TOPIC 1.1

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

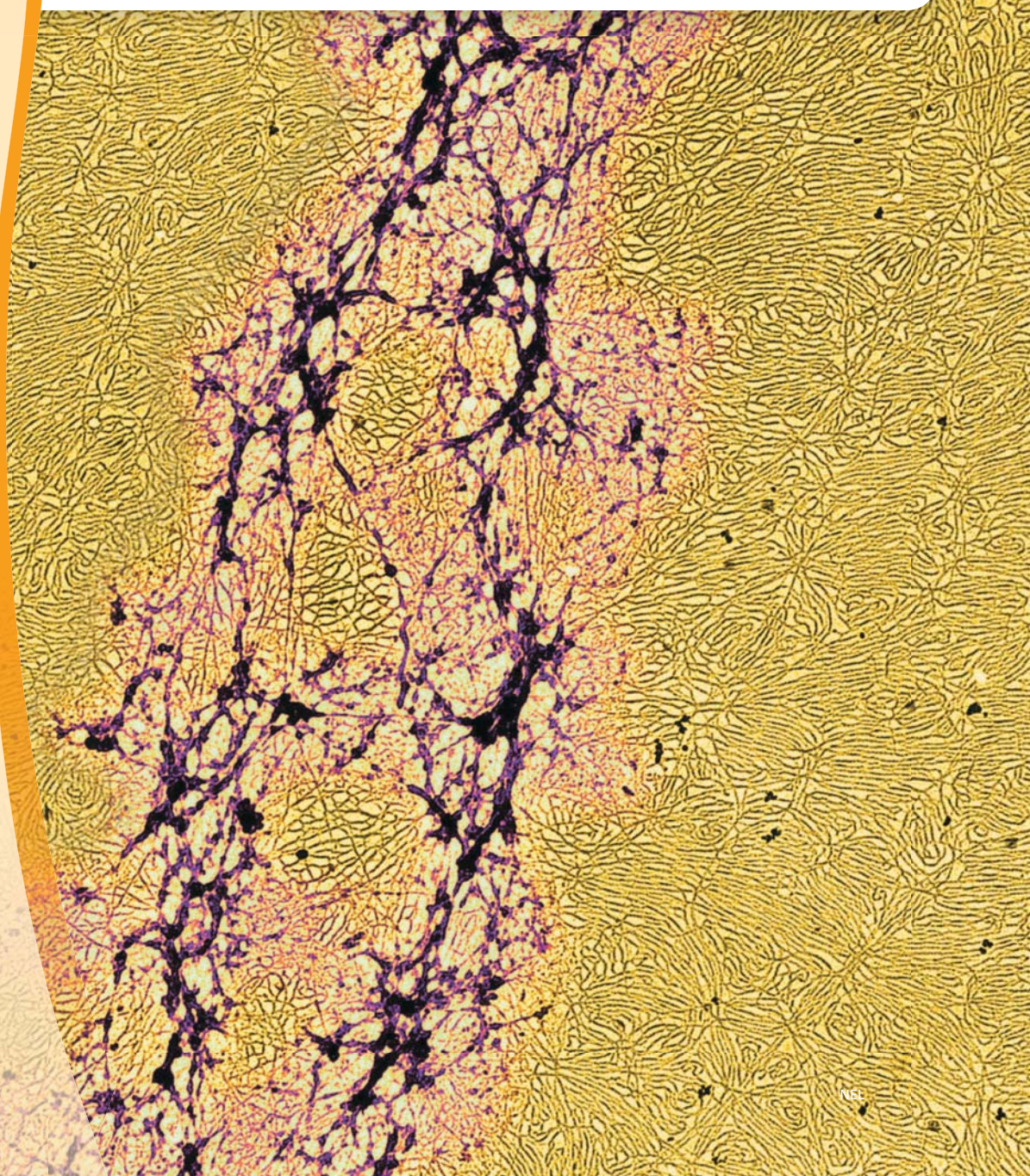
The nuclei of your cells have an average width of only 5 micrometres, which is about 10 times smaller than the width of a single human hair. One of the structures stored in the nucleus is DNA—about 2 metres' worth. How can all this DNA fit in the nucleus of your cells? The millions of coiled threads you see here, called chromatin, help with this. Chromatin, along with certain proteins, is condensed DNA. As chromatin, DNA is compact and fits into the nucleus of a cell. This is like stuffing 100 km of string into a lunch box. In this Topic, you will learn about the structure and function of DNA and its importance to living things.

Key Concepts

- 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.

Curricular Competencies

- Make observations aimed at identifying your own questions.
- Consider changes in knowledge over time.
- Consider the role of scientists in innovation.



Starting Points

Choose one, some, or all of the following to start your exploration of this Topic.

1. **Identifying Preconceptions** What do you recall about the structure and function of DNA from previous studies? Skim through the pages of this unit. How does the text and visual information you see in this unit compare with what you recall?
2. **Making Connections** How many different kinds of living things do you think there are on Earth? How might this diversity be important or valuable? Where does this diversity come from?
3. **Applying First Peoples Perspectives** Some scientists speculate that a living organism without DNA could exist. Nevertheless, as far as we know, the genetic information of all living things is stored using the same molecules: nucleic acids. How does this reflect the First Peoples world view that everything is interconnected?

