

Name: _____

Chapter 4: DNA- The Code of Life

Lesson 1: The Genetic Code

What Forms the Genetic Code?

DNA contains the genetic information for cells to make proteins.

- Proteins determine traits like hair color to the ability to digest food.

The Structure of DNA

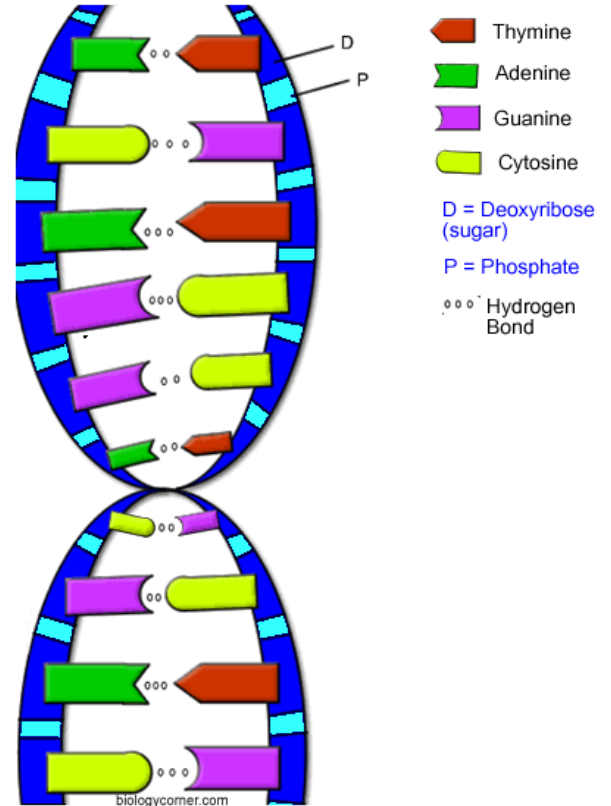
Parents pass traits to offspring through chromosomes, which are made of DNA and proteins.

- Located in cell nucleus

DNA is a “double helix” or twisted ladder structure.

- Sides made of sugar molecules (deoxyribose) alternating with phosphate molecules.
- Rungs of DNA made of nitrogen bases
- **NITROGEN BASES**: molecules that contain nitrogen and other elements.

- o 4 kinds of nitrogen bases:
 - 1) Adenine (A)
 - 2) Thymine (T)
 - 3) Guanine (G)
 - 4) Cytosine (C)



Chromosomes, Genes, and DNA

A gene is a part of DNA that has the information to code for one SPECIFIC protein.

- Genes are made up of a series of bases in a row and are arranged in a specific order.
 - o Can contain between several hundred to a million+ bases
 - o Each gene has a specific place on a chromosome.

Each individual has unique set of DNA.

- DNA found in all cells of body except red blood cells.

Order of the Bases

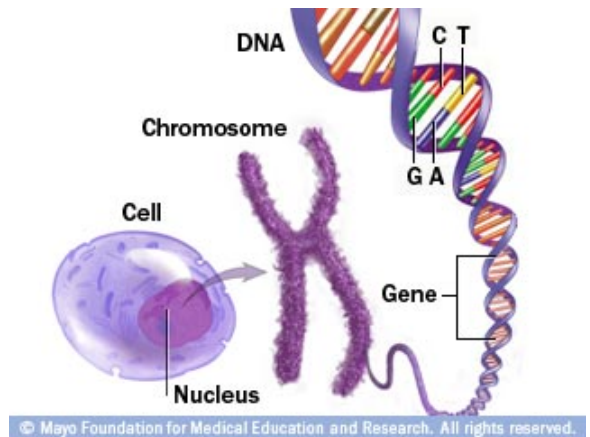
Order of nitrogen bases along a gene forms a genetic code that specifies what type of protein will be made.

- Group of 3 DNA bases codes for one specific amino acid.
- Amino acids are put together to form proteins.

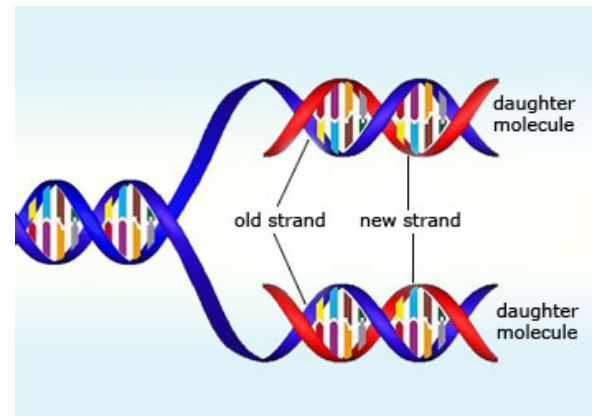
How Does DNA Copy Itself?

When a cell divides, it produces two new daughter cells.

- DNA must copy itself to ensure each daughter cell has genetic information it needs.
- **DNA REPLICATION**: the process in which an identical copy of a DNA strand is formed for a new cell.
 - o Step 1: Two sides of DNA unwind and separate between nitrogen bases.
 - o Step 2: Nitrogen bases in the nucleus pair up with bases on each half of DNA
 - o Step 3: Two new strands of DNA are created



- Nitrogen bases always pair up the same way → A pairs with T and C pairs with G
- New DNA strand is identical to the original DNA strand.



Lesson 2: How Cells Make Proteins

How Does A Cell Make Proteins?

PROTEIN SYNTHESIS: the cell uses information from a gene on a chromosome to produce a specific protein.

