

Living Systems

All living things...

- | | |
|---------------------------|----------------------------------|
| 1. are made up of cells. | 4. are able to reproduce. |
| 2. grow and develop. | 5. respond to their environment. |
| 3. obtain and use energy. | 6. adapt to their environment. |

Examples:

All animals are **living** things.

Stereos are **nonliving** things

All plants are **living** things

Trains are **nonliving** things

Living systems are organized by level of complexity, i.e., cells, tissues, organs, and systems.

cells -the basic building block of all living things

tissue -a group of similar cells that perform a common function

organ -a structure composed of a number of tissues that work together to perform a specific task

The Nervous System -The system of cells, tissues, and organs that regulates the body's responses to internal and external stimuli. In vertebrates it consists of the brain, spinal cord, nerves, ganglia, and parts of the receptor and effector organs.

The Circulatory System -The system composed of the heart, arteries, capillaries and veins. It serves to transport blood low in oxygen from the body to the lungs and heart (veins) and oxygenated blood from the lungs and heart throughout the body (arteries). (see heart, blood).

The Respiratory System -The system of organs that are involved in breathing. These include the nose, throat, larynx, trachea, bronchi, and lungs.

The Digestive System -The system of organs that are responsible for getting food into and out of the body and for making use of food to keep the body healthy. These include the mouth, esophagus, stomach, liver, gallbladder, pancreas, small intestine, colon, and rectum.

The Immune System -The body system, made up of many organs and cells, that defends the body against infection, disease and foreign substances.

The Endocrine System -The system of glands that release their secretions (hormones) directly into the circulatory system. It controls your metabolism.

Together, all of these systems help an organism maintain a stable internal environment; they work together to maintain *homeostasis*.

Human Growth & Development

In humans, the male reproductive system produces gametes called sperm, and the female reproductive system produces gametes called eggs. A sperm and egg fuse during the process of **fertilization**. Fertilization occurs inside a female's fallopian tube.

Once the egg is fertilized, it becomes a new type of cell called a **zygote**. A zygote is a cell that is capable of developing into a new human being. A zygote has a full set of DNA – half was received from the mother and half was received from the father.

The zygote travels down the fallopian tube to the female's uterus. During this journey, the zygote undergoes cell division many times and becomes an embryo. An **embryo** is an organism in the earliest stage of its development.

When the embryo reaches the uterus, it implants itself in the uterus's wall. Over the course of nine months, the embryo will develop into a fetus. Then, the mother will give birth to the fetus. **Birth** is the process in which a fetus leaves its mother's body.

When the fetus is born, it is an infant. An **infant** is a human being in its earliest stage of life. Infancy lasts from birth to 1 year of age. Over that first year of life, the infant grows rapidly and becomes more coordinated. As you can see in the chart below, infants develop into toddlers before entering childhood, adolescence, and finally adulthood.

Stage of Life	Approximate Age Range	Description
Infancy	0 - 1	When infants are born, they are almost completely helpless. Their muscles are not strong enough for most movements.
Toddler	1 - 2	When an infant begins to walk, it becomes a toddler.
Childhood	2 - 10	Childhood is characterized by rapid growth and mental develop. During this period baby teeth are shed for permanent teeth.
Adolescence	11 - 19	During adolescence, the body continues to grow and mature. Adolescents also begin to develop the ability of complex thought.
Adulthood	20 +	Adulthood is the peak of physical and mental development.

Sexual & Asexual Reproduction

Reproduction is the process by which an organism passes its genetic information to its offspring. The two main types of reproduction are **sexual reproduction** and **asexual reproduction**.

Asexual Reproduction

Asexual reproduction is generally used by simple organisms, such as bacteria. In asexual reproduction, an organism produces an **identical copy** of itself. Only **one parent** is required for asexual reproduction, and the offspring and the parent are exactly the same. In general, asexual reproduction is **quicker** and **simpler** than sexual reproduction. Since the members of an asexually-reproducing population are identical, the population does not usually survive a major change in its environment.

Types of Asexual Reproduction:

Fission - a single-celled organism divides into two.

Budding - an offspring forms from an outgrowth of its parent.

Regeneration - a part of a parent organism is removed and forms into an offspring.

Conjugation - two bacterial cells join together, exchange genetic information, then separate. When the bacterium later divides asexually, the result is two daughter cells with genetic information that is unique from the parent cell.

Sexual Reproduction

Sexual reproduction is generally used by complex organisms, such as humans. A sexually-reproducing organism produces unique sex cells called *gametes*. A gamete contains **half** of an organism's genetic material. In sexual reproduction, the gamete of one organism is combined with the gamete of another organism to produce a unique offspring. So, sexual reproduction requires **two parents**. Since the offspring receives half of its genes from each parent, the offspring is **not identical** to either parent. In this way, sexual reproduction produces **more genetic diversity** throughout a species than asexual reproduction.

Genes

The instructions, or code, that is responsible for all the inherited traits of an organism is held in **genetic material** called **DNA**.

A **gene** can be defined as a basic unit of hereditary information. It refers to a specific segment of DNA that influences a particular trait or group of traits.

