

BC Science CONNECTIONS

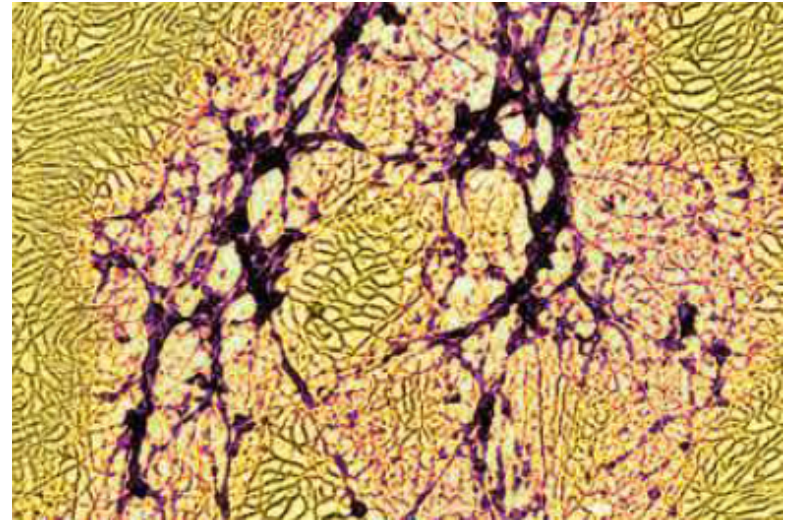


BC Science Connections 10

Unit 1: DNA is the foundation for the unity and diversity of living things.

Topic 1.1: How does an understanding of DNA help us investigate living things?

- The variation in living things we see around us is due to DNA.
- DNA is made of many nucleotides linked together in a specific order.
- DNA exists in chromosomes, which contain thousands of genes.
- The structure of DNA is important to passing on information.
- The different genetic make-up of organisms is reflected in the diversity of living things.



Concept 1: The variation in living things we see around us is due to DNA.

- All living things have DNA.
- Variations among all organisms are due to DNA.

Figure 1.1: Life, variety, and DNA. Questioning: What is the role of DNA in the variety of Earth's organisms? Do you think it is the only factor?



DNA

- **DNA:** deoxyribonucleic acid, a double-stranded nucleic acid that stores genetic information
- Differences in DNA result in variations in characteristics and allow organisms to exist in diverse aquatic and terrestrial ecosystems.

Discussion Questions

1. Why is there variation among organisms on Earth?
2. Choose one group of organisms in Figure 1.1 and describe some of the similarities and differences between species in that group. Use examples not already listed in the text.

Concept 2: DNA is made of many nucleotides linked together in a specific order.

- Nucleotides are the basic building blocks of nucleic acids.
- There are two types of nucleic acids:
 - 1)DNA (deoxyribonucleic acid)
 - 2)RNA (ribonucleic acid)

The Structure of DNA

Nucleotides consists of three components:

- 1) a phosphate group
- 2) a sugar
- 3) a nitrogenous base

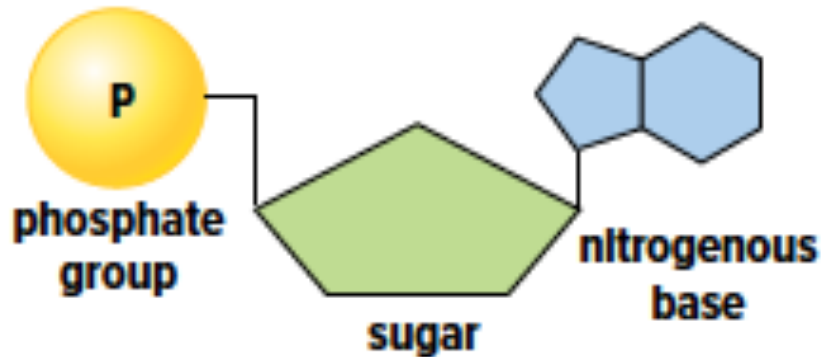


Figure 1.2: Nucleotides are the basic building blocks of DNA and RNA.

The Structure of DNA (cont'd)

Nitrogenous bases in DNA include:

- 1)adenine (A)
- 2)cytosine (C)
- 3)guanine (G)
- 4)thymine (T)

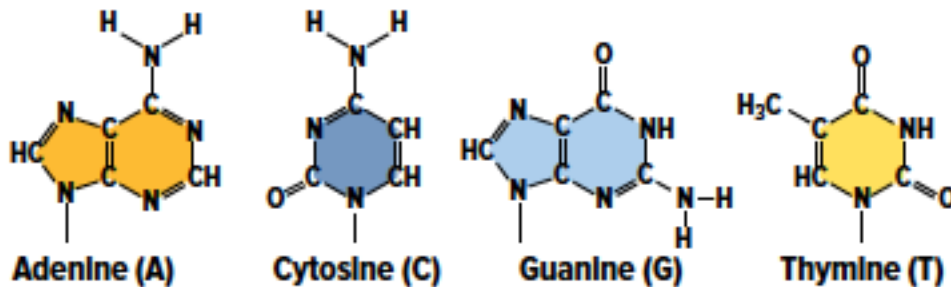


Figure 1.2: Nucleotides are the basic building blocks of DNA and RNA.

The Structure of DNA (cont'd)

Characteristics of the DNA molecule:

- Two strands of nucleotides
- Twisted ladder (double helix) structure
- Sides of ladder made up of sugar and phosphate groups
- Rung of ladder is made of two nitrogenous bases held together by hydrogen bonds

The Structure of DNA (cont'd)

Nitrogenous bases that pair together are **complementary bases**:

- adenine (A) and thymine (T)
- cytosine (C) and guanine (G)

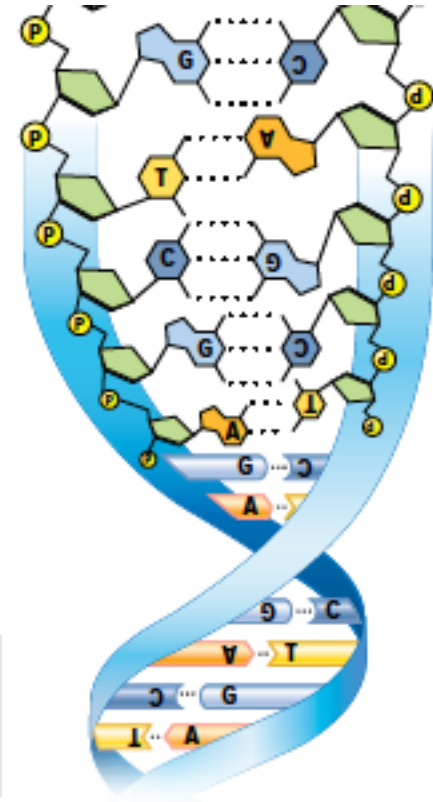


Figure 1.3: DNA is found in the nucleus of a cell. The bases of the nucleotides pair only in specific ways.

The Function of DNA

- DNA stores genetic information.
- Parents pass their DNA on to their offspring.
- DNA codes for specific **proteins** that are essential for life functions.
- A complete sequence of DNA is called a **genome**.

Discussion Questions

1. If the bases on one strand of DNA are ATGGGCTA, what is the sequence of complementary bases on the other strand of DNA?
2. Think of an analogy to describe base pairs. Share it with a classmate.

Concept 3: DNA exists in chromosomes, which contain thousands of genes.

- During interphase, DNA exists as condensed fibres called **chromatin**.
- During mitosis, DNA is found in a very condensed form called **chromosomes**.

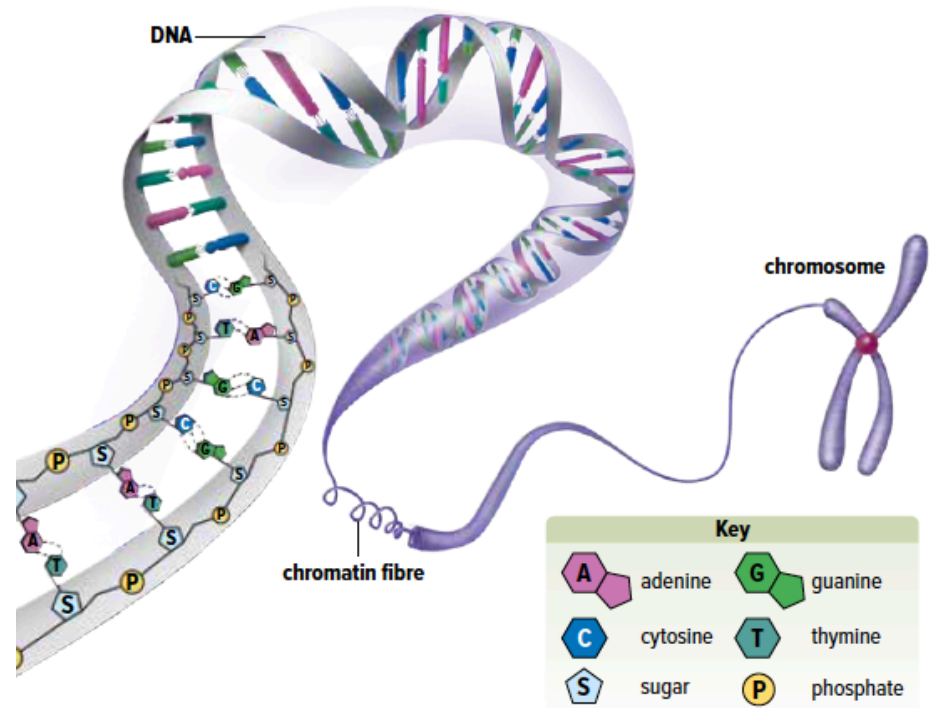


Figure 1.4: DNA is part of chromatin fibre, which condenses to form chromosomes.

Chromosomes Are Paired

- There are 46 chromosomes in human somatic cells.
- Half the chromosomes come from the biological father and the other half are from the biological mother.
- Chromosomes are organized into 23 pairs:
 - One pair consists of the *sex chromosomes* (X and Y chromosomes).
 - The other 22 pairs are called *autosomes*.

Homologous Chromosomes Contain Alleles

- **Homologous chromosome:** a chromosome that contains the same sequence of genes as another chromosome
- Homologous chromosomes are not identical to each other.

