What Makes You, You?

A Reading A–Z Level X Leveled Book
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Written by Rachel Kamb

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Back cover: A lab technician works with a new research tool called DNA microarray technology, which can identify genes that are active in specific parts of the body.

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Correlation

LEVEL X	
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Table of Contents

Genes make every person unique.

Introduction

Have you ever wondered why your hair is brown, while your best friend's is blond? Have you ever wondered why you have brown eyes, while your brother has blue eyes? Have you ever wondered why you look like your parents? Just *what* is it that gives you all of your individual characteristics?

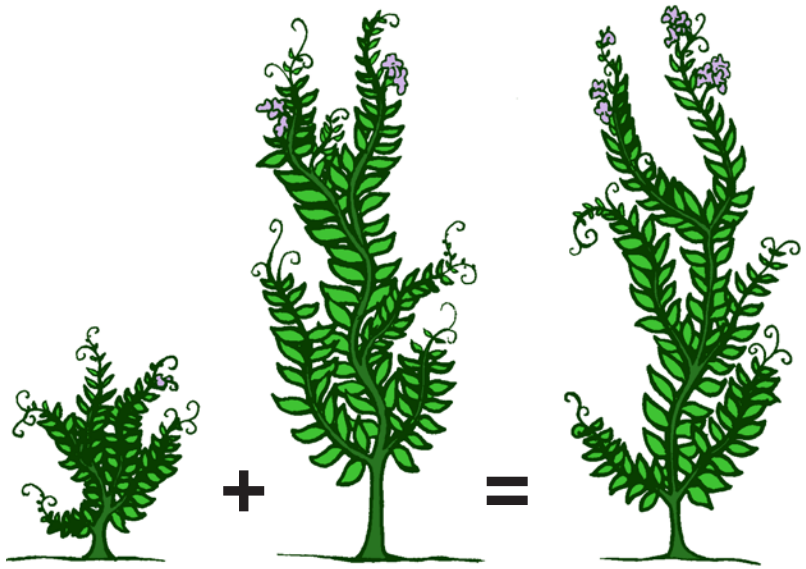
The answers to these questions have to do with **heredity** and **genetics.** Heredity is the way **traits**, such as hair and eye color, are passed on from one generation to the next. Genetics is the field of science that studies how these traits are passed on. In the following pages, we will take a closer look at genetics and answer some of these questions about what makes you, you.

Brief History of Genetics

When did we first learn about heredity? The idea of heredity has been around since ancient times; even long ago, people understood that certain traits could be passed from one generation to the next. Using this basic knowledge, they were able to **domesticate** animals by breeding those with desirable traits, such as cows that gave a lot of milk or chickens that laid many eggs. They also used this knowledge to create new food crops, such as larger, more nutritious types of wheat and rice.

Although ancient people understood basic heredity, the science of genetics didn't begin until around the 1850s and 1860s, when an Austrian man named Gregor Mendel began to study the heredity of pea plants.

Gregor Mendel



Crossing a short pea plant with a tall pea plant creates a tall pea plant.

Mendel wondered what would happen if he crossed a very short pea plant with a very tall pea plant. He expected the plant to be medium height, the size right in between the very short plant and the very tall plant. He was surprised by what he discovered. When a short plant was crossed with a tall plant, the resulting plant always turned out tall!

Mendel went on to study other traits of pea plants, such as seed color and whether the seeds were round or wrinkled. When he crossed pea plants with other pea plants possessing opposite traits (like short with tall, or smooth-seeded

with wrinkled-seeded), he discovered that the resulting plant always looked like one or the other, rather than like a mix of both.

To explain these results, Mendel came up with the idea of units of heredity, now called **genes,** that transfer traits from one generation to the next. These genes are typically found in pairs. The **offspring** receives one gene from one parent and the other gene from the other parent.

Genes, which carry all hereditary traits, are either **dominant** or **recessive.** Dominant genes always **override** recessive genes. For example, in Mendel's experiments, he found that the gene for "tall" in pea plants is dominant, and the gene for "short" in pea plants is recessive. A purebred tall pea plant has two dominant "tall" genes. A purebred short pea plant has two recessive "short" genes.

