UNIT

4

Evolution

Unit Preview

In this Unit, you will discover

- the scientific evidence that supports the theory of evolution,
- the mechanisms that result in evolution, and
- how the science of evolution is related to current biological research.

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Chapter 12 Adaptation and Speciation 390

Unit Project 420

UNIT PROJECT PREP

Read pages 420–421 before beginning this unit.

- Choose the types of technologies that are related to the unit project on Searching for the Common Ancestor.
- Set up files to organize your information on Searching for the Common Ancestor.
- As you read through this unit, collect information that would help you work on your project.

Dive into the water off one of Canada's coasts and you will be surrounded by a myriad of life. Life in the ocean, and in all habitats on Earth, is rich and varied. Species differ from one another, but individual members of a single species also differ. These sea stars are all the same species but they exhibit different colours. The diversity within a species can be obvious (such as variations in size or colour) or "hidden" (such as differences in DNA sequencing). This diversity is a cornerstone of evolutionary biology.

When *Hallucigenia* (inset photo) swam in the sea over 500 million years ago, there was a *greater* diversity of life forms than there is today. *Hallucigenia* was found in the Burgess Shale — a rich fossil bed in the Rocky Mountains in Yoho National Park, British Columbia. The fossils there provide a piece of the puzzle that has helped shape our current ideas about evolution — the process by which organisms alive today descended from ancient forms of life and have been modified over time. Using fossil evidence, observation of species over time, and modern techniques such as genetic analysis, scientists are adding to our understanding of life on Earth. How has life on Earth changed over the millennia? What are the mechanisms that give rise to new species? In this unit, you will explore the fascinating science of evolution. You will learn how early studies and observations of life shaped early theories of evolution. As well, you will see how new discoveries and scientific techniques and technologies contribute to our understanding of evolution.

Why did some species, such as *Hallucigenia*, become extinct, while others survived?

CHAPTER 10

Introducing Evolution

Reflecting Questions

- What ideas and observations helped develop the current theory of evolution?
- What is some of the evidence that helps explain evolution?
- What are the roles of genetics and the environment in evolution?

Prerequisite Concepts and Skills

Before you begin this chapter, review the following concepts and skills:

- describing how heritable traits are passed from one generation to the next (Chapter 6, section 6.4; Chapter 8, section 8.4).

Living organisms are constantly faced with challenges in their environment. Severe weather, drought, famine, and competition for food and space are all struggles living organisms may or may not overcome. Severe weather such as snowstorms and freezing temperatures are some of the challenges that animals, such as the wolf, face in northern environments. Animals that survive have the opportunity to reproduce and pass along to their offspring the traits that helped them survive. The diversity within species and the interactions of organisms with their environment help explain how populations can change over time and why some organisms survive while others become extinct.

The millions of species on Earth today are only a small fraction of the species that have ever lived. In fact, it is estimated that 99 percent of all species that have ever lived are now extinct. While some of the fossilized animals are ancestors of animals that are common today, others have long been extinct and are unlike anything in our modern oceans. Fossils help to show that there was a *greater* diversity of basic animal forms half a billion years ago than there is today. The animals like the fossils unearthed in the Burgess Shale lived during the Cambrian Explosion (over 500 million years ago), a time when there was a stunning burst of biodiversity that is now recorded in the fossil record.

What factors affect which organisms survive and pass on their genes to the next generation? How do environmental conditions affect survival and reproductive ability of organisms? Species diversity and environmental conditions are crucial factors when discussing evolution.

In this chapter, you will learn how changes in the environment and diversity within a *species* can result in changes in *populations* of particular species, and even the formation of new species. You will also learn how the early observations and ideas of naturalists and biologists helped provide a foundation for our current understanding of evolution.

Why is variation within a species necessary for evolution to occur?

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