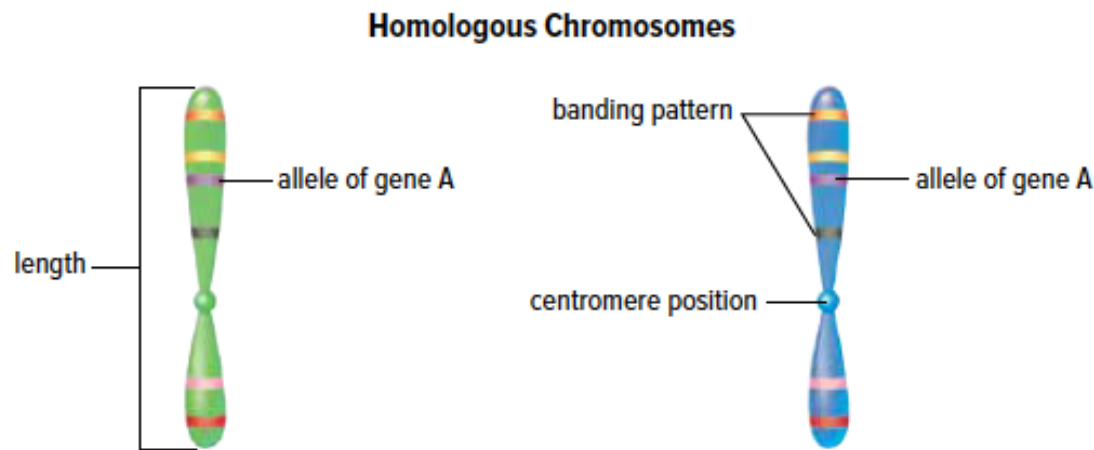


Figure 1.5: Homologous chromosomes have several characteristics in common, but they are not identical.

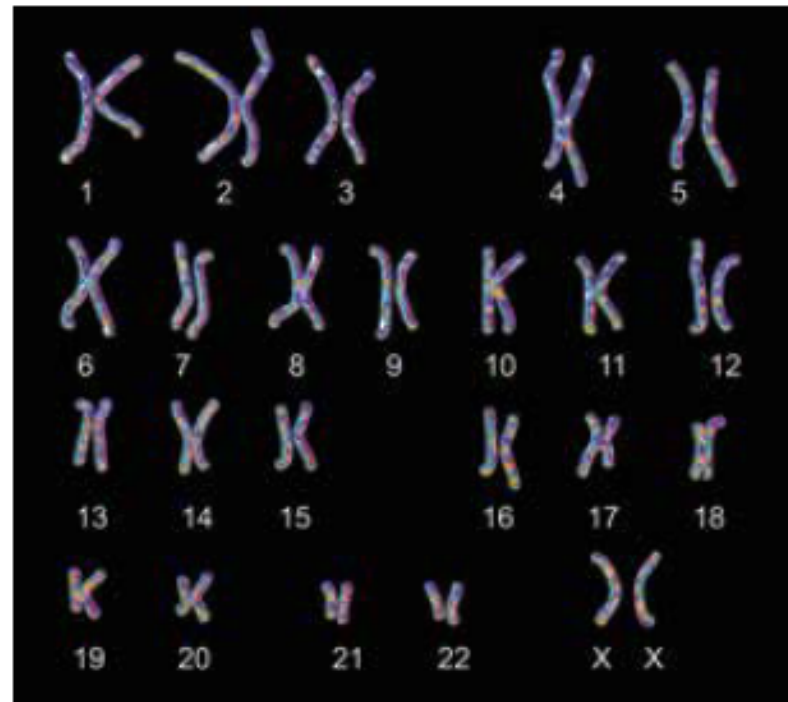
Homologous Chromosomes Contain Alleles (cont'd)

- **Gene:** a part of a chromosome that governs the expression of a trait and is passed on to offspring
- **Allele:** a different form of the same gene

Examining Chromosomes: The Karyotype

Karyotype: a photograph of pairs of homologous chromosomes in a cell

Figure 1.6: This is a human karyotype. The chromosome pairs are arranged and numbered in order of their length, from longest to shortest. The sex chromosomes are placed last.



Discussion Questions

1. Describe the relationships among chromatin, a chromosome, DNA, and a gene.
2. Make an analogy that helps explain homologous chromosomes.

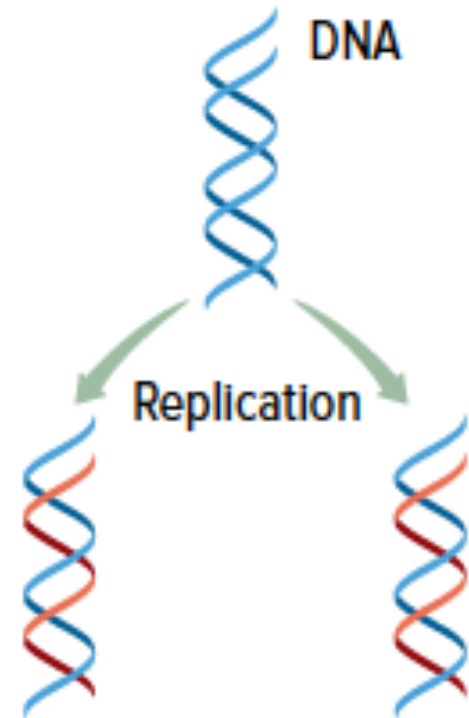
Concept 4: The structure of DNA is important to passing on genetic information.