Key Terms

There are 13 key terms that are highlighted in bold type in this Topic:

- DNA
- complementary bases
- chromosome
- allele
- population
- nucleotide
- protein
- homologous chromosome
- karyotype
- nitrogenous bases
- chromatin
- gene
- species

Flip through the pages of this Topic to find these terms. Add them to your class Word Wall along with their meaning. Add other terms that you think are important and want to remember.

CONCEPT 1

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

Activity

Gallery of Living Things

Think about the variety of organisms you know. Brainstorm examples that best fit these categories: largest; smallest; most unusual; most important. Create five more categories, and list examples. How are your lists alike and different? How can you explain the differences? How do your lists compare with your classmates' lists?

DNA deoxyribonucleic acid, a double-stranded nucleic acid that stores genetic information

Within and around the places you know, you can identify many different organisms, such as people, trees, grass, dogs, flies, and crows. If you think about just one of these—grass, for example—you likely can identify many ways one blade or patch of grass differs from another. Despite all this variation, you know that all life shares characteristics such as being made up of cells, using energy, growing, and reproducing. In addition to these, all the living things that we see are closely linked to something we cannot see—a molecule called DNA.

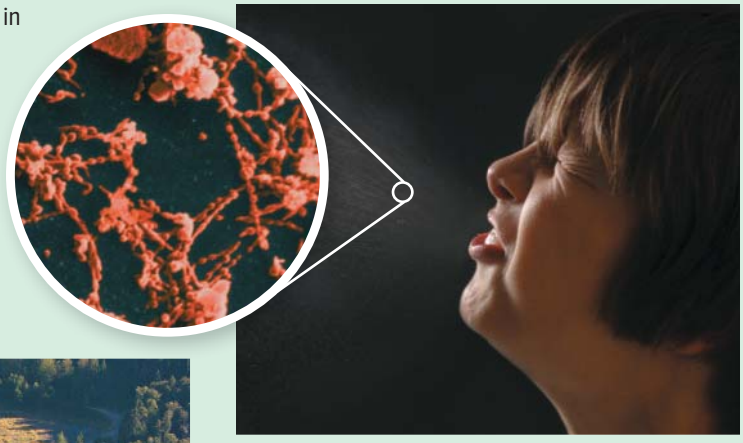
DNA (deoxyribonucleic acid) is genetic material that stores information. DNA is responsible for variation among all living things. Most cells of an organism contain genetic information that has an influence on its appearance and life processes. Figure 1.1 shows some of the similarities and differences in organisms that result from 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?**

Plants have some form of roots, a stem, and leaves. Plants carry out photosynthesis to produce their own food. But differences in DNA result in variations in root systems, types of stems, and leaf shape that enable plants to live in ecosystems as diverse as temperate rainforests, alpine meadows, and bogs.

Animals are multicellular, must ingest food, and display some form of movement. But differences in DNA result in variations in body shape, types and numbers of limbs, and organ systems. These and other variations enable animals to live in ecosystems as diverse as deciduous forests, lakes and ponds, and coniferous forests.

Bacteria are single-celled and microscopic. They are found in almost every ecosystem on Earth, including living in and on humans and other organisms. Scientists estimate that there are over 100 000 species of bacteria. Some are critical to the health of an ecosystem, such as those that decompose dead material. Some are harmful, such as those that cause diseases like pneumonia (shown in the photo). As with other organisms, differences in the DNA of bacteria enable them to live and thrive in a multitude of ecosystems, including living on and within us.



Protists are single-celled, microscopic organisms. You might recognize the names of different types, such as *Paramecium*, *Euglena*, or amoebas. Protists are found in aquatic ecosystems (and are often the cause of the algal blooms in Burgoyne Bay, shown on the left) and in soil. Variation in protist species is due to differences in DNA. Fungi, such as the mushrooms shown on the left, are multicellular organisms that decompose organic matter to get energy. Like other groups of organisms, different species of fungi exist because of variations in DNA.

Before you leave this page . . .

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.

Activity

Follow the Instructions

Think of something that has to be put together a certain way in order for it to function properly, such as a bicycle. Draw the basic steps needed to put together your example. Can your example be put together in any way? Why or why not?

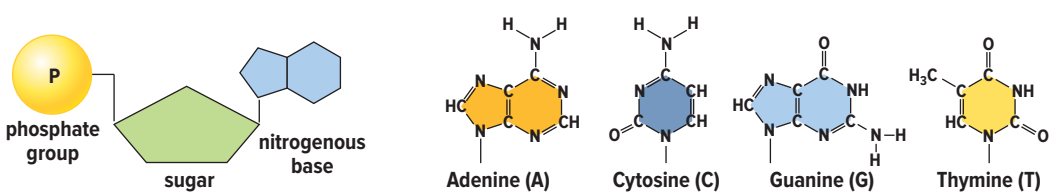


Figure 1.2 Nucleotides are the basic building blocks of DNA and RNA.

