Glossary

alignment: Information lined up to show similarities or differences between different samples. Using complicated computer models, scientists create alignments of genetic sequences or amino acids and then use them to develop evolutionary trees.

allele: Different forms of the same gene or stretch of DNA. New alleles form through mutations. Sometimes, different forms of a gene or stretch of DNA cause different phenotypes.

ancestral state: The characteristic that was found in a common ancestor of two or more organisms. For example, suppose there are two species of plant, one with yellow flowers and one with red flowers. Scientists may use evidence to infer that the common ancestor of the two species also had a red flower. Red flowers would be the ancestral state.

aniridia: A rare genetic disease in humans caused by mutations to the *Pax6* gene. People with aniridia are missing part of the iris in the eye. People with aniridia are heterozygous for a working *Pax6* gene. They often also have other problems with their eyes.

antigenic drift: One type of evolutionary change in influenza viruses that results in relatively small changes among influenza strains from year to year.

antigenic shift: One type of evolutionary change in influenza viruses that occurs when a new strain of influenza differs substantially from strains that have recently circulated. In the examples known to date, this has resulted from "reassortment" of genetic material from two or more influenza viruses. In this reassortment, some of the genetic material comes from one virus and the rest comes from a different virus or multiple viruses.

endocytosis: A process in which a cell takes in materials from outside the cell by folding in the plasma membrane.

epidemiology: The study of diseases in a population. Scientists look for patterns in a disease to determine its cause and to find ways to prevent the disease.

evolution: Broadly, change over time. In biology, evolution is the change over time in the frequency of alleles in a population.

evolutionary tree: A diagram that summarizes the relationships among different organisms. These diagrams are based on evidence. Scientists revise them when new evidence indicates different relationships.

evoprint: A diagram that summarizes the similarities and differences in a genetic sequence for multiple species.

hemagglutinin: A protein in influenza viruses that helps the virus get inside host cells.

heritable: The degree to which a trait can be passed from parents to offspring. A trait that is highly heritable is controlled by genes.

heterozygote advantage: A situation in which individuals that have two different forms of a gene have relatively higher survival or reproductive rates compared to individuals that have one form of the gene.

homology: When two or more species have a trait that came from a common ancestor. Scientists use evidence to determine homology.

influenza: A disease caused by the influenza virus. The disease is often called the flu. Influenza is highly contagious. The influenza virus infects lung cells and causes respiratory problems. The illness caused by the influenza virus can be mild, severe, or even fatal. A wide range of influenza viruses infects birds; a smaller range infects humans.

lactase: An enzyme that breaks down the sugar lactose into two simpler sugars.

lactase nonpersistence: The condition in which individuals stop making the lactase enzyme sometime in their lives. Most human infants make lactase. After infancy, some people stop making the enzyme.

lactase persistence: The condition in which individuals make the lactase enzyme throughout their lives.

lactose intolerant: Individuals who are unable to digest the lactose sugar in milk or dairy products. When lactose intolerant individuals ingest foods with lactose, they have symptoms that can be mild or severe. Symptoms include gas, diarrhea, and pain in the abdomen. Lactose intolerant individuals are often lactase nonpersistent.

lactose tolerant: Individuals who can digest the sugar called lactose. Lactose is found in milk and other dairy products. Lactose is broken down by the enzyme lactase. People who are lactose tolerant are lactase persistent.

lineage: A line of populations or species that are connected over time. The group may contain a single species, a single population, or a group of species.

malaria: An infectious disease caused by a parasite spread to humans by mosquitoes. Symptoms of malaria include fever, chills, flulike symptoms, and anemia. Malaria causes about 1 million deaths per year, mostly in children.

methicillin-resistant *Staphylococcus aureus* (MRSA): A strain of bacteria that is not killed by methicillin, a specific type of antibiotic.

model species: Animals or other organisms that scientists often use in medical research. Information learned from experiments in these species helps researchers better understand human health and disease. This is because humans share many features with other organisms due to common ancestry. Examples of model species are mice, fruit flies, zebrafish, and the bacterium *Escherichia coli*. They are sometimes referred to as "model organisms."

mutation: Any change to genetic information in an individual. This can include changing one nucleotide, deleting nucleotides, or adding new nucleotides. Mutations cause variation among different individuals. Mutations occur randomly. Most mutations are harmful, but some can be helpful to individuals.

natural selection: A process that can cause evolution. This process can result in adaptations. It can be summarized as five principles:

1. **variation:** Individuals within a population vary in many traits, including physical and biochemical traits.
2. **inheritance:** Some of the differences in traits among individuals can be passed from parents to offspring. (Some variation is heritable.)
3. **origin of variation:** Some of the variation in traits among individuals has a genetic basis. This variation originated, often many generations ago, as mutations—changes in the genetic information that are random with respect to the needs of the organism.
4. **fitness:** Both the environment and the traits that individuals possess affect survival and reproduction. Individuals with heritable traits that enable them to better survive and reproduce in a particular environment will leave relatively more offspring.
5. **evolutionary change in populations:** The frequency of traits and the alleles that affect those traits change in a population over time.

population: All the individuals from one species living in one area.

positive selection: A type of natural selection. In positive selection, a new form of a gene (allele), and the protein it produces, is favored. The new form of the gene spreads quickly within a population.

purifying selection: A type of natural selection. This type of selection eliminates or decreases the frequency of mutations to a gene that have a negative effect. In other words, the mutations cause serious health problems or death to individuals who have them. Natural selection then eliminates these mutations from a population.

substitution: The replacement of one nucleotide with another within a lineage of organisms. For example, the DNA nucleotide A (adenine) may be replaced with nucleotide C (cytosine) in one species of organisms.

thalassemia: A genetic disease that causes anemia. Thalassemia results from mutations in the alpha-globin gene that produces the alpha-hemoglobin protein. The disease is more severe if a person has more alleles of the alpha-globin gene that do not work correctly. A person who has one nonfunctional allele has few symptoms; someone with no functional alelles of the alpha-globin gene usually dies before or soon after birth.

Van der Woude syndrome: A genetic disease that is one cause of cleft lip and palate. Mutations to the *Irf6* gene cause the syndrome.

variation: Differences among individuals for some trait in a population. For example, some frogs in a population might have longer legs than others do. The differing leg lengths is variation.