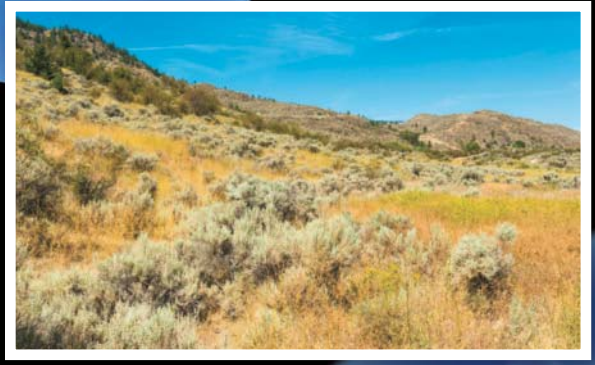
UNIT 1

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

Organisms live in almost every imaginable habitat in, on, and above Earth's surface. Even our own bodies are home to trillions of microbes—we are *their* habitat! The thread that binds all living things, that is responsible for the unity and diversity of life, is the double-helix molecule: DNA.

"It never occurred to me that there was going to be any stumbling block. Not that I had the answer, but [I had] the joy of going at it. When you have that joy, you do the right experiments. You let the material tell you where to go, and it tells you at every step what the next has to be because you're integrating with an overall brand new pattern in mind."

Barbara McClintock
Geneticist, Nobel Prize Winner



- What do you think makes you different from the fish in the photo? How are you different from the plants in the photo? How are you different from the person next to you? What do you think makes you similar to another organism?
- What molecules and processes do you think account for the diversity of living things?
- What questions do you have about—these photos? the introduction? the quotation? the title for this unit? ...?

UNIT 1

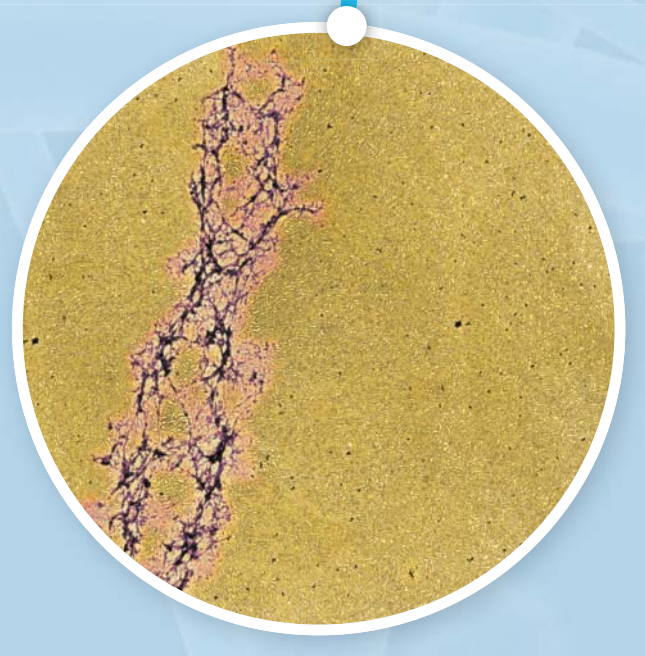
At a Glance

You will demonstrate what you know, can do, and understand by being able to

- Perform investigations and use other investigative methods to explore DNA, simple patterns of inheritance, and mechanisms for the diversity of life
- Seek patterns and connections to describe, explain, and apply findings and understandings
- Apply a variety of ways of knowing, including First Peoples perspectives and knowledge, to reflect on and investigate the unity and diversity of life
- Use scientific understandings to evaluate scientific and technological applications of gene manipulation

ESSENTIAL QUESTION

How is DNA the foundation of unity and diversity of living things?



TOPIC 1.1:

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

Some things you will do:

- formulate physical and mental models
- consider social, ethical, and environmental implications of findings
- generate and introduce new or refined ideas

Some things you will come to know:

- DNA accounts for variation in living things.
- The structure of DNA is related to its function.

TOPIC 1.2:

How is hereditary information passed from one generation to the next?

Some things you will do:

- formulate multiple hypotheses and predict multiple outcomes
- demonstrate an awareness of assumptions and bias in your work and in secondary sources

Some things you will come to know:

- Genes pass on inherited traits from parent to offspring.
- Punnett squares are tools to show the probability of inheriting specific traits.

