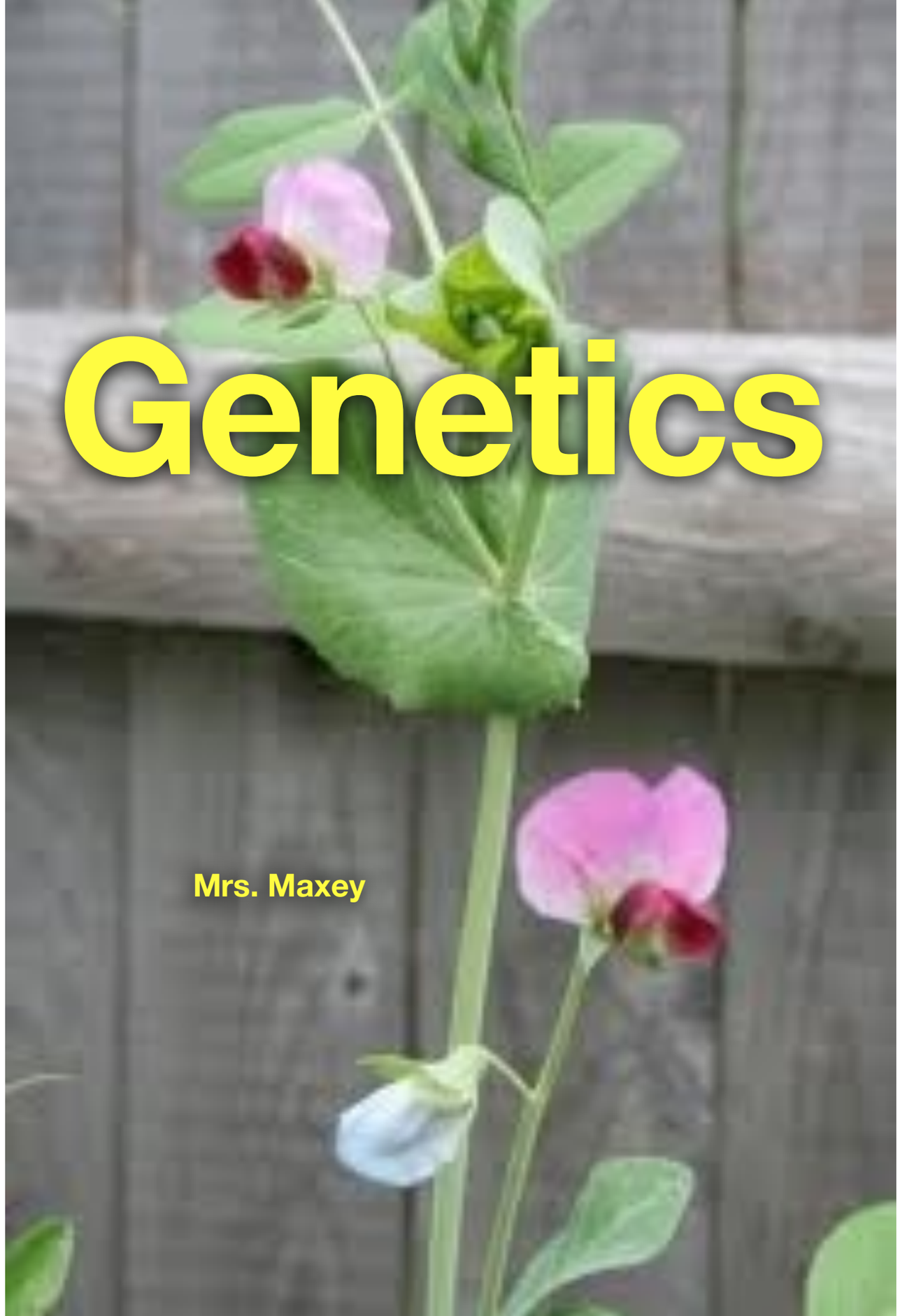

Genetics
Mrs. Maxey

Chapter 1

The Study of Inheritance

When you go to a family reunion or browse through family pictures, you can’t help but notice similarities and differences among your relatives.

Section 1

Heredity

GOALS

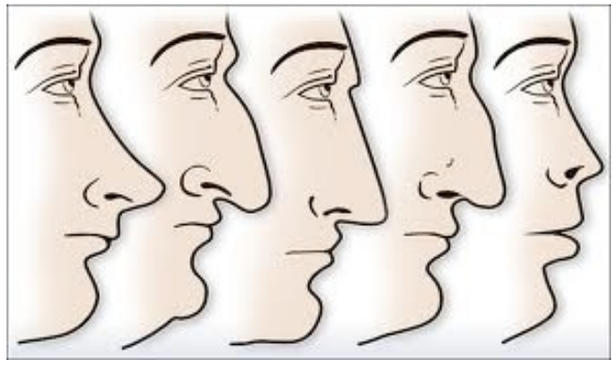
1. **Explain how traits are inherited.**
2. **Relate chromosomes, genes, and DNA to one another.**

