



**Figure 1.53** Domestic animals have been bred to help us with various tasks. Canada's Aboriginal people once relied on dogs to carry loads. Items were packed onto travois, triangular wooden frames that the dogs would drag. After the horse was reintroduced into North America, people used horses to pull larger travois.

### Pause & Reflect

How do wildflowers found around Alberta differ from cultivated flowers grown in gardens? Do you think cultivated flowers would survive unattended in the wild? Record your thoughts in your Science Log.

Do you have a cat or dog at home? Do you own a pet rabbit? **Domestic** animals have had a long history of living with people. Cats and dogs are ideal living companions. They share our houses, eat our food, and sleep in our beds.

There are other domestic animals that are important to us. Do you drink milk or eat cheese or yogurt? Do you eat eggs or meat? Where did these animals come from, and why do they meet our needs so well? The distant ancestors of these animals were wild. Our own ancestors captured them, and over time, shaped these animals into the ones we know today.

In the last Topic you saw how biotechnology can be used to create animals and plants with favourable traits. People have used breeding, or **artificial selection**, for thousands of years, to produce domestic plants and animals with particular characteristics.

Farmers bred dairy cows that produced the most milk. In other cases, farmers selected the best beef cattle. Sheep were bred based on the quality of their wool or meat. By breeding animals with the most desirable qualities, farmers were able to manipulate the characteristics of domestic animals over a number of generations.

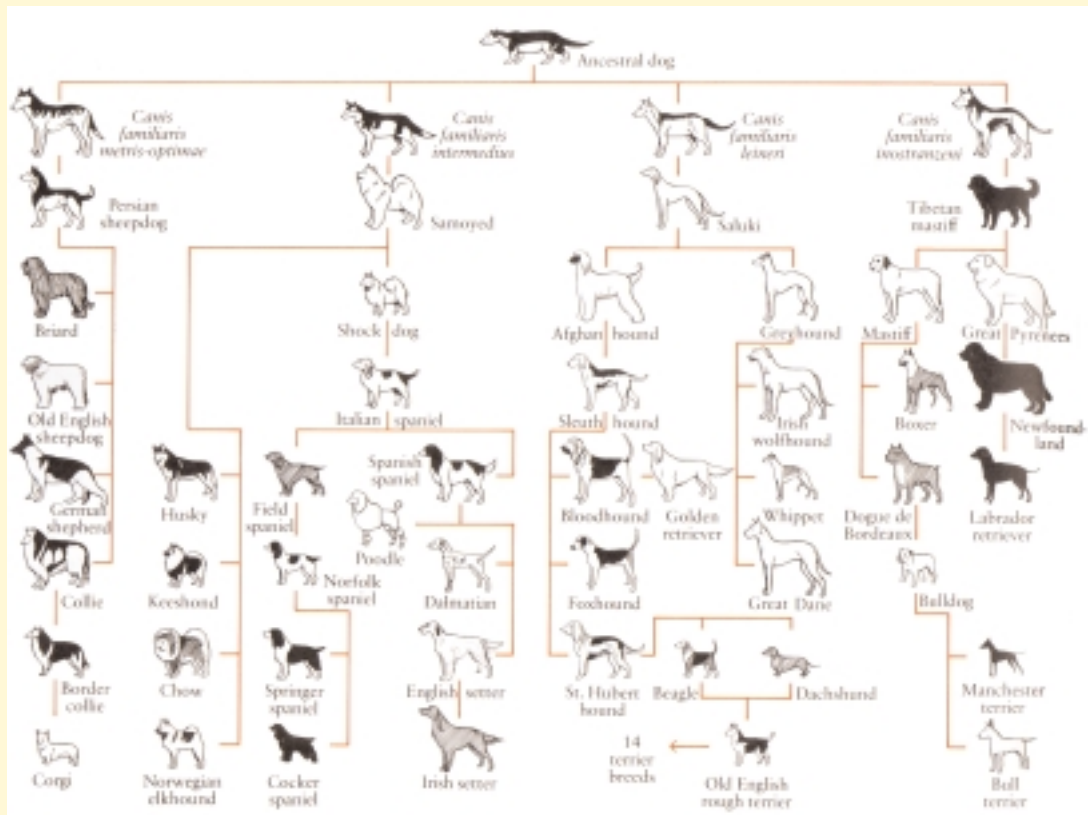


**Figure 1.54** Distinctive dog breeds, such as this tiny Chihuahua and enormous Great Dane, have been produced through selective breeding. Health problems are common in purebred animals. Why do you think this is so?