- A cell replicates its DNA once in the cell cycle.

DNA Replication

- **Replication:** a process that makes identical copies of a DNA molecule
- Each new DNA molecule consists of an original strand and a new strand.

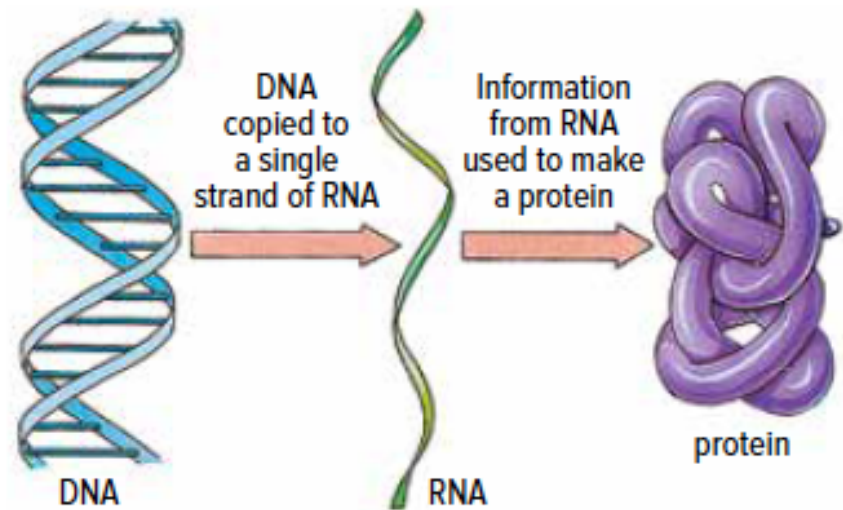
Figure 1.7: During DNA replication, two molecules of DNA are made from one. The resulting new molecules are identical to the original. Each new molecule contains one original strand of DNA (shown here in blue) and one new strand (shown in red).



DNA Replication (cont'd)

- DNA is used to produce RNA.
- RNA is then translated to produce a protein.
- The sequence of bases in the DNA molecule determines the specific sequence of amino acids in the protein molecule.

Figure 1.8: Genetic information passes from the genes (DNA) to an RNA copy of the gene, and the RNA copy directs the sequential assembly of a chain of amino acids to produce a protein.



Discussion Questions

1. Explain how the structure of DNA is related to how genetic material is passed from one generation to the next.
2. How are genes involved in the production of proteins?

Concept 5: The different genetic make-up of organisms is reflected in the diversity of life.

- Biodiversity exists at three different levels:
 - 1) species diversity
 - 2) genetic diversity
 - 3) ecosystem diversity

Species Diversity

- **Species diversity:** variety and abundance of species in a given area
- **Species:** group of organisms that can interbreed in nature and produce fertile offspring

Genetic Diversity

- **Genetic diversity:** variety of inherited traits within a species
- Genetic diversity is due to mutations in genes.
- **Gene pool:** genetic diversity within a population
- **Population:** members of the same species living in the same geographical area at the same time

Ecosystem Diversity

- **Ecosystem diversity:** variety of ecosystems in the biosphere
- Ecosystems are made up of biotic (living) factors and abiotic (non-living) factors.

Discussion Questions

1. Describe the differences among the three types of biodiversity.
2. Explain how variation in genes is related to all three types of biodiversity.

Topic 1.1 Summary: How does an understanding of DNA help us investigate living things?

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