The Structure of DNA

Cells contain two types of *nucleic acids*: DNA and RNA (ribonucleic acid). Nucleic acids are large molecules made of smaller components called **nucleotides**. Figure 1.2 shows the general structure of nucleotides. Each consists of a phosphate group, a sugar, and a nitrogen-containing molecule called a **nitrogenous base**. The nitrogenous bases in DNA are adenine (A), cytosine (C), guanine (G), and thymine (T).

nucleotide consists of a phosphate group, a sugar, and a nitrogenous base; found in DNA and RNA

nitrogenous base part of the structure of a nucleotide; nitrogenous bases in DNA are adenine (A), cytosine (C), guanine (G), and thymine (T)

complementary bases nitrogenous bases that pair together in a specific way; A and T always pair together, and G and C always pair together

As shown in Figure 1.3, DNA is a molecule made up of two strands of nucleotides linked together. The structure of DNA looks like a twisted ladder, or double helix. The sides of the ladder are made up of the sugar and phosphate groups. Each rung of the ladder is made up of two nitrogenous bases bonded together as a base pair. The two strands are joined by hydrogen bonds that form between the nitrogenous bases of each strand. In Figure 1.3, you can see that each set of base pairs in the "rungs" of DNA must pair in a specific way. Adenine always pairs with thymine and guanine always pairs with cytosine. Nitrogenous bases that bond, or pair together in this way, are called **complementary bases**.

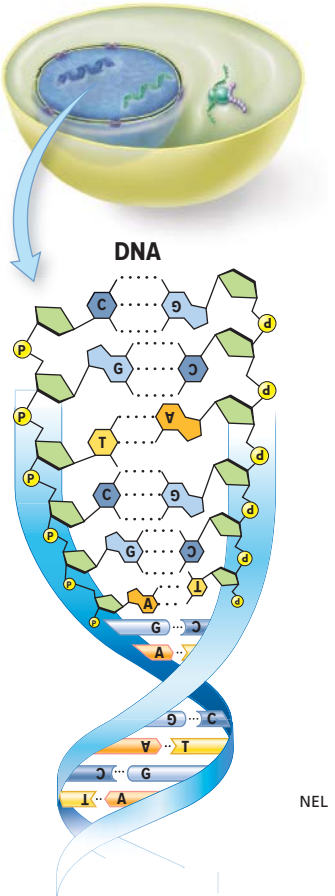


Figure 1.3 DNA is found in the nucleus of a cell. The bases of the nucleotides pair only in specific ways.

The Function of DNA

DNA stores genetic information. Organisms inherit DNA from their biological parents (or parent, for certain types of organisms). The genetic information stored in DNA is found in the order, or sequences, of bases along one side of the molecule. This genetic information tells each cell what **proteins** to make and how to make them. Protein molecules make up much of the structure of cells in all organisms as well as tissues in plants and animals. In addition, various proteins control how a cell is formed and how it functions. The instructions provided by DNA are therefore responsible for the development of an organism and the function of all of its parts.

The complete DNA sequence in each cell of an organism is called the organism's *genome*. The human genome consists of about three billion base pairs. These are found distributed in the 46 chromosomes in every cell that forms the human body.

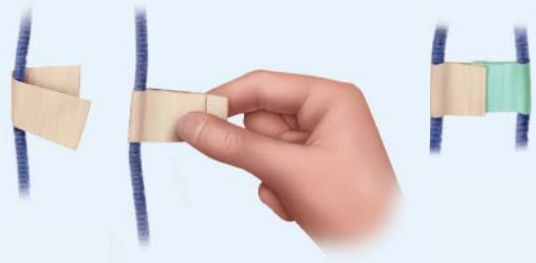
protein an organic chemical composed of a chain of building-block molecules called amino acids

Activity

Modelling DNA

In this activity you will use the materials provided by your teacher to assemble your own DNA model.

1. Place two pipe cleaners of the same colour in an orientation that represents the sugar-phosphate backbones of DNA.
2. Write a sequence of bases that you will use to build your DNA model. Be sure to use each base at least once. Decide which colour of tape will represent each base. Wrap a piece of tape to one of the pipe cleaners, according to the following instructions and the diagram on the right.
   - **a)** Choose the colour of tape that matches the first base in your sequence. Start at one end of the pipe cleaner, 2 cm to 3 cm from the end.
   - **b)** Centre a piece of tape on the pipe cleaner. Fold and press the tape around it.
   - **c)** Repeat step b with the other pipe cleaner. Use a piece of tape that represents a complementary base, but leave some of the sticky side of the tape exposed. Connect the two pipe cleaners by overlapping the sticky side of the tape with the piece of tape on the opposite pipe cleaner.
   - **d)** Continue steps b and c, adding "bases" along the length of each pipe cleaner.



3. Holding both ends of the double-stranded DNA model, twist the two ends in opposite directions to form a helix structure.
4. Use your model to answer the questions.
   - What determined the bases you added in step c?
   - What are the strengths and weaknesses of your model?

Before you leave this page . . .

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.

Activity

Coiled and Condensed

Recall the photo that began this Topic. Then examine the yarn and the box provided by your teacher. Can you get all the yarn to fit inside? How does this experience help you appreciate the structure of DNA and the complexity of life?

chromatin fibres of DNA in its condensed form; the usual form of DNA in the nucleus during interphase

chromosome structure composed of DNA as a very condensed form of chromatin; visible only during cell division

Figure 1.4 shows the relationship among DNA, **chromatin**, and **chromosomes**. During most of the cell cycle, DNA exists as strands of chromatin. Once the cell's nucleus and genetic material begin to divide (mitosis), the chromatin condenses into distinct chromosomes.

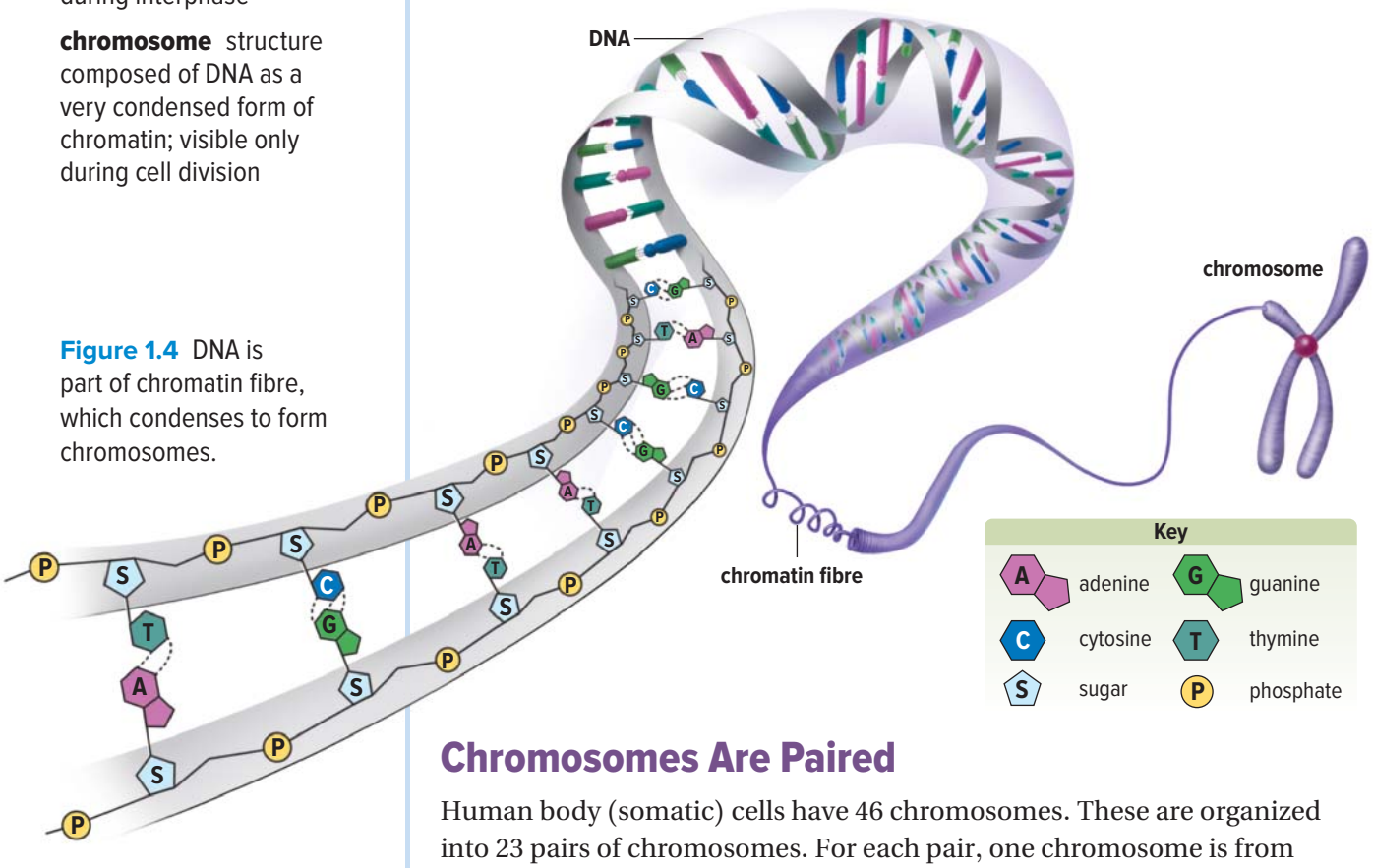


Figure 1.4 DNA is part of chromatin fibre, which condenses to form chromosomes.

Chromosomes Are Paired

Human body (somatic) cells have 46 chromosomes. These are organized into 23 pairs of chromosomes. For each pair, one chromosome is from the biological father and one is from the biological mother. One of these chromosome pairs is the *sex chromosomes*. The sex chromosomes, called X and Y, determine the genetic sex of an individual. A genetic female has two X chromosomes. A genetic male has one X chromosome and one Y chromosome. The sex chromosomes are always counted as a pair, even though X and Y are not similar. The remaining 22 pairs of chromosomes are called *autosomes*. Chromosomes are paired based on sharing similar characteristics.

Homologous Chromosomes Contain Alleles

As shown in Figure 1.5, **homologous chromosomes** are pairs of chromosomes that are similar in features such as length and centromere location but are not identical to each other. As you know, chromosomes contain the cell's DNA. **Genes** are sections of DNA that contain genetic information for the inheritance of specific traits. Homologous chromosomes carry genes for the same traits, such as hair type, at the same location. However, they can carry different forms of the same gene. Different forms of the same gene are called **alleles**. These different forms account for differences in specific traits, such as straight hair versus curly hair.

homologous chromosome a chromosome that contains the same sequence of genes as another chromosome

gene a part of a chromosome that governs the expression of a trait and is passed on to offspring; it has a specific DNA base sequence

allele a different form of the same gene

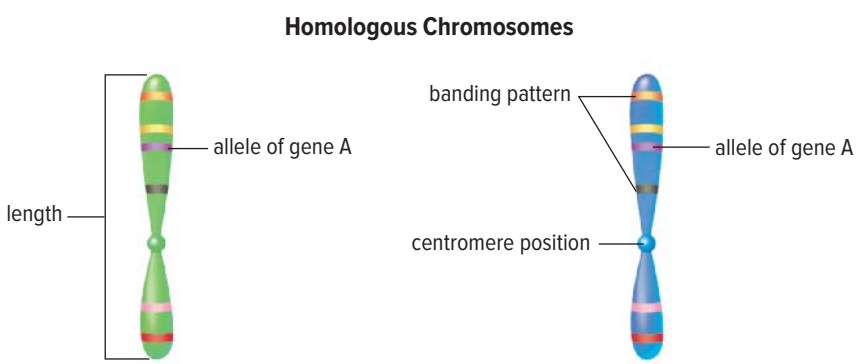


Figure 1.5 Homologous chromosomes have several characteristics in common, but they are not identical.

Examining Chromosomes: The Karyotype

The particular set of chromosomes that an organism has can be seen in a **karyotype** [CARRY-oh-type]. To prepare a karyotype, a cell sample is collected and treated to stop cell division during metaphase of mitosis. The sample is stained, which produces a banding pattern on the chromosomes that is clearly visible under a microscope. The chromosomes are then sorted and paired. The autosomes are numbered 1 through 22, and the sex chromosomes are labelled as X or Y. For example, Figure 1.6 shows the karyotype of a genetic female, because there are two X chromosomes.

karyotype a photograph of pairs of homologous chromosomes in a cell

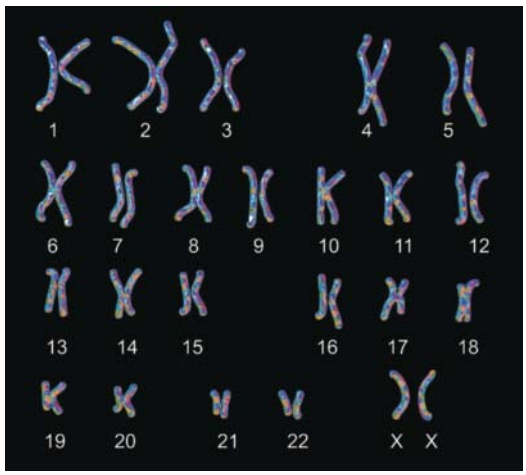


Figure 1.6 This is a human karyotype. The chromosome pairs are arranged and numbered in order of their length, from longest to shortest. The sex chromosomes are placed last.

Before you leave this page . . .

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.

Activity

Mitosis and Meiosis

Use your prior knowledge to explain what needs to happen to genetic material in order for cells to reproduce. Share your explanations with a partner and then the class to be sure everyone agrees and understands.

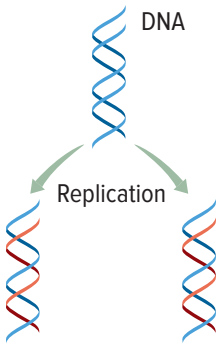


Figure 1.7 During DNA replication, two molecules of DNA are made from one. The resulting new molecules are identical to the original. Each new molecule contains one original strand of DNA (shown here in blue) and one new strand (shown in red).

DNA Replication

Replication is the process of creating an exact copy of a molecule of DNA. A cell replicates all of its DNA—its whole genome—once, and only once, in the cell cycle. A human cell can copy all of its DNA in a few hours, with an error rate of only about one per one billion nucleotide pairs. The speed and accuracy of replication relies on the structural features of DNA and the action of a set of specialized proteins.Each new molecule of DNA serves as a template for the formation of its complementary strand. As shown in **Figure 1.7**, each new molecule of DNA contains one strand of the original complementary DNA molecule and one new daughter strand.

After DNA replicates, the genetic code is copied to RNA and translated so that proteins can be made. **Figure 1.8** summarizes the overall path of how proteins are made. When needed, a cell accesses the genetic information coded within a single gene to create protein for cellular activities. An enzyme is used to copy the sequence of DNA's nitrogenous bases to create a single strand of RNA nucleotides. Next, this single strand of RNA is used to produce the correct sequence of amino acids to build the protein. Thus, the sequence of bases in DNA's genetic code will determine the sequence of bases on a strand of RNA, which in turn will determine the sequence of amino acids needed to make a protein.