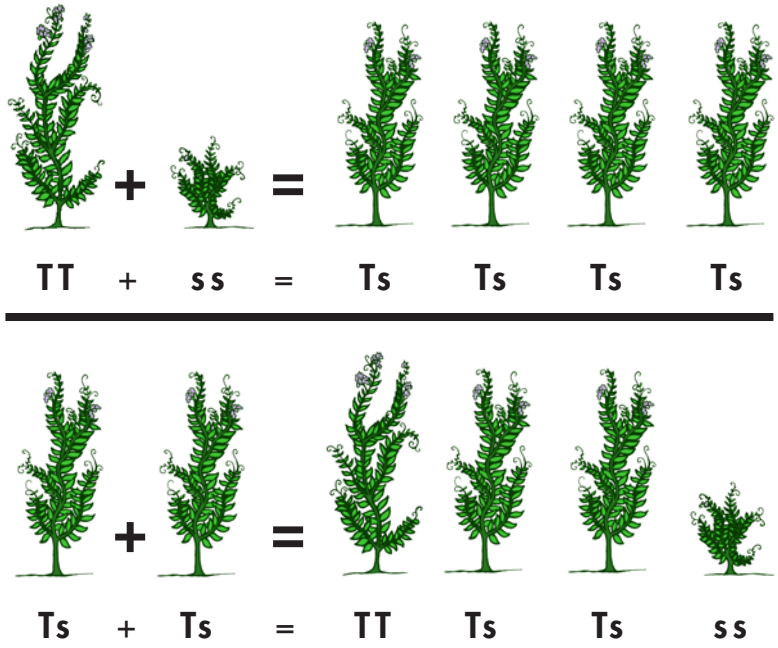
When he crossed a purebred tall pea plant

TT Two dominant genes

Ts One dominant gene and one recessive gene

ss Two recessive genes

Dominant genes are represented by uppercase letters. Recessive genes are represented by lowercase letters.



with a purebred short pea plant, the offspring received one dominant "tall" gene from the tall pea plant and one recessive "short" gene from the short pea plant. An offspring with one dominant tall gene and one recessive short gene is always tall, because the "tall" gene completely overrides the "short" gene (top row above). It was from these simple pea plant experiments that the field of genetics was born.

The second row above shows what happens when the parent plants both have one "tall" gene and one "short" gene. The offspring may have one of three different combinations (TT, Ts, or ss).

Acquired vs. Inherited Traits

From Mendel's experiments on pea plants, scientists began to learn why some traits are passed on from one generation to the next and why some traits are not. However, while the traits of pea plants are straightforward, the traits of people can be very confusing.

Acquired Traits

All sorts of things can affect a person's appearance. Genetics and heredity are some of these things. Behavior and the environment are other things.

You can think of inherited traits as those that you are born with and cannot change, such as your height or the color of your hair and eyes.

Do You Know?

A common mistaken idea called Lamarckism was named after the French biologist LaMarck. In 1801, he wrote that acquired traits could be inherited. He suggested that if a giraffe stretched its neck out reaching for food, its offspring would inherit that long neck. But that's not the case. Only genetic traits—not traits an organism gains over its lifetime—can be passed on.

However, sometimes you can change the appearance of inherited traits or **acquire** new traits. For example, you can change your appearance by wearing high heels if you are short, or by wearing blue-colored contact lenses if your eyes are brown.

You will appear to be tall and have blue eyes, but these changes are not permanent; they do not actually change the way you are. You will still be short with brown eyes when you take off your shoes and your contact lenses. However, some environmental traits can be permanent; for example, poor nutrition may cause someone to be short, even if he or she has "tall" genes.

Tall shoes can make a woman seem tall, even if she is not.

Driving a car
is an acquired ability.

Other traits are acquired, such as the ability to drive a car. It is not something you are born knowing how to do. There are all kinds of acquired traits. Some of these include the ability to swim, dance, tell good jokes, cook, juggle, and lots more.

There are even traits that come from a mixture of heredity and the environment. For instance, every human is born with the ability to learn how to speak and use language. But depending on where you were raised, you may have learned to speak Dutch, Spanish, Swahili, or Korean.

DNA works like a blueprint for building your body.

Inherited Traits

Genes, Chromosomes, and DNA

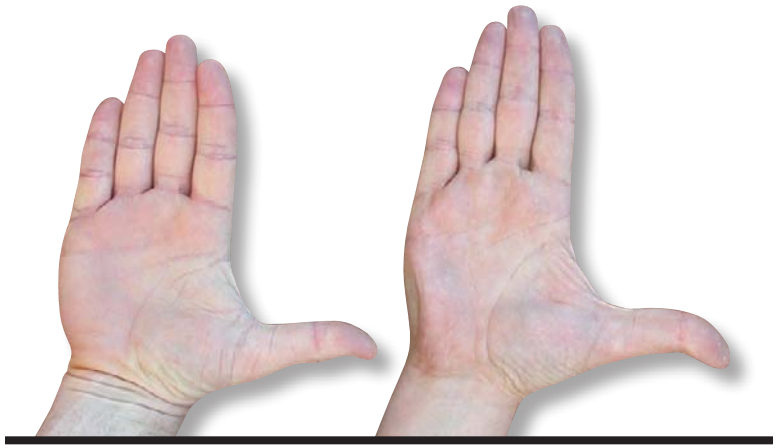
As Mendel discovered with pea plants, traits are passed down from parents through genes. You can find your genes on rod-shaped structures, called **chromosomes**, inside your cells. Chromosomes carry the genes that determine if you will be a boy or a girl, and all the other characteristics you inherit from your parents.

Genes are made of even smaller molecules called **DNA**. DNA molecules are found in all your cells. You can think of DNA as a code or a blueprint of how a living thing is put together. DNA molecules carry all the information needed to make each living thing. Every living thing that you can think of was put together following the blueprint provided by its DNA.

Dominant vs. Recessive Traits

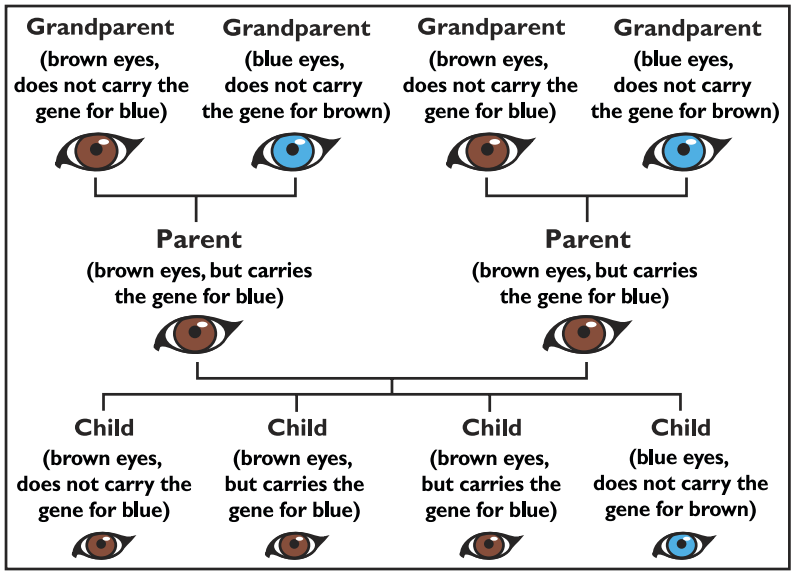
Let's get back to genes. For now, genes are as small as we need to go. Each parent carries two genes for most simple characteristics, like eye color, dimples, and tongue rolling. As explained earlier with Mendel's pea plants, a gene is either dominant or recessive. A dominant gene is stronger and will always win when combined with a recessive gene.

For example, say your mother has brown eyes and your father has blue eyes. You receive one brown-eye gene from your mother and one blue-eye gene from your father. Brown-eye genes are dominant, while blue-eye genes are recessive. The brown-eye gene wins out over the blue-eye gene. That means you would have brown eyes.



Having a straight thumb (left) or a bent thumb (right) is another genetic trait.

This is where it gets a little confusing. Now, just because you have brown eyes does not mean all your children will have brown eyes. You are still carrying one recessive blue-eye gene. If that recessive gene gets paired with another recessive blue-eye gene, your child will have blue eyes. However, if that recessive blue-eye gene gets paired with a dominant brown-eye gene, or if you pass on your own dominant brown-eye gene rather than your blue-eye gene, your child will have brown eyes. When parents have both dominant and recessive genes, it is difficult to say what genes the child will receive. This may be easier to visualize by using a Punnett square.



