left out

-insertion-an extra base is added

-substitution-a wrong base is used

-Do Mutations Matter? There are 3 possible changes

-improved trait

-no change

-harmful trait

-some proteins can detect errors in DNA and can fix it.

-some times a change isn't corrected

-if the mutation occurs in sex cells then it can be passed from generation to generation.

-How Do Mutations Happen?

-happen with random errors when DNA is copied

-abnormal things that happen to cells

-physical or chemical agent that can cause a mutation in DNA is called a mutagen.

-include high-energy radiation from x-rays and ultraviolet radiation

-An Example of a Substitution

Example-Sickle Cell Anemia

-Uses of Genetic Knowledge

-Genetic Engineering-manipulating individual genes within organisms.

-genes may be transferred from one type of organism to another.

-used to create new products

-Genetic Identification

-Genetic Fingerprinting-identifies the unique patterns in an individual's DNA

-can be used to identify family relations or hereditary diseases

-clone-a new organism that has a exact copy of another organism's genes.