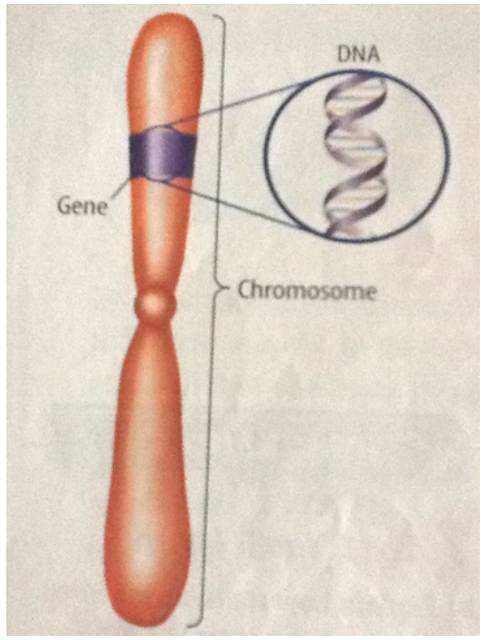
When you look a family photos, you notice that your mother's eyes look just like your grandmother's, and one of your uncles is tall while his brothers are short. These similarities and differences are the result of the way traits are passed from one generation to the next. Family members that share similar physical features can be obvious, like curly hair, or not so obvious, like color blindness (Figure 1). Heredity is the passing of traits from parent to offspring.

Figure 1

When you look around at your classmates, what makes each person an individual? Is it hair color or eye color? Is it the shape of a nose or the arch in a person's eyebrows? Eye color, hair color, skin color, nose shape, and many other features, including those inside an individual that can't be seen, are traits that are inherited from a person's parents. A trait is a physical characteristic of an organism. The study of how traits are passed from parents to offspring is called genetics. Every single thing about you is a trait you inherited from your parents. From the time you were conceived during fertilization of the egg and sperm, the DNA had the instructions for you. The instructions were read and it was determined how tall you would be, your eye color, your hair color, how your stomach would work.

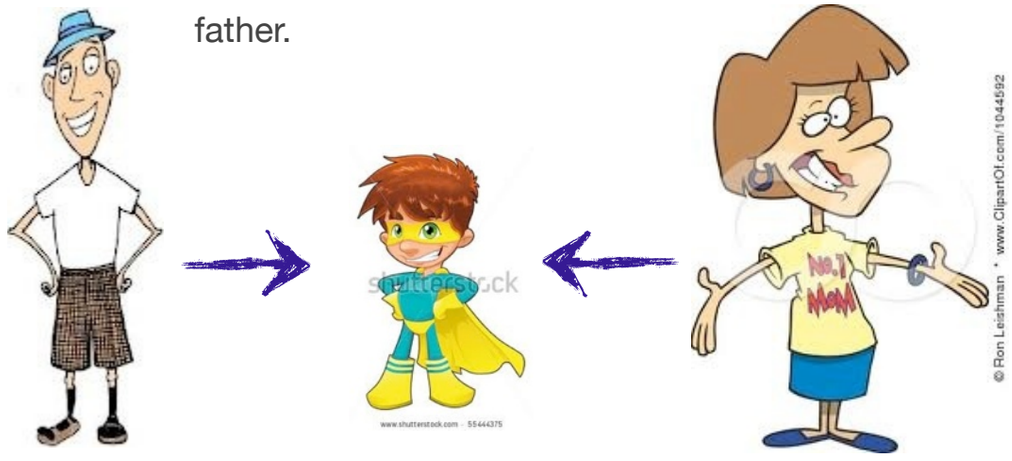
Every single thing about you is a trait you inherited from your parents.





So, where is the information located in DNA? Inherited traits are controlled by genes on chromosomes. A gene is a small section of DNA on a chromosome that has information about a trait. Humans have thousands of different genes arranged on 23 pairs of chromosomes. Genes control all the traits of the organism even those that can't be seen, such as the size and shape of your stomach and your blood type. Genes contain all the information that is needed for growth and life.

So, to review, genes are small sections of DNA. Chromosomes are made up of DNA and are found in the nucleus inside cells. Remember, too, that sex cells contain half the number of chromosomes so that when a sperm and egg join, you receive half the genetic information from your mother and half from your father.



Section 2

What Determines Traits?

GOALS

1. **Understand and explain the differences between the following vocabulary:**

    allele

    hybrid

    pure

    heterozygous

    homozygous

    dominant

    recessive.

Recall that in body cells, such as skin cells or muscle cells, chromosomes are in pairs. The genes on the chromosomes come in pairs, as well. Each gene on one chromosome has a similar gene on the other chromosome of the pair. Each gene of the gene pair is called an allele. The genes of a gene pair may or may not contain the same information. Let's look at pea plants as an example.