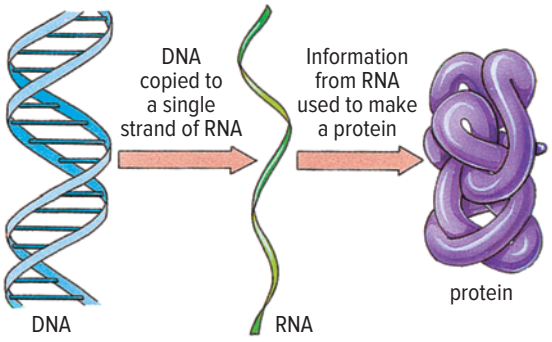


Figure 1.8 Genetic information passes from the genes (DNA) to an RNA copy of the gene, and the RNA copy directs the sequential assembly of a chain of amino acids to produce a protein.

Before you leave this page . . .

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.

Activity

Variety—The Spice of Life

Think about and list the variety of organisms that live in your area. Also consider the variety of places (habitats, ecosystems) where they live. Compare your lists with others in the class. How would you classify the biodiversity of your area? Is there a lot of variety? Only some? How did you arrive at your opinions?

When you hear or read the word *biodiversity*, you may think first about species diversity. *Species diversity* is the variety and abundance of **species** in a given area. However, the concept of biodiversity involves more than just numbers of species. Also included are genetic and ecosystem diversity. *Genetic diversity* is evident in the variety of inherited traits *within* a species. For example, the patterns on the tails of humpback whales (**Figure 1.9**) are evidence of genetic diversity within this species. *Ecosystem diversity* is the rich diversity of ecosystems found on Earth, each of which contains many species.

species group of organisms that can interbreed in nature and produce fertile offspring

Figure 1.9 Biological diversity exists at different levels. A Within species there is *genetic diversity*, as evident in the different tail patterns of humpback whales. B Within ecosystems, like this freshwater wetland, is *species diversity*. C Finally, a variety of ecosystems, such as this one in Great Bear Rainforest Park, make up *ecosystem diversity*.

Genetic Diversity

Genes are the genetic material that control the expression and inheritance of traits, such as sugar content in blueberries, pattern arrangement in ladybeetles, and height in humans. The variation among individuals in a **population** is largely a result of the differences in their genes. Genetic diversity *within a population* is known as the *gene pool*. In other words, the gene pool is the sum of all the versions (alleles) of all the genes in a population. The genetic diversity *within* a species is always greater than it is within a population, because the gene pools of separate populations usually contain different types or combinations of alleles.

population members of the same species living in the same geographical area at the same time

Genetic diversity within a species results from mutations to genes. You will read more about mutations later in this unit. The variation in genes among individuals in a population and within a species, along with other factors, can lead to the formation of a new species.

Species Diversity

From microscopic bacteria to carnivorous plants, from whales that migrate thousands of kilometres to fungi that help break down dead trees, there are millions of species on Earth. To date, scientists have identified about 2 million species. This is a large number, and new species are discovered every day. However, biologists estimate that the total number of species ranges from 5 million to one trillion! As you read this unit, you will learn how new species form and how variation in genes is critical to the formation of a new species.

Ecosystem Diversity

If the smallest scale at which scientists consider biodiversity is genetic diversity, then the largest scale is ecosystem diversity. Ecosystem diversity refers to the variety of ecosystems in the biosphere. Recall that ecosystems are made up of two components—biotic factors and abiotic factors. Biotic factors are all of the living organisms in an environment. Examples of abiotic factors include altitude, latitude, geology, soil nutrients, climate, and light levels. Because of the diversity of relationships among organisms and the variety of abiotic factors, Earth's surface is highly varied physically and chemically, making ecosystem diversity very rich. So many species exist and thrive in all of Earth's ecosystems because of genetic diversity and factors that affect the gene pool.

Before you leave this page . . .

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

AT ISSUE

What Are the Accomplishments and Legacies of the Human Genome Project?

What's the Issue?

The international Human Genome Project (HGP) was completed in 2003. Its main goals were to determine, nucleotide by nucleotide, the complete sequence of the human genome and to identify all of the genes. This genetic blueprint for a human has shown us that

- the human genome consists of about 3 billion base pairs of DNA
- humans have about 21 000 genes, which is much fewer than scientists had predicted
- our genes are only about 1.5% of our DNA. Scientists have found that sections of the remaining 98.5% are extremely important, but there is still much of the genome that is poorly understood.