Depending on the mix of genes, people with brown eyes can still have children with blue eyes.

The odds for an individual coin toss do not apply to many coin tosses. The same goes for the odds of heredity.

Using a Punnett Square

You can use a Punnett square to help figure out the odds of two parents passing on particular genes to their children. It does not guarantee that these odds will happen in real life. It's like tossing a coin. There is a 1-in-2 chance that the coin will come up heads and a 1-in-2 chance that it will come up tails. But that doesn't mean it can't come up heads five times in a row.

An example might help. What would be the odds of having a child with brown eyes if the mother has brown eyes, with one dominant brown-eye gene and one recessive blue-eye gene, and the father has blue eyes with two recessive blue-eye genes? Let's use a Punnett square to figure this out. We'll use a capital "BR" for the dominant brown-eye gene, and a small "bl" for the recessive blue-eye gene.

First, chart the mother's pair of genes along the top of the Punnett square. Align one gene with the boxes on the left and the other gene with the boxes on the right. Chart the father's gene pair along the left side of the Punnett square, like this:

Mom (brown eyes)

	BR	**bl**
bl		
bl		

Dad (blue eyes)

Next, carry the genes from the mother down from the top. Write each one in each of the boxes below it, like this:

Mom (brown eyes)

	BR	**bl**
bl	BR	bl
bl	BR	bl

Dad (blue eyes)

Then carry the genes from the father across from the left. Write them in each of the boxes to the right, like this:

Mom (brown eyes)

Dad (blue eyes)	BR	bl
bl	BR bl	bl bl
bl	BR bl	bl bl

Now, count the gene pairs that contain at least one dominant gene, and then compare them with the total number of gene pairs. Do the same with the pairs that contain only recessive genes. There is a 2-in-4, or 50 percent, chance the child will have brown eyes and a 2-in-4, or 50 percent, chance the child will have blue eyes. You can use a Punnett square with other simple genetic traits, too.

Tracking Simple Genetic Traits

You can use a Punnett square to figure out from which parent you inherited a particular trait. For example, can you roll your tongue? Tongue rolling is a dominant trait; if you have it, you can be sure at least one of your parents has it, too. But if you can't roll your tongue, you know you inherited recessive genes from both parents, even if they both have one dominant gene and can roll their tongues.

Tongue rolling is a genetic trait. You can't learn it if you can't already do it!

Attached earlobes are a recessive trait. If both of your parents have attached earlobes, then you and all your brothers and sisters will, too.

Dimples are another dominant trait. Do you have dimples? Do either of your parents have dimples? What about your grandparents?

An attached earlobe (left) and an unattached earlobe (right)

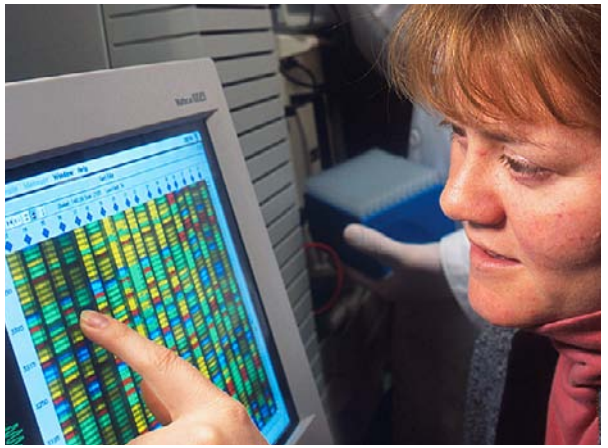
Do You Know?

Albinism is a genetic trait. Albinism is when a person or animal has no pigmentation in the skin, making it appear very white. Albinism occurs when a person inherits a recessive group of genes for the skin from each parent. The irises, or colored part, of their eyes are colorless, too. The blood vessels in the eyes make them appear red. You may have seen common albino rats and rabbits with pinkish eyes.

Genetics in Our Future

Besides all the fun things, like figuring out whether you got your blue eyes from your mom's side of the family or your dad's, and who in your family are tongue rollers, genetics is used in very practical and important ways. Understanding more about the genetic makeup of humans can help scientists diagnose and treat genetically transmitted diseases. New medicines can be developed to fight the diseases.