TOPIC 1.3:

How can natural and artificial selection influence changes in populations?

Some things you will do:

- select and use appropriate equipment to collect and record data
- ensure safety and ethical guidelines are followed in investigations
- draw conclusions that are consistent with evidence

Some things you will come to know:

- Genetic variation provides natural selection with the raw material with which it can interact and effect change.
- Humans select, and therefore affect, characteristics in certain organisms in order to suit our needs and wants.

TOPIC 1.4:

How and why are the genes of organisms manipulated?

Some things you will do:

- exercise healthy, informed skepticism to plan investigations and evaluate claims
- critically analyze and evaluate validity of information
- express and reflect on experiences, perspectives, and worldviews through place

Some things you will come to know:

- Biotechnology has benefits and risks and raises some ethical issues.

UNIT 1

Connect To What You Already Know

This feature helps you reflect on what you know about some foundational ideas that you have learned in previous grades. Work alone or quietly in small groups to answer the questions. Reach out to your classmates to ask about things that you are unsure about or to offer assistance. Your teacher also can provide additional reinforcement materials to help you prepare for this unit.

1. Compare and contrast asexual reproduction and sexual reproduction.
2. All eukaryotic cells reproduce by the cell cycle.
   a) Make an illustration of the cell cycle. Show the two stages and include the labels interphase, mitosis, and cytokinesis.
   b) Explain what happens during each stage.
3. Create a series of illustrations, with captions, to describe mitosis to Grade 5 students.
4. What happens to DNA in each stage of mitosis? Why is it important that DNA is replicated during interphase?
5. Draw a diagram of a cell with six chromosomes going through meiosis.
6. Identify whether each of the following is an event in meiosis I or meiosis II.
   a) Individual chromosomes move to the middle of the cell.
   b) Homologous pairs of chromosomes move together to the middle of the cell.
   c) Crossing over occurs.
   d) Homologous chromosomes move to opposite sides of the cell.
7. Explain why meiosis is related to the diversity of living things on Earth.
8. Make flowchart to show the steps involved in the formation of a zygote, beginning with one gamete from a genetic male and one gamete from a genetic female.
9. Explain the difference between haploid and diploid cells.
10. What role does meiosis play in sexual reproduction?
11. A dog has 76 chromosomes.
    a) How many pairs of homologous chromosomes does it have?
    b) How many chromosomes are in each sperm cell of a male dog?
12. Which phases of meiosis are most similar to the phases of mitosis? Explain your answer.
13. Create a table to show the number of chromosomes of the following list of cells before, during, and as a result of mitosis.
    a) human cell: 46 chromosomes
    b) horse cell: 64 chromosomes
    c) apple cell: 34 chromosomes
14. Repeat question 12 for the same list of cells before, during, and as a result of meiosis.
15. Copy and complete this table.

	Mitosis	Meiosis
Function		
Type of cells it occurs in		
Number of divisions		
Number of chromosomes in parent cell		
Number of daughter cells produced by each parent cell		
Number of chromosomes in daughter cells		
Are daughter cells genetically identical?		

Mitosis and meiosis both result in cell division, and they have many other similarities as well. For example, the DNA is copied before the start of meiosis and mitosis. However, there are some important differences too, which are summarized in **Table 1**. The events in meiosis I are unique to meiosis. The events in meiosis II and mitosis are virtually identical. But it is very important to keep in mind that the cell is haploid at the start of meiosis II and diploid at the start of mitosis.

Table 1 Mitosis and Meiosis

Mitosis	Meiosis
• One division occurs during mitosis.	• Two sets of divisions occur during meiosis: meiosis I and meiosis II.
• DNA is copied during interphase.	• DNA is copied once before meiosis I.
• Pairing of homologous chromosomes does not occur.	• Pairing of homologous chromosomes occurs during prophase I.
• Two diploid cells ($2n$) are formed per cell cycle.	• Four haploid cells (n) are formed per cell cycle.
• The daughter cells are genetically identical.	• The daughter cells are not genetically identical.
• Mitosis occurs only in body cells.	• Meiosis occurs only in reproductive cells.
• Mitosis is involved in growth and repair.	• Meiosis is involved in the production of gametes and providing genetic variation in organisms.