The HGP Is Complete, but There's Still Work to Do

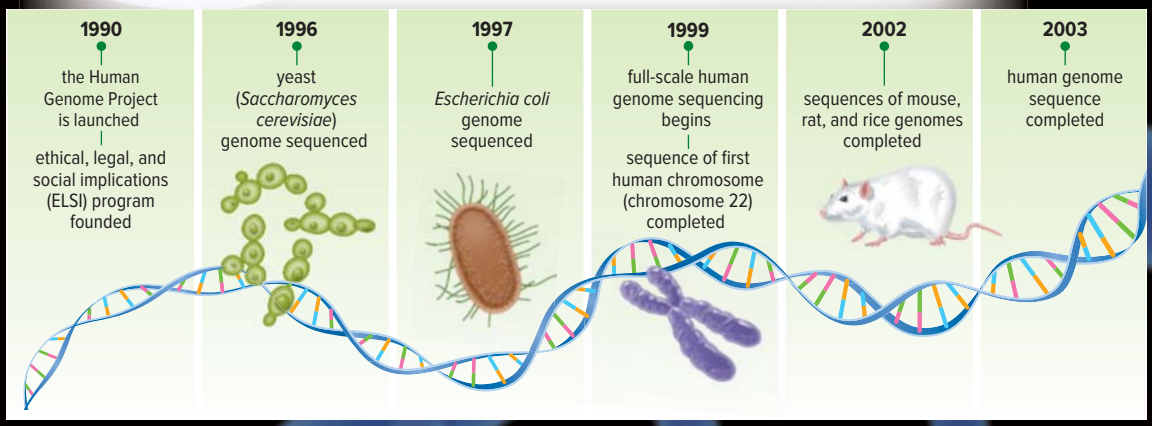
Though the HGP is finished, analysis of the data generated from this project will continue for decades. To complete this huge task, researchers have also studied the genomes of other organisms, including the fruit fly, the mouse, and *Escherichia coli*—a bacterium present in our intestines.

The DNA sequences of the genomes of thousands of organisms have also now been determined. Studies on non-human organisms help to develop the technology required to handle the large amounts of data produced by the HGP. These technologies help to interpret the function of newly identified human genes. Although the HGP represents a huge advance in science and technology, it also has raised many social, legal, and ethical questions.

Dig Deeper

Collaborate with your classmates to explore one or more of these questions—or generate your own questions to explore.

1. Who owns and controls genetic information? How will the genetic information of individuals be used, and by whom?
2. How does the use of genetic information for research affect isolated communities?
3. Why is it important to regulate research that involves genetic information?



AT ISSUE

Seeding the Future: Native and Heritage Varieties

What's the Issue?

Most fruits and vegetables you see in a grocery store are *hybrids*. Hybrids, which are created by crossing two plant lines, are bred to enhance selected features such as size, appearance, or longer shelf life. However, hybrids may be less flavourful, and their crops often cannot produce fertile seeds. This means that farmers must purchase new seeds each year from the commercial seed market.

Advantages of Native and Heritage Varieties

An alternative to growing hybrids is to plant native and heritage varieties of crop plants. Heritage (also called heirloom) varieties are usually defined as being at least 50 years old, and are often linked to a particular region. Both native species and heritage varieties are non-patented, naturally pollinated plants that produce fertile seeds.

Native and local heritage varieties are adapted to a region's environmental conditions. These adaptations give them increased resistance to pests and disease, which in turn means they require less maintenance and irrigation. Maintaining more plant varieties in the gene pool also provides greater genetic diversity.

Seed Libraries and Seed Banks

To help maintain genetic diversity, mechanisms for distributing and preserving seeds have been established. *Seed libraries* provide seeds and information about heritage plant varieties. *Seed banks* preserve seeds in case a disaster destroys other seed reserves. Some seeds can be kept for decades by drying and storing them in cold conditions. A combination of seed banking, seed sharing, and the planting of native and heritage plants may be the best way to preserve biodiversity for the future.

Dig Deeper

Collaborate with your classmates to explore one or more of these questions—or generate your own questions to explore.

1. In a group, brainstorm how you could encourage people to plant and purchase heritage crops in your community. Give at least three detailed ideas.
2. How does the Twin Sisters Native Plants Nursery at Moberly Lake balance sustainability and economics in their approach to renewing and restoring areas damaged by human activity?

Check Your Understanding of **Topic 1.1**

QP Questioning and Predicting PC Planning and Conducting PA Processing and Analyzing E Evaluating
AI Applying and Innovating C Communicating

Understanding Key Ideas

1. Think about a time you have seen a flock of Canada geese flying overhead. If you could examine the geese closely, would they look identical? Would they be genetically identical? Explain your answers. PA C

2. Describe the structure of DNA. C

3. What is the role of DNA in cells? C

4. Suppose a section of DNA has 27 percent thymine (T). PA

a) What percentage of cytosine (C) does it have?

b) What percentage of adenine (A) does it have?

c) What percentage of guanine (G) does it have?

5. What is a genome? PA

6. Using a diagram or flowchart, illustrate the relationships among nucleotide, DNA, gene, allele, chromatin, and chromosome. C

7. Why is the word *homologous* used to describe chromosome pairs, rather than the word *identical*? PA

8. How are homologous chromosomes alike? How are they different? Make a diagram to help explain your answer. PA C

9. Draw and label a karyotype for an organism that has three pairs of homologous chromosomes. PA C

10. Why are the X and Y chromosomes commonly referred to as the sex chromosomes? PA

11. How does DNA replication ensure that daughter cells can produce the same proteins? PA

Connecting Ideas

12. Use a graphic organizer to show the relationships among the terms *biodiversity*, *genetic diversity*, *species diversity*, and *ecosystem diversity*. PA C