All of your inherited traits are the result of your genes. You received half of your genes from your mother and half from your father. In many other species, genes are passed to an offspring from one parent only.

So, what is a gene? In general, a gene refers to a specific segment of an organism's DNA.

The unique DNA code in that segment influences one or more traits of the organism.

Sometimes, a single gene can control a single trait. Sometimes, multiple genes work together to control a single trait. Sometimes, a single gene can influence many traits.

It is important to know how genetic material is organized. A gene is one "piece" of a DNA molecule. A molecule of DNA is "packaged" and carried by a larger molecule called a **chromosome**. The **genome** of an organism refers to its complete genetic makeup and includes the organism's entire set of chromosomes. A human has a total of 46 chromosomes: 23 chromosomes come from the mother and 23 come from the father.

In the cell of a sexually-reproducing organism, a pair of similar chromosomes with the same genes in the same locations is known as a homologous pair.

Homologous pairs are found in diploid cells. Each member of the pair was received from one of the organism's parents.

The genes on a pair of homologous chromosomes often have alternate forms, or alleles, which influence the organism's traits.

Gene Expression

Genes are responsible for all the inherited traits of an organism. The way genes interact to produce an organism's traits is called **gene expression**.

Vocabulary

Gene - a basic unit of hereditary information. It refers to a specific segment of DNA that influences a particular trait or group of traits.

Trait - a characteristic of an organism (e.g., hair color).

Alleles - alternate forms of a particular gene. Alleles of a particular gene influence the same trait, occur at the same location on a chromosome, but have slightly different chemical structures, resulting in different expressions of the trait.

Dominant/Recessive Pattern - some traits follow a dominant/recessive pattern of inheritance. In this pattern, the trait produced by one allele "masks" the trait produced by the other allele.

Dominant Allele - the trait produced by a dominant allele "masks" the trait produced by the recessive allele. If an organism always expresses a trait when it has the allele for that trait, then the allele is dominant.

Recessive Allele - the trait produced by a recessive allele gets "masked" by the trait produced by the dominant allele. If an organism does not necessarily express a trait when it has the allele for that trait, then the allele is recessive. The only time a recessive trait can be expressed is when a person has two copies of the recessive allele (homozygous recessive).

Homozygous - an organism that contains two of the same alleles for a trait is said to be homozygous for that trait.

Heterozygous - an organism that contains two different alleles for a trait is said to be heterozygous for that trait.

Genotype - the genetic makeup of an organism (set of alleles present).

Phenotype - the observable traits of an organism that result from its genotype.

Example of Dominant/Recessive Pattern

The allele that produces brown eyes is dominant to the allele that produces blue eyes. Let's represent the allele for brown eyes with a B and the allele for blue eyes with a b .

What eye color would a child have if his mother is homozygous dominant (BB) and his father is homozygous recessive (bb)?

The child will receive half of his genetic information from his mother (B) and half from his father (b), so the child will be heterozygous (Bb). Since the allele for brown eyes is **dominant** to the allele for blue eyes, the child will have **brown** eyes.

Genes & Heredity

In **incomplete dominance**, an individual that is heterozygous for a trait will exhibit an intermediate version of the trait. In other words, the trait will appear to be "in-between" the pure recessive trait and the pure dominant trait.

Example:

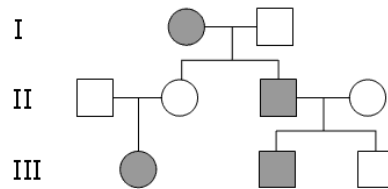
In snapdragon flowers, the allele for red petals (R) is dominant to the allele for white petals (r). So, a snapdragon that is homozygous dominant (RR) will have red petals, and a snapdragon that is homozygous recessive (rr) will have white petals.

A snapdragon that is heterozygous (Rr) will not have red petals. Instead, it will have pink petals. The pink petals are a blend of the red (from the dominant allele) and the white (from the recessive allele). This is an example of incomplete dominance.

Pedigree Analysis

A **pedigree chart** is a chart that shows two types of information: (1) how members of a family are related to each other, and (2) which members of the family express a certain trait or set of traits.

A sample of a pedigree chart is shown below:



On a pedigree chart, each generation is represented by a Roman numeral on the side. In the chart above, 3 generations are shown.

Males are represented with squares and females are represented with circles.

Mates are represented using a horizontal line between the symbols.

An offspring is represented by a vertical line that connects to the union of its parents.

Siblings are represented by multiple vertical lines that are connected together with a horizontal line above the symbols. A vertical line connects this horizontal line to the union of the parents.

Human Traits

Human traits are influenced by inheritance, environmental factors, and lifestyle choices.

Inheritance - Inherited traits are traits that are passed to a child from both of the parents through genetic material. Examples of inherited traits are eye color, bone structure, and genetic diseases.

Environmental factors - Environment can play a large role in influencing a person's traits. For example, the amount and types of food that are most available in a person's environment can have a major effect on the person's height, weight, and overall health.

Lifestyle choices - Lifestyle choices can also play a large role in influencing a person's traits. For example, a boy may have inherited brown hair from his parents, but he may choose to dye his hair a different color.

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