Chapter 8 General Science

Genetics: The Code of Life

**trait-** a characteristic that can be inherited from parents; it identifies an organism as an individual

**offspring-** a new organism that results from reproduction

**heredity-** the offspring of parents that have been crossbred

**crossbreeding-** the matching of parents that have been crossbred

**hybrid-** the offspring of parents that have been crossbred

**dominant-** describes a trait that will show its effect no matter the effect on its partner trait

**recessive-** describes a trait that will be masked by a dominant partner trait

**chromosome-** a threadlike structure in a cell nucleus that holds thousands of bits of information about an organism’s traits

**gene-** a bit of information in a chromosome

**mutation-** a change in the genetic code of an organism

**8-1 The Same But Different**

\* Have you ever wondered why you look the way you do? Do you look like some members of your family but not like others? Which features are like relatives?

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Which features are not like your relatives? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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How about your personality? Is it like any other family members? Describe.

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What is different about your personality than other family members? Describe.

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Which family member are you most like overall? Describe. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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A **trait** is a characteristic that can be inherited from parents. It identifies an organism as an individual. The way you look and act are traits. The color of your skin, hair, and eyes, and your height and shape are traits. You also have personality traits. Are you quiet or talkative? Are you careful or reckless? These are different personality traits.

\* Where do traits come from? All living things reproduce. This means that they produce new organisms to take their place when they die. For examples, humans have babies. Plants make seeds that grow into plants. These are **offspring.** Offspring get many of their traits from their parents.  **Heredity** contributes to many of your characteristics.

The Beginning of Genetics

\* Some basic laws of genetics were first discovered in the mid-1800s. An Austrian monk named Gregor Johann Mendel grew 22 different kinds of pea plants in his garden. He bred these plants to study how their traits were passed from parents to offspring. **Breeding** means producing offspring, especially with the idea of getting new or better kinds.

\* Some of his Mendel’s plants were short and bushy. Others were tall and climbing. Some plants had white flowers. Others had purple flowers. Some produced round seeds. Others produced wrinkled seeds.

\* Mendel used the pollen from a tall plant to pollinate a short plant. He was **crossbreeding**. He crossbred white-flowered plants with purple-flowered plants. Then he crossbred plants that had round seeds with plants that had wrinkled seeds. Thus, he created **hybrids**. Mendel was a teacher of both biology and physics.

What do you think his experiments resulted in?

Tall with short?

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Purple-flowers and white-flowers?

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Round seeds and wrinkled seeds?

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He chose to study the above characteristics because they were easy to observe and could be kept track of separately.

\* Mendel’s results may surprise you. When he crossed tall plants with short plants, he always got tall plants. When he crossed purple-flowered plants with white-colored plants, he always got purple-flowered plants. When he crossed round seeds with wrinkled seeds, he always got round seeds.

\* Mendel discovered that there are two kinds of traits. One kind may cover or hide the other kind. In pea plants, being tall is a trait that can hide the trait of shortness. The color purple can hide the color white. Roundness can hide wrinkling in seeds.

**\*** What he discoveredwere **dominant** and **recessive** traits. Recessive traits are not lost. They may show up in later generations. This explains how two brown-eyed parents can have a blue-eyed child. Both parents carry a recessive trait for blue eyes. They both pass that trait on to the child.

**8-2 The Building Blocks of Heredity**

\* A **chromosome** is made up of DNA. Scientists now know that traits are controlled by DNA. Remember, DNA is a special kind of molecule found in the nuclei of cells. It controls many of the characteristics of living things. Scientists often use fruit flies to study genetics. That is because fruit flies have hundreds of offspring at a time, and they reproduce every ten days. Scientists can easily and quickly observe the passing of traits over many generations. Fruit flies also have large chromosomes in their salivary glands that are easy to see through a microscope.

\* A **gene** consists of a DNAS code that controls a trait. Genes are the basic building blocks of heredity. They form the genetic code of life.

\* Chromosomes come in pairs. Half an organism’s chromosomes are from the father. Half are from the mother. Genes come in pairs, too. Most inherited traits are controlled by at least one pair of genes. These genes will be either dominant or recessive, like the traits they control. However, traits are often controlled by more than one pair of genes.

\* Each species has a certain number of chromosomes. Humans have 23 pairs. This means that every nucleus in every human body cell has 46 chromosomes. Fruit flies have only 4 pairs. Every body cell in a fruit fly has 8 chromosomes in its nucleus.

Fertilization

Most cells reproduce by dividing in half. One cell divides into two cells. However, before the cell divides, it copies its chromosomes exactly. This way, both of the new cells are complete and are exactly the same. Remember, all living things are made of cells.

\* Many organisms, including humans, begin with two special kinds of cells called sex cells. Like body cells, the sex cells reproduce by dividing. However, sex cells divide twice. The second time, they do not make copies of the chromosomes. As a result, each new sex cell gets only half the number of chromosomes found in body cells.

\* When organisms reproduce, a sperm cell and an egg cell join. This is **fertilization**. The two cells become one cell with a full set of chromosomes. The offspring that results has genes from both the sperm cell and the egg cell.

Where Do New Traits Come From?

\* New traits may suddenly appear in an organism. For example, a purple-flowered plant may have a single red flower. Then some of its offspring may only have red flowers. The new trait may be the result of a change in the organism’s DNA. This is a **mutation**.

\* Most mutations are harmful and can cause an organism’s early death. These mutations are not usually passed on to offspring. For example, a bird born with a soft beak would not be able to crack nuts or dig for worms. It would die young.

\* Sometimes, a helpful mutation occurs. Imagine a mutation that causes a giraffe to have a longer neck. The giraffe could reach more leaves on a tree than other giraffes could. The giraffe would pass along this mutation to its offspring.

\*\*On a separate sheet of paper, design mutations for 3 animals. Describe each mutation and how it would help the animal.

**8-3 Controlling Heredity**

Plant and Animal Breeding

\* Long before scientists knew anything about DNA, people used genetics. For examples, farmers have used genetics to control the traits of the offspring of their plant crops and animals. Even in ancient times, farmers bred the best fruit trees to get better fruit. They bred the best milk cows to get better milk.

\* Today, scientists, farmers, and gardeners carefully choose plants and animals for breeding. This is called **selective breeding**.

The Environment and Traits

Your genes do not control everything about you. Your environment also plays a big part in forming your traits. Your environment includes the air you breathe, the food you eat, the education you get, and other things in your surroundings.

\* Suppose, for example, that a woman has the genes to be a very fast runner. Yet, she has a poor diet and never exercises. These environmental influences would probably keep the woman from running very fast.

\* A tomato plant may be the offspring of parents that produced big, juicy tomatoes. The young plant has very good genes for producing delicious fruit. Yet, suppose the plant is rooted in poor soil and does not get enough water. Despite its good genes, the tomato plant may not produce any fruit at all because of its environment.

Transferring Genes

\* Today, scientists can produce new traits in organisms by removing a gene from the DNA of one organism and transferring it to the DNA of another organism. As a result, the organism that receives the gene has the trait that is controlled by that gene. Some people think that scientists should not change the genetic codes of organisms. They fear that the change may be harmful to those organisms. The change may also produce new kinds of organisms that are harmful to other organisms. The government has strict regulations that must be followed in genetic engineering experiments.

Read *A Closer Look Cloning Animals on page 117 and On the Cutting Edge A Powerful Weapon Against Diabetes on page 114. Answer the critical thinking question for each.*

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