The genes for the flower color trait for pea plants might be purple flowers or it might be white flowers. The figure to the right shows one flower color allele to be white and one flower color allele to be purple. When a pair of chromosomes contains different alleles, such as this, the trait is said to be hybrid. Hybrid is also referred to as heterozygous. When a pair of chromosomes has two of the same alleles, such as two purple or two white, it is said to be pure. Pure is also referred to as homozygous.

Well, now it makes sense that if the two alleles in the gene pair are both purple flower alleles that the pea plant will have purple flowers. Likewise, if the two alleles in the gene pair are both white flower alleles then the pea plant will have white flowers. But, what if the alleles are hybrid (different)? What color will the flowers be on the pea plant?

In pea plants and other organisms, that depends on something called dominance. Dominant means that one allele covers over or masks another allele of the trait. For instance, if a pea plant has one purple flower allele and one white flower allele, the flowers will be purple. Why? In pea plants, purple flowers are dominant over white flowers. So, if a pea plant has two purple flower alleles or one purple and one white, then the flowers will be purple. The only way a pea plant will have white flowers is if there are two white flower alleles. Purple is the dominant trait and will mask a white flower allele if it is present. In pea plants, white flowers are said to be recessive because they are the allele that is masked or covered up when the dominant allele is present. Recessive alleles are seen only when a trait is recessive pure.

Humans, as well as many other living organisms, have traits that are controlled by the dominant or recessive alleles. Which trait the organism inherits depends on the combination of egg and sperm during fertilization. Depending on the combination of the sperm and egg, your eyes could be the color of your mother or your father. It all is a matter of chance. What if the color is not exactly the same as either your mother or father, but it is very close?

Let's investigate in the next section.

Section 3

Variation, Mutation, Selective Breeding

GOALS

1. **Explain the following concepts:**

    variation

    mutation

    selective breeding

Variation

Variations are the different ways that a certain trait appears, and they result from permanent changes in an organism's genes. Some gene changes produce small, insignificant variations, such as the different shades of blonde hair. Other gene changes produce large variations, such as albinism shown in the picture below.

Mutations

So, how do variations occur? If you've searched successfully through a patch of clover for one with four leaves instead of three, you've come face to face with a mutation. The word "mutate" simply means "to change." In genetics, a mutation is a change in a gene or chromosome. These changes can happen because of an error during meiosis or mitosis or because of something in the environment, and many mutations happen by chance.

Look back at the albino zebra. Obviously, something changed to cause the skin of the zebra to lack color. Did this happen during meiosis? Mitosis? We don't know. What we do know is that the genes for skin color have changed. How will this affect the offspring when this albino zebra mates? Will the offspring look normal with normal colored stripes and skin, or will it have the skin coloring of the albino? Or, will it have some variation in color? Whatever the result, it will be slightly different (varied) from the norm.

How do mutations affect the organism? Sometimes mutations affect the way cells grow, repair, and maintain themselves. If the mutation affects, say the muscle cells and how they grow, will the organism be able to move normally? These types of mutations that affect the cells are usually harmful to the organism.

What about the four-leaf clover? Does the extra clover leaf harm the plant? Does it help the plant? Because it neither harms nor helps the plant, it is said to have neutral effect.

Some mutations are beneficial for a species survival. In the pictures above, you see an arctic fox. Notice the fur color is different in the two pictures. Notice also the climate in each picture. The arctic fox's fur color depends on the environment. In the winter months, the arctic fox does not produce fur pigment, and the fox's fur appears white. As a result, the fox blends with the snow helping it to avoid predators. In the warmer months, the fox produces brown pigment, and the fox blends with the tundra.

No matter whether a mutation is beneficial, harmful, or neutral, they all add variations to the genes of a species.

Selective Breeding

Sometimes, a mutation produces a different version of a trait that many people find attractive. To continue this trait, selective breeding is practiced.

Selective breeding is controlled and not left to being random. For many years, cattle have been bred on the basis of how much milk they can produce.

Cattle ranchers will breed cattle that produce large amounts of milk and weed out the ones that don't produce very much.

Racehorses are bred according to how fast they run. Will a racehorse owner take his champion down the road to Uncle BillyBob's farm and breed it with an ordinary horse? He could, but it definitely would not produce a thoroughbred offspring.

Section 4

Review

Review 1.1

What is any change in the DNA of a gene or chromosome?

- **A.** an embryo
- **B.** sex cells
- **C.** clone
- ✓ **D.** mutation

Check Answer

Review 1.2

What is the small section of DNA that contains the code for a trait?

- ✓ **A.** gene
- **B.** heredity
- **C.** variation
- **D.** cell

Check Answer

Review

Review 1.3

How are specialized breeds of dogs, cats, horses, and other animals produced?

- **A.** regeneration
- **B.** asexual reproduction
- ✓ **C.** selective breeding
- **D.** budding

Check Answer

Review 1.4

If you were looking at a pea plant with white flowers, what flower color trait(s) would be in the sex cells?

- **A.** two purple
- ✓ **B.** two white
- **C.** purple and white
- **D.** none of the above

Check Answer