## Why Are There So Many Different Kinds of Dogs?

Archaeological finds prove that dogs have been domesticated for more than 14 000 years. There are over 160 breeds of dog recognized

by the Canadian Kennel Club. There are also countless combinations of these breeds called mutts, mongrels, or mixed-breeds.



### Procedure

The chart above shows that all of today's dog breeds came from one ancestral species. Use the chart to trace how so much variation came about.

### What Did You Find Out? Analyzing and Interpreting

1. For what purpose was the Tibetan mastiff bred? What characteristics do you think the breeders were looking for?
2. Many of these dogs were bred to help in hunting. Which specific characteristics were bred for in:
  - (a) hounds?
  - (b) terriers?
  - (c) setters and spaniels?

3. Which dogs were bred for protection?

4. How would you go about breeding a dog that would make a good house pet? What characteristics would you look for?



## Word **CONNECT**

Have you ever heard of *beefalo*? Beefalo are a cross between bison and domestic cattle. Unlike domestic cattle, beefalo have thick fur, which protects them from cold temperatures. Another advantage of beefalo is that the meat is low in fat and cholesterol. If you could develop a cross-breed, what would it be? Describe this new breed's characteristics and give it a name.

## Artificial Selection in Agriculture

Our hunter-gatherer ancestors began planting seeds in order to have a reliable source of food. Wheat and barley, members of the grass family, were among the first plants that were grown for food. Archaeologists have found samples of these plants in the sites of some of the oldest settlements in the Middle East. Although 80 different plants were domesticated during prehistoric times, today only a few make up the majority of the world's food supply. Wheat and rice alone provide 40% of our food energy.

The science of plant breeding is an important part of agriculture. By choosing individual plants with desirable traits, scientists use **selective breeding** to bring the positive characteristics of two different varieties together. Selective breeding was used to create specific varieties of Canada Western Red Spring Wheat. Wheat flour from this class of wheat is commonly used to make pan bread. Researchers have developed varieties that produce high quantities of flour that is high in protein. In contrast, Canadian Western Amber Durum wheat flour is good for making pasta. One new variety of this wheat has improved cooking qualities and a pleasant yellow colour. Researchers stationed throughout the country work to find out what kind of wheat will grow the best in their region. Some wheat varieties have been bred to mature faster than others or resist colder temperatures and early frost. Others are resistant to insects and diseases. By breeding plants that produce good-quality flour with plants adapted to specific locales, researchers have developed valuable crop plants.

## STRETCH Your Mind

Organism	Energy (kJ/m <sup>2</sup> /year)
wheat cereal	3400
rice or rice cereal	5200
carrots	3400
milk	1800
eggs	840
beef (feedlot)	550

This table lists the average amount of energy, in kilojoules (kJ) per square metre of land per year, in different organisms that people use for food. Assume that 800 kJ of each organism is consumed in one meal. Team up with another student to calculate the area needed to produce 800 kJ of food energy from wheat and 800 kJ from beef in one year.

**Figure 1.55** Canada is one of the major suppliers of wheat to the world. We grow about 20 billion tonnes of wheat each year, and export about 14 billion tonnes. Most of the wheat grown in Canada is one of two different species, but there are also many other varieties grown for specific uses.



## INTERNET **CONNECT**

[www.mcgrawhill.ca/links/sciencefocus9](http://www.mcgrawhill.ca/links/sciencefocus9)

Conduct research on how Canadian scientists have developed cold-tolerant varieties of wheat, triticale, and rye. Go to the web site above, and click on **Web Links** to find out where to go next. Write a short report on how one of the crops mentioned above was developed.



## DidYouKnow?

Agriculture is only about 10 000 years old. Prior to that time our ancestors were mostly hunters and gatherers. Groups of people moved from place to place hunting available game and gathering edible plants. Farming (and the ability to stay in one place) is believed to have originated in an area called the “fertile crescent.” This area included the land between the Tigris and Euphrates rivers, which contained rich soil that was suitable for growing crops.