- Proteins determine size, shape, color and other traits of organism by triggering cellular processes.
- Protein code passed from parent to offspring via DNA.

The Structure of Proteins

Proteins made of amino acids.

- 20 amino acids that can combine in different ways to form thousands of proteins.
 - Example: 26 letters of alphabet combine to form thousands of different words.

The Role of RNA

Protein synthesis happens in cytoplasm, but directions are inside nucleus on chromosomes.

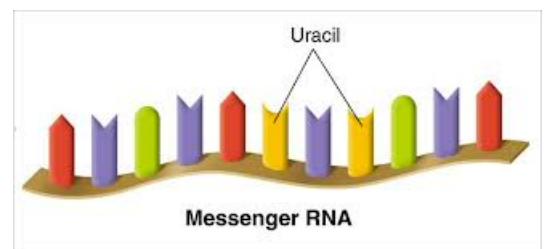
RNA: ribonucleic acid, messenger to carry genetic code from DNA in nucleus to cytoplasm

- Has only one strand
- RNA has nitrogen base, uracil (U), instead of thymine.

Types of RNA

MESSENGER RNA (mRNA): copies the message from DNA in the nucleus and carries the message to the ribosome in the cytoplasm.

TRANSFER RNA (tRNA): carries the amino acids to the ribosome and adds them to the growing protein.



Steps in Protein Synthesis

Step 1: mRNA enters the Cytoplasm

- DNA unzips between its base pairs and directs production of mRNA strand
- RNA bases pair up with DNA bases.
 - Cytosine with guanine, Adenine with URACIL!
- mRNA leaves the nucleus and enters cytoplasm

Step 2: Ribosomes attach to mRNA

- Ribosome attaches to mRNA in cytoplasm
- mRNA provides the code for the protein that will be made.
- In cytoplasm, specific amino acids attached to specific molecules of tRNA.

Step 3: tRNA attaches to mRNA

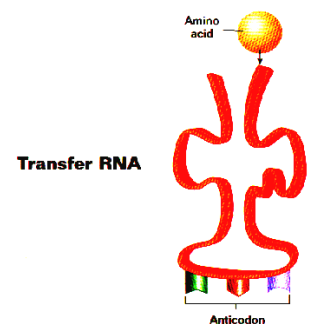
- Molecules of tRNA and their amino acid attach to mRNA.
- Bases on tRNA “read” the message and pair with bases on mRNA.

Step 4: Amino Acids Join in the Ribosome

- Transfer molecules attach one at a time on ribosome and continue to read message.
- Amino acids linked together to form a chain
- Amino acid order determined by the order of 3 base codes on mRNA.

Step 5: Protein Chain Forms

- Protein grows when amino acids are added as ribosome moves along mRNA
- As amino acid added, tRNA is released and picks up another amino acid of same kind
- Protein continues to grow until ribosome reaches a stop code.
- Protein is released.



Lesson 3: Mutations

How Can Mutations affect an Organism?

MUTATION: any change in the DNA of a gene or chromosome.

- Can result in a trait NOT inherited from parent organism.
- Mutations can cause a cell to produce an incorrect protein during protein synthesis.
 - o Cause trait different from normal.
- If mutation occurs in body cell → not passed onto offspring.
- If mutation occurs in sex cell → mutation can be passed onto offspring.

Types of Mutations

- 1) Deletion: one or more bases are deleted from a section of DNA.
- 2) Addition: one or more bases are added to a section of DNA.
- 3) Substitution: one base pair is switched for another.
- 4) Chromosomes don't separate correctly during formation of sex cells.

Effects of Mutations

Mutations introduce changes in an organism and can be harmful, helpful or neither.

- Harmful if it reduces the organism's chances for survival and reproduction.
 - o Example: white alligator
- Helpful if it increases an organism's ability to survive and reproduce.
 - o Example: antibiotic resistant bacteria.
- Neither if it has no impact on the organism



How is Cancer Related to Mutations and the Cell Cycle?

CANCER: a disease in which cells grow and divide uncontrollably, damaging the parts of the body around them.

- Like weeds in a garden → cancer cells overrun normal cells.
- Inherited traits can make people more likely than others to develop certain cancers.
- Environmental factors may also lead to an increased risk of developing cancers.

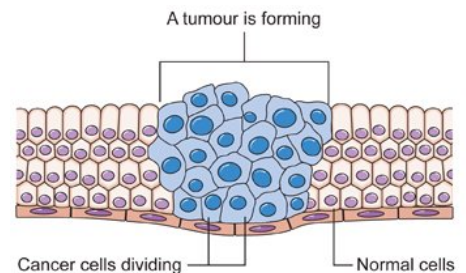


Diagram showing how cancer cells keep on reproducing to form a tumour
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Stages in Cancer Development

- 1) Cancer begins when something damages a portion of DNA in chromosome.
 - a. Damage causes a mutation and cells function abnormally.
 - b. Cancer cells disrupt normal cell cycle caused uncontrolled growth.
- 2) Abnormal cell develops and divides to make more and more abnormal cells.
 - a. Produces a **TUMOR**: a mass of abnormal cells that develops when cells divide and grow uncontrollably.
- 3) Tumors can take years to grow and cells become more abnormal as they divide.
 - a. Cancerous cells may break off from tumor and enter the bloodstream, moving to other parts of the body.

How Cancer is Treated

Surgery: doctors completely remove a cancerous tumor.

Radiation: uses beams of high-energy waves that try to destroy the cancer cells.

CHEMOTHERAPY: the use of drugs to treat a disease.

- Uses cancer-fighting drugs that kill cancer cells.