Lesson 11

Traits, Heredity, and Gene Expression

Key Words

heredity: the passing of traits from parent to offspring
dominant: gene that dominates, or masks, another gene for the same trait
recessive: gene that is not expressed when paired with a dominant gene
homozygous: organism that has two identical genes for a particular trait
heterozygous: organism that has two different genes for a particular trait

KEY IDEAS

Genes control the traits passed from generation to generation. More than one form of a gene may exist for a particular trait. By understanding how genes interact, it is possible to predict the inheritance of certain traits.

Blood type is just one of many traits passed from parents to their offspring. Certain tests performed by blood laboratory technicians indicate the blood type of an individual. This information is useful when giving blood transfusions. Blood typing can even help solve crimes.

Traits and Heredity. Gametes join to form a single cell through sexual reproduction. The new cell contains chromosomes from each parent. These chromosomes are made up of a series of genes. Genes determine which traits, or characteristics, the new organism will inherit from its parents. The passing of traits from parent to offspring is known as **heredity** (huh-REHD-ih-tee).

Some traits are controlled by two genes, or a *gene pair*. One gene is inherited from each parent. If one gene in the pair is **dominant** (DAHM-uh-nuhnt), that gene will mask the traits carried by the other gene. The organism will show the trait of the dominant gene. The gene whose traits are masked is said to be **recessive** (rih-SEHS-ihv). In some gene pairs, neither trait masks the other. The genes blend, showing a trait that is a combination of the two.

A **homozygous** (hoh-moh-ZY-guhs) organism has two genes that are alike for a particular trait. They can be either two dominant genes or two recessive genes. A **heterozygous** (heht-er-oh-ZY-guhs) organism has two genes that are different for a trait, one dominant and one recessive. A heterozygous organism shows the dominant form of the trait.

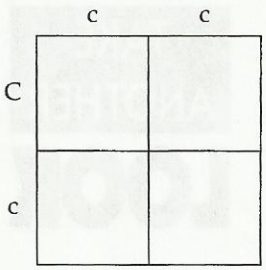
1. **How are heterozygous and homozygous organisms alike? How are they different?** _____

Predicting Traits. You can predict the traits an organism might inherit if you know what gene pairs its parents have. A Punnett square is a diagram that helps you make such predictions. Let's consider the trait for hair texture in humans. The gene for curly hair is dominant. The gene for straight hair is the recessive. A capital letter is always used to represent the dominant gene; a lower case letter is used to represent the recessive gene. In this case, **C** stands for curly hair and **c** stands for straight hair.

Assume that in our example, the mother is homozygous recessive for hair texture. Her genes are represented as **cc**.

Step 1: We write the first gene, **c**, of the mother's gene pair above the top left-hand square. The second **c** is written above the top right-hand square. In this example, the father is heterozygous for this trait. His genes are represented as **Cc**. We show this by writing **C** to the side of the upper left-hand square and **c** to the side of the lower left-hand square. See Fig. 11-1.

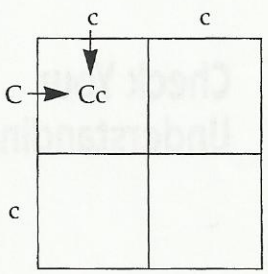
Fig. 11-1 Step 1



Next, we find the different combinations of genes that can be inherited by their child.

Step 2: In each square, we write the gene from the side of the square next to the gene from above the square. See Fig. 11-2. To the side of the top left-hand square is the first gene from the father's gene pair, **C**. Above the square is the first gene of the mother's gene pair, **c**. So, we write **Cc** in the top left-hand box.

Fig. 11-2 Step 2



Step 3: In the top right-hand box, we write the first gene from the father's pair and the second gene from the mother's pair. We write **Cc** in that square. See Fig. 11-3.

Step 4: To fill in the bottom left-hand box, we match the second gene of the pair from the square's side, **c**, with the first gene of the pair above, **c**. See Fig. 11-4

Step 5: To complete the square, we pair the second gene of the pair to the square's side, **c**, with the second gene from the pair above the square, **c**. See Fig. 11-5.

Fig. 11-3 Step 3

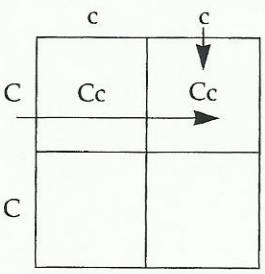


Fig. 11-4 Step 4

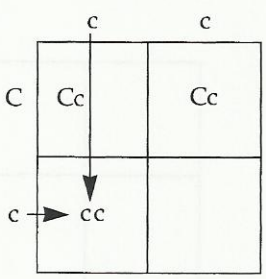
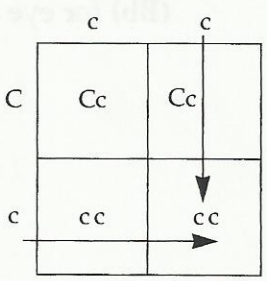


Fig. 11-5 Step 5



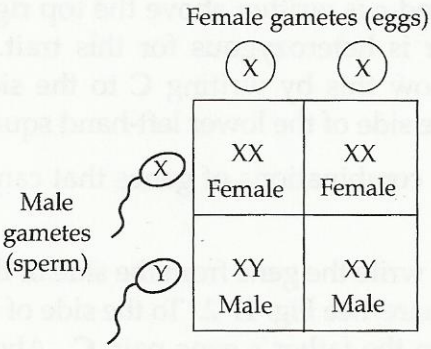
By using a Punnett square, you find that two gene combinations can result from these two parents. The offspring will either be heterozygous **(Cc)** or homozygous recessive **(cc)** for the trait of hair texture. The heterozygous person will have curly hair. The homozygous person will have straight hair.

Some traits are controlled by more than one gene pair. For example, a mix of four different gene pairs controls a person's skin color. Another human trait, gender, is determined by the absence or presence of a **Y** chromosome. All female gametes contain an **X** chromosome. Male gametes may contain either an **X** chromosome or a **Y** chromosome. If a female gamete joins with a male gamete containing an **X** chromosome, the offspring will be female **(XX)**. If a female gamete joins with a male gamete containing a **Y** chromosome, the offspring will be male **(XY)**.

TAKE ANOTHER LOOK

The process of sex, or gender, determination is shown in Fig. 11-6.

Fig. 11-6



Check Your Understanding

Write a sentence explaining the connection between each pair of words.

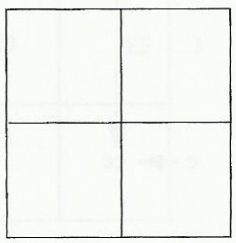
2. traits, heredity _____

_____

3. dominant, recessive _____

_____

4. The gene for brown eyes **(B)** is dominant over the gene for blue eyes **(b)**. Draw a completed Punnett square to show all possible gene combinations that may result from two parents who are heterozygous **(Bb)** for eye color.



Fill in the numbered blanks with a term from the list below.

dominant *homozygous* *heterozygous*
Punnett square *recessive*

A **(5)**_____ is a diagram that shows the possible gene combinations an offspring can inherit from its parents. A capital or upper case letter represents the **(6)**_____ gene. A lower case letter represents the **(7)**_____ gene. A gene pair represented by two capital letters shows the offspring is **(8)**_____ dominant for the trait. An uppercase and lowercase letter shows the offspring is **(9)**_____ for the trait.

10. Why do children often have traits similar to those of their parents?

_____

_____

_____

11. In pea plants, green peas are a recessive trait and yellow peas are a dominant trait. Explain how two plants with yellow peas can produce offspring with green peas. _____

_____

_____

12. How is the gender of an organism determined?

_____

_____

_____

13. Could a person with curly hair and a person with straight hair both be homozygous for the hair type trait? Explain.

_____

_____

_____