## Thoughts on Food

### Procedure

Examine the pictures of the different types of cattle.

beef cattle



## Find Out **ACTIVITY**



Jersey cow

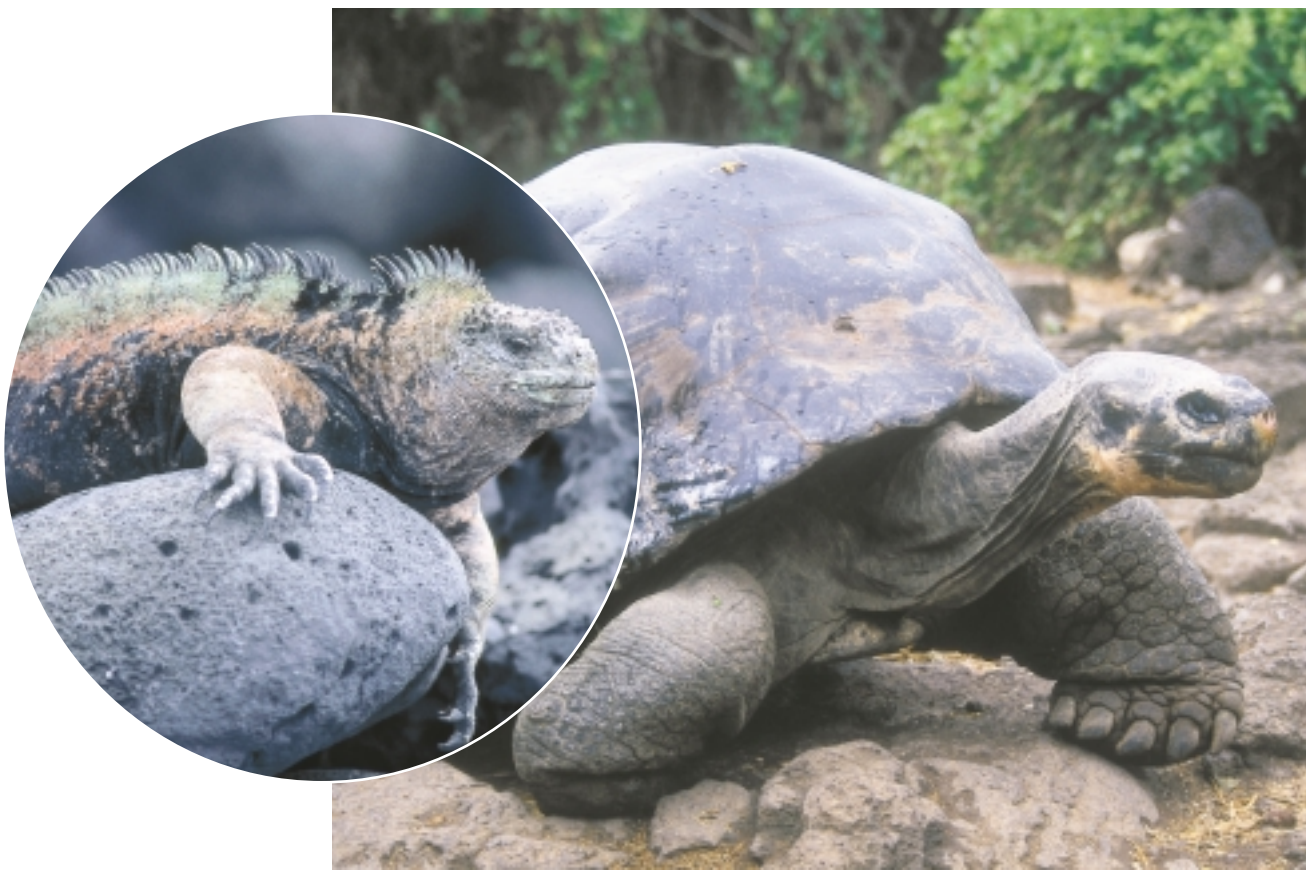
### What Did You Find Out? **Analyzing and Interpreting**

1. What characteristics do you think were selected for in each type of cattle?
2. How does the sex of the animal affect its function?
3. Are all of the differences between the two kinds of cattle due to selective breeding? What else could account for these differences?

4. **Apply** What are some ways in which farmers can produce beef cattle with very tender meat?

### Extension

5. There are many cattle breeds. Choose one to research on the Internet. Find out what traits this variety is bred for and what makes it different from other breeds. Design a one-page “Wanted” ad to describe this breed of cattle.



**Figure 1.56** This iguana (left) and tortoise (right) are just two of the many unusual species adapted to life on the Galápagos Islands. Naturalist Charles Darwin was very interested in the biological diversity he found in this region.

## Accounting for Biological Diversity

When the H.M.S. *Beagle* set sail to map the coast of South America in 1831, 22-year-old Charles Darwin was aboard. During the five-year voyage, which would eventually take the crew around the world, Darwin explored and gathered specimens from a wide variety of habitats. The Galápagos Islands off the west coast of South America were just one stop on a long voyage, but these islands would be permanently linked to Darwin and his theory. When the *Beagle* returned to England, Darwin tried to make sense of his observations. In 1859 he published his most influential book, *Origin of Species by Means of Natural Selection*.



Discuss with your group how you could monitor and record the plant life in an area before making a decision about burning a forested area.

### DidYouKnow?

Charles Darwin was born into a family of doctors in 1809 in Shrewsbury, England. He was educated in his home town before being sent to university to become a doctor like his father and grandfather. However, Darwin was a terrible student and preferred to spend his time exploring the surrounding woods. He particularly disliked medical school, which he eventually quit. Convinced that Darwin would never be a success, his father sent him to study theology at Cambridge in the hope that Darwin would become a church minister. Darwin did graduate, but later signed on as “gentleman naturalist” of the H.M.S. *Beagle* — against his father’s wishes.

# Diversity in the Galápagos

## Think About It

The chart below was taken from *Darwin's Journal During the Voyage of the H.M.S. "Beagle" Round the World*. The table was composed of data gathered by Darwin and other naturalists. At the time, Darwin had no explanation of the results.

The Plants of the Galápagos Islands

Name of Island	Number of Plant Species			
	A	B	C	D
James Island	71	33	38	30
Albemarle Island	46	18	26	22
Chatham Island	32	16	16	12
Charles Island	68	39	29	21

A = Total number of plant species found on this island

B = Number of plant species found in other parts of the world

C = Number of plant species found only on the Galápagos Archipelago

D = Number of plant species found only on this island



A cactus finch feeds from a cactus plant.

## Analyze

1. Draw a bar graph to illustrate the data from the chart above. The data for each island should be represented using four bars (A–D).
2. Is it likely that plants found growing on the Galápagos could also be found growing where you live? Explain your thinking. How might the data above be used to support your answer?
3. Darwin found these results “striking,” and pointed out that most of the islands were within sight of each other, in the same climate, and formed from the same rock. Which is the most “striking” column in the above chart? Explain your reasoning.
4. Can you offer an explanation for the data?

## Extend Your Skills

5. Make a hypothesis about the more “striking” data. Devise a way of testing your hypothesis.

### Skill

### FOCUS

For tips on drawing bar graphs turn to SkillFocus 10.

### INTERNET CONNECT

[www.mcgrawhill.ca/links/sciencefocus9](http://www.mcgrawhill.ca/links/sciencefocus9)

Which species are unique to the Galápagos? What threats from human activities do these species face? To answer these questions, go to the web site above, and click on **Web Links** to find out where to go next. Create a poster to illustrate what you have learned about one species unique to the Galápagos. You may use a computer to create your poster.



## Did You Know?

Darwin was hesitant to publish *The Origin of Species by Means of Natural Selection*. He knew that the book would generate controversy because it attempted to explain how the process of evolution occurred. Many people in England and the rest of the world felt that this theory disagreed with their religious beliefs.

## Pause & Reflect

Illustrate the evolution of an organism of your choice using models, posters, or video presentation. Organize your ideas by making notes in your Science Log.