13. What is the difference between a gene and an allele? How is each related to diversity among living things? PA

Making New Connections

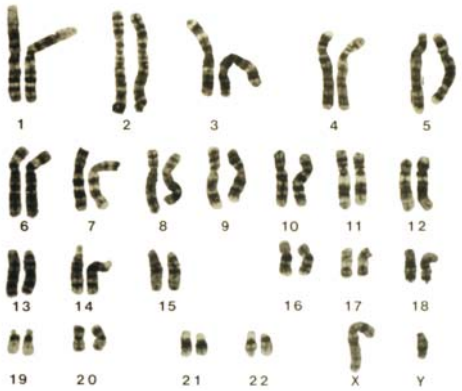
14. The human genome contains about 3.0×10^9 pairs of bases. Humans have approximately 21 000 genes, and a typical gene has 3000 base pairs. Suppose that the genome is a railway track and each base pair is a railway tie. If each railway tie is 1 m from the next, how many kilometres long is the track? Given this information, how much of the human genome consists of DNA that does not code for proteins? AI

15. The image below shows chromosomes in a human cell. PA

a) What is this representation called and how is it prepared?

b) Identify the sex of the individual.

c) Does this individual have the correct number of chromosomes? How do you know?



INVESTIGATION
1-A

GUIDED INQUIRY

Using Karyotypes to Diagnose Genetic Disorders

Skills and Strategies

- Planning and Conducting
- Processing and Analyzing Data
- Evaluating
- Communicating

Safety

- Handle scissors with care.

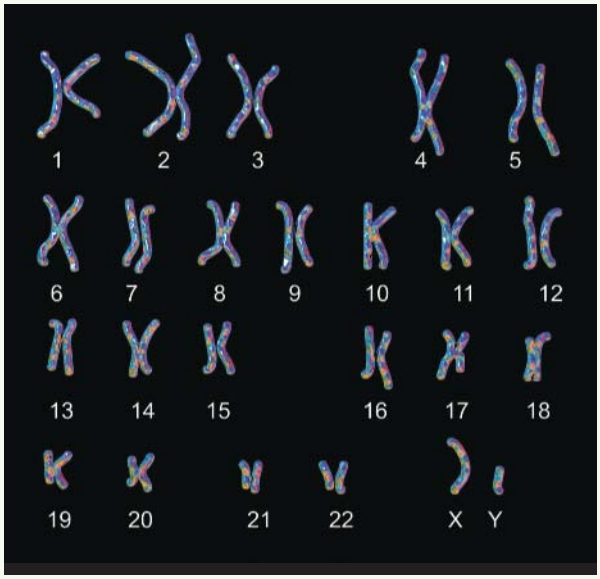
What You Need

- model chromosome image
- scissors
- tape or glue stick
- paper

In this activity, you will model and analyze a karyotype. A karyotype can be prepared before or after a baby is born to look for abnormalities in the number or structure of chromosomes within the cells. To prepare a karyotype, scientists take a tissue sample and then grow it in a culture dish in the lab. A chemical is added to the sample to stop cells during mitosis. Cells from this tissue are then placed on a microscope slide, stained, and treated with a chemical that makes the cells burst open. The stained chromosomes are then photographed through a microscope.

Question

What information can you infer from a karyotype?



To make a karyotype, the chromosomes are paired, placed in order of decreasing size, and numbered. **Identifying: Is this the karyotype of a genetic male or female? Explain.**

Procedure

1. Your teacher will supply you with a model image of a person's chromosomes.
   a) Cut out the chromosomes, and examine them closely to help you decide how to match them up in pairs. Remember that the sex chromosomes are not an identical pair. The X chromosome is larger than the Y chromosome.
   b) Compare your pairings with those of other groups. Confirm your decisions before moving on to the next step.

2. Tape or glue the chromosomes to a piece of paper. Arrange and number the pairs from largest to smallest. Leave a few centimetres of space between each pair. Place the sex chromosomes last. Number each pair of chromosomes from 1 to 22. Then label the sex chromosomes.
3. Examine your karyotype. Record the number of autosomes and the number of sex chromosomes.
4. Your teacher will give you an additional chromosome. Try to match it with one of the pairs in your original karyotype. Tape it in place next to the correct pair.
5. Examine your new karyotype. Note how it differs from your original.

Analyze and Interpret

1. Was your first karyotype from a somatic cell (body cell) or a gamete (sex cell)? How can you tell?
2. Based on your first karyotype, how confident are you that it represents someone who has no genetic abnormalities? Explain your reasoning.
3. Diagnose the disorder indicated by your karyotype in Procedure step 4. Give evidence for your answer. (Trisomy 13 = Patau syndrome; Trisomy 18 = Edward syndrome; Trisomy 21 = Down syndrome)
4. Cri-du-chat syndrome is a genetic disorder that results from a deletion of genes on the short arm of a chromosome 5. Make a sketch to show how the fifth chromosome pair might look in the karyotype of a child who has cri-du-chat syndrome.
5. Could you use a karyotype to detect a mutation in a single gene? Explain why or why not.

Conclude and Communicate

6. Did you find it difficult to match up the chromosome pairs? What features were most helpful when you were trying to identify homologous chromosomes?
7. You worked with a model image of chromosomes. Why might it be more challenging to interpret a photo taken through a microscope? What do you think is the likelihood of error when scientists interpret a karyotype?

Extend Further

8. Research and describe the cause and symptoms of Williams syndrome. Can it be detected using a karyotype? Why or why not?