How Is Gender Inherited? U-9 L-6

Exploring Science / Historical Steps

You're biased because you're a girl!
You're biased because you're a boy!

These may seem like silly arguments. However, to a scientist, being called biased is very serious. A **biased** person lets their own experiences influence how they view things. Scientists must view things **objectively** - meaning without bias.

It is very difficult to avoid biases. For example, a person raised in a small town might be biased (in a negative way) about life in a big city. Of course, the opposite might also occur.

A good experiment is designed without biases. Scientists must also be unbiased as they judge an experiment's conclusion.

Scientists have tried for years to create unbiased experiments in their study of the brains of girls and boys. Does a person's **gender** (sex) mean that they have differences in their brains?

This became an even more exciting field when new tools that could "see" brain activity were invented. You have probably heard of MRI and f**MRI** machines. The "f" indicates a special type of MRI that can tell which part of the brain is "**f**unctioning" at a specific time. MRI's have a long history.

Experts in physics made discoveries related to MRI's in the 1930s. Eventually these discoveries were applied to medicine. The first MRI scan was used on a cancer patient in 1978. Millions of scans are now completed each year. In fact, even more advanced brain imaging machines - with names like MEG, and PET - have been developