crush and open the hard seeds. Unfortunately, finches that have beaks that are neither long nor dense may slowly begin to decline in number because they are limited in their ability to obtain nutrients. Finches that obtain food can put energy into reproduction and survival needs. When those finches reproduce, they pass along those adaptations that allow them to be successful in their respective feeding environments. Over time two distinct groups may arise, those with thick, dense beaks and those with longer skinnier beaks (Figure 1.5). If these individuals genetically change in such a way that they no longer can interbreed with one another, a speciation event will have occurred.

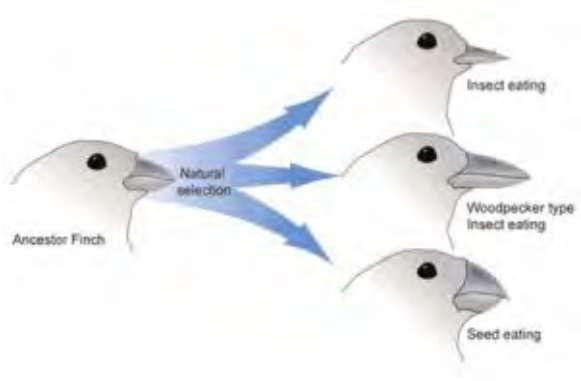

Figure 1.5 Different finch phenotype variations due to environmental changes. (credit: National Human Genome Research Institute's Talking Glossary/Wikimedia Commons)

Growth and Development

Development is often described as the processes that an individual goes through as it grows and matures. For example, in humans, development begins once the sperm fertilizes the egg. Human development can be broken down into different stages including embryonic development, fetal development, infancy, childhood, puberty, and adulthood. Development can also be observed in many other organisms. For example, butterflies go through a developmental process called metamorphosis that begins at the egg stage and then proceeds to the larva, pupa, and adult stages.

Both multicellular and single-celled organisms grow and develop according to specific instructions encoded in their DNA. DNA is organized into genes that provide information for cellular growth and development. An individual's DNA ensures that a species' young (Figure 1.6) will grow up to exhibit many of the same traits as its parents.

Figure 1.6 Although no two looks alike, these kittens have inherited genes from both parents and share many of the same characteristics. (credit: Pieter & Renée Lanser/ Concepts of Biology OpenStax)

Homeostasis

Even the smallest organisms are complex and require multiple regulatory mechanisms to coordinate internal functions, such as the transport of nutrients (Figure 1.7), response to stimuli, and coping with environmental stresses. **Homeostasis** or "steady state" is the ability of an organism to regulate and maintain constant internal conditions.

Figure 1.7 Human circulatory system plays an important role in transporting oxygen, removal of waste, and delivering nutrients to every cell. (credit: Public domain/Wikimedia Commons)

Cells require appropriate conditions such as proper temperature, pH, and concentrations of nutrients to function correctly. Although these conditions may change, organisms can maintain internal conditions within a narrow range. For example, many organisms regulate their body temperature in a process known as thermoregulation. Organisms that live in cold climates, such as the polar bear (Figure 1.8), have body structures such as thick layers of fur or fat, which help them withstand low temperatures and conserve body heat. In hot climates, plants carry out unique versions of photosynthesis to reduce water loss and optimize their potential of making sugar.

a b

Figure 1.8a. Polar bears and other mammals living in ice-covered regions keep their body temperature relatively constant, even though the environment can be very hot during the day and cold at night. (credit: "longhorndave"/Flickr) b. Polar bear maintain their body temperature by generating heat and reducing heat loss through thick fur and a dense layer of fat under their skin. In this infrared image the polar bear's body heat hardly registers; only the uninsulated eyes and mouth show temperatures significantly warmer than the environment. (credit: Arno/Coen/Wikimedia Commons)

Organisms like humans (Figure 1.9), use their skeletal muscles to generate heat. The contraction of skeletal muscles helps humans maintain stable internal body temperature as environmental conditions fluctuate. If body temperature drops below a certain point, metabolism begins to slow and may even stop, leading to death. Conversely, if body temperature rises above a certain point, it can lead to the destruction of key molecules called proteins. Students that continue and take Anatomy and Physiology classes will spend time discussing how the body works to maintain homeostasis. Students will also look at what occurs when the body loses its ability to maintain stable internal conditions, otherwise referred to as a homeostatic imbalance.

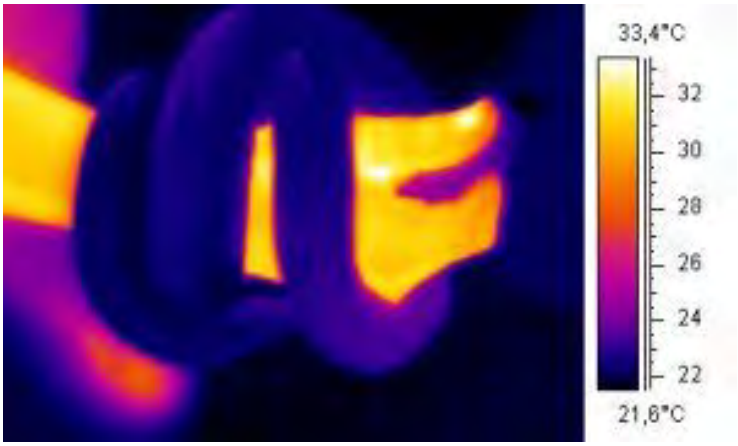

Figure 1.9 Thermogram of a snake wrapped around a human arm. (credit: Arno/Coen/Wikimedia Commons)

Energy Processing

All organisms, including the California condor shown in Figure 1.10, use a source of energy for their metabolic activities. Some organisms can obtain energy through metabolic pathways such as photosynthesis. Photosynthesis is a process where light energy can be captured and converted into chemical energy. Organisms that are capable of making their own chemical energy are referred to as **autotrophs**. Others must obtain their chemical energy by consuming other organisms. These individuals are referred to as **heterotrophs**. Regardless of whether an organism is an autotroph or a heterotroph, all living cells must have energy to drive metabolism.

Figure 1.10 A lot of energy is required for a California condor to fly. (credit: Pacific Southwest Region U.S. Fish and Wildlife/ Concepts of Biology OpenStax)