## The Theory of Natural Selection

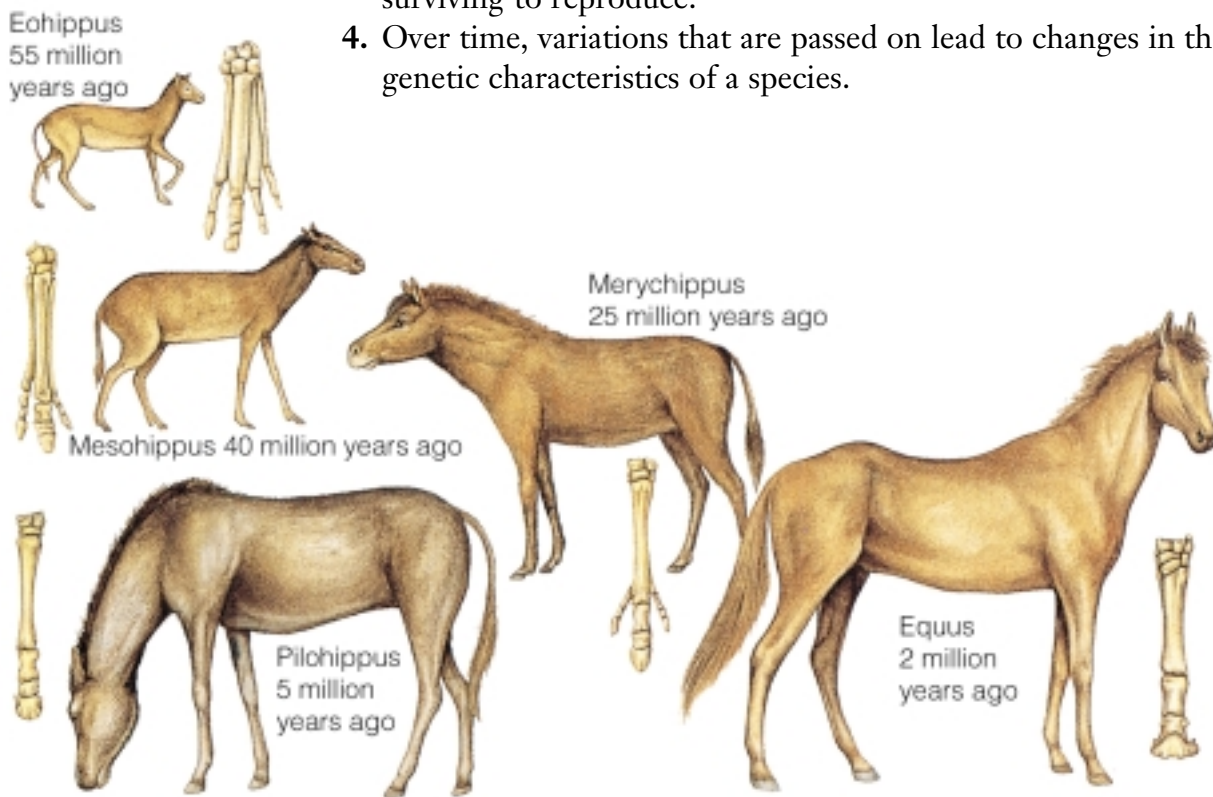
When Darwin tried to explain the diversity of life in the Galápagos, he began to think about artificial selection. He spoke with farmers and breeders about breeding cattle, horses, and other domestic animals. Darwin himself raised fancy pigeons and knew that artificial selection could produce great diversity, even within a species. Darwin developed a theory of **natural selection** to explain how a process closely related to artificial selection occurred in nature. Around the same time, biologist Alfred Wallace had also made similar conclusions. The Galápagos finches provided a good illustration of how the fittest, or best-adapted, organisms for a specific environment survived.



**Figure 1.57** Pigeon fanciers have developed diverse breeds of pigeons. Some of the pigeons have been bred for racing. Other varieties come in various forms and colours.

The theory of natural selection can be summed up in four statements:

1. All organisms produce more offspring than can possibly survive.
2. There is incredible variation within each species.
3. Some of these variations increase the chances of an organism surviving to reproduce.
4. Over time, variations that are passed on lead to changes in the genetic characteristics of a species.



different from its ancestors. Horse breeders have made further changes using artificial selection.

## Did You Know?

Can you spot the peppered moth? Birds are more likely to prey on the moths that are easier to see. Light-coloured peppered moths are hard to detect on tree trunks covered with white lichen. In mid nineteenth-century England, soot from industrial pollution covered the trees. The once rare, dark-coloured moths became predominant. When air became cleaner in the 1970s, the light-coloured moth became common once again. People were able to influence natural selection by causing changes in the environment.



## STRETCH Your Mind

Suppose a group of children that attend a local day care have become ill with ear infections. All of the children are treated with the antibiotic methicillin. After a few days, all of the children, except one, are well. The following week, most of the children are sick again. This time, none of the children get better after taking methicillin. Why? How is this situation an “unnatural example of natural selection”?

## TOPIC 6 Review

1. Which animal would you guess is the ancestor of the domestic pig? Explain your answer. (Hint: see the photo below.)
2. How do artificial and natural selection contribute to biological diversity?
3. Why does artificial selection produce changes in organisms faster than natural selection?
4. Game farms in Canada raise animals such as deer and elk. Explain how elk bred on game farms are the result of both natural and artificial selection.
5. Purebred animals are sometimes very unhealthy. For example, Great Danes often have weak hearts and Dalmations commonly become deaf.
  - (a) Would you expect to see similar health problems in wild animals? Explain your answer.
  - (b) What are the advantages and disadvantages to owning a purebred animal compared to a mixed breed?

