Getting the Idea

Why do children tend to look like their parents in one way or another? People look like their parents because they inherit chemical recipes, or DNA, from each parent. Because they get DNA from the same parents, brothers and sisters also tend to look alike.

Traits and Heredity

A trait is any characteristic of an organism, such as its body shape or what it eats. Organisms get many characteristics from their parents. Heredity is the passing of traits from one generation to the next. Organisms inherit traits when parents pass their genetic information, or DNA, to their offspring during reproduction.

Most plants and animals reproduce sexually. Sexual reproduction requires the joining of specialized cells from two parents. These cells—sperm and eggs—are often called sex cells. Each sex cell carries half the genetic information needed to make an offspring. You will learn more about sexual reproduction in the next lesson.

DNA, Chromosomes, and Genes

DNA determines what traits are passed from one generation to the next. DNA, or deoxyribonucleic acid, is a large molecule found in all living things. DNA is located in the cell nucleus. When a cell divides, it makes a copy of its DNA for each new cell. This gives each new cell all the genetic information it needs.

A molecule of DNA is very long. To fit inside the nucleus, DNA wraps around proteins and forms tight coils. These tightly coiled structures that contain the genetic information are called chromosomes.

Did You Know?

The nucleus of a single human cell contains more than one meter of DNA.
Each chromosome carries information for many traits. A gene is a segment of DNA that determines a trait. Since chromosomes are made of DNA, genes are found on chromosomes. The diagram illustrates the relationship between genes, chromosomes, and DNA.

**Genes and Inherited Traits**

Genes determine what traits an organism inherits. Your genes are why you have arms and legs, not fins or wings. Fur or hair color, eye color, flower color, and many other traits are controlled by the genes an organism inherits from its parents. Those genes produce the traits that distinguish one individual from another.

Genes for a specific trait usually come in two or more forms. Each form is called an allele. The different alleles of a gene produce different results, such as brown or black hair.

During sexual reproduction, offspring receive chromosomes from both parents. This gives each offspring a unique combination of genes. Because different alleles produce different traits, an organism's genes can be described in two ways: as a genotype or a phenotype. **Genotype** refers to the genes an organism carries. The organism's physical traits are its phenotype. That is, **phenotype** refers to the way genes are expressed. The difference between genotype and phenotype will become clearer in the next section.
Dominant versus Recessive Traits

Many inherited traits are controlled by a single gene. However, this gene can have different forms or alleles. For example, humans have a gene for earlobe shape. One form of this gene causes earlobes to be attached to the head. Another form causes the earlobes to hang freely. Whether you have dimples is also the result of a single gene that comes in two forms.

In sexual reproduction, offspring inherit two alleles for each trait—one from each parent. Usually, the trait carried by one allele is dominant over the other. A dominant trait is a trait that is always expressed in the phenotype of an organism. That is, if the organism has that allele, it will show the trait.

Other alleles are recessive. A recessive trait is expressed only when two recessive alleles are present. If an offspring receives one dominant allele and one recessive allele for a trait, the recessive trait is not expressed.

The table below lists some dominant and recessive traits in humans.

<table>
<thead>
<tr>
<th>Trait</th>
<th>Dominant</th>
<th>Recessive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hairline</td>
<td>Widow’s peak</td>
<td>Straight</td>
</tr>
<tr>
<td>Color vision</td>
<td>Normal vision</td>
<td>Color-blindness</td>
</tr>
<tr>
<td>Dimples</td>
<td>Having dimples</td>
<td>No dimples</td>
</tr>
<tr>
<td>Earlobes</td>
<td>Free</td>
<td>Attached</td>
</tr>
</tbody>
</table>

Inheriting Genotypes

Each pair of genes is part of an individual’s genotype. The genotype identifies the organism’s alleles. Genotypes are written as two letters. Dominant alleles are shown by capital letters. Recessive alleles are shown by lowercase letters. In humans, the allele for free earlobes is dominant over the allele for attached earlobes. So F is used to show the free earlobe allele, and f is used for the attached earlobe allele.
Since each parent contributes one allele for each gene, an offspring can have three possible genotypes: FF, ff, or Ff. When an organism has a dominant allele, it will have the dominant trait. Since free earlobes are dominant, the genotypes FF and Ff both produce the free earlobe phenotype. Since attached earlobes are recessive, that phenotype appears only when a person has two recessive alleles. The genotype for attached earlobes is ff.

**Discussion Question**

Some people look more like their cousins than others. Why do you think this happens?

**Lesson Review**

1. What are two forms of the same gene called?
   - A. phenotypes
   - B. genotypes
   - C. dominant traits
   - D. alleles

2. In humans, having dimples is a dominant trait. You meet a person and notice that she does not have dimples. What can you conclude about this person?
   - A. She has inherited two recessive alleles for the dimples trait.
   - B. She has inherited one recessive allele for the dimples trait.
   - C. She has inherited two dominant alleles for the dimples trait.
   - D. She has inherited one dominant allele for the dimples trait.

3. Where are an organism’s chromosomes located?
   - A. on the genes
   - B. on the alleles
   - C. in the cell membrane
   - D. in the nucleus