Genetics recently has helped law enforcement officers fight crime. Crimes have been solved by identifying criminals using their DNA from small samples of hair, skin, or fluid. The FBI has opened a national database of genetic information to help law enforcement keep track of and find criminals.



A scientist compares several DNA samples.

Some farmers delight in growing enormous prize vegetables.

Genetics is also helping farmers increase the production of food crops to meet the demands of the world's growing population. Scientists create grains, vegetables, and fruits that look better, last longer, have extra nutrients, and are more plentiful.

Although many of these discoveries are very useful, some believe that tampering with genes may cause harm to our world. How will organisms that have been genetically altered affect our environment and us? This is something that scientists, and all of us, must think about.

Conclusion

So, just *what* is it that makes you, you? You now know that much of the way you look and the way you are is inherited from your parents. They pass down genes, or units of heredity, that have transferred traits from your grandparents to your parents, and then from your parents to you.

There is a lot more to learn about genetics. Many people spend their entire lives studying genetics. Not only will understanding more about genetics be important in the future, it is also sure to be fun and interesting!

Do You Know?

Some genetic traits are linked to your gender. Hemophilia (hee-mo-FEEL-ee-ya) is a genetic disease that is linked to males. People with hemophilia are unable to produce a blood-clotting agent called fibrin, and they bleed very easily. Men and boys with hemophilia often need blood transfusions.

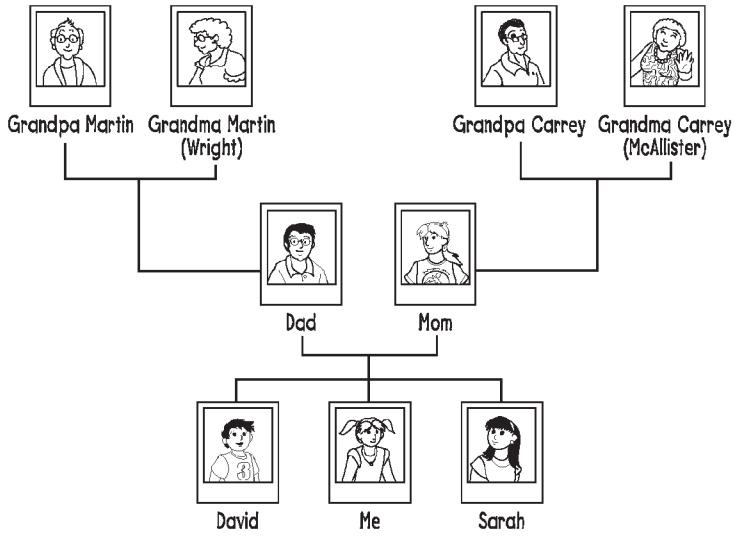

This photograph shows a blood cell (background) and the web-like clotting agent, called *fibrin*.

Try This

Make a family tree.

Use pictures of your family to create a diagram of your family history, called a family tree. A family tree usually begins on top, with your earliest known relatives. Below each couple, write the names of their children. Then, below each child, write the names of her or his children.

To find out this information and other facts about your family, ask your parents, grandparents, and other relatives some questions, and write down the answers on your family tree. Where were your parents born? Where were their parents born? You can make the diagram as simple or as complicated as you want, depending on how much information you can find.



Glossary

acquire *(v.)* to get; to come to have (p. 10)

chromosomes *(n.)* rod-shaped structures inside your cells that carry all genes (p. 12)

DNA *(n.)* a code of how a living thing is put together found in all cells (p. 12)

domesticate *(v.)* to raise an animal so that it will more easily live with or near people (p. 5)

dominant *(adj.)* superior to all others in influence or importance (p. 7)

genes *(n.)* units of heredity, which transfer traits from one generation to the next (p. 7)

genetics *(n.)* the field of science that studies how traits are passed on (p. 4)

heredity *(n.)* the way traits, such as hair and eye color, are passed on from one generation to the next (p. 4)

offspring *(n.)* progeny; young; children (p. 7)

override *(v.)* to take priority over something else; to outweigh something (p. 7)

recessive *(adj.)* inferior in influence or importance (p. 7)

traits *(n.)* individual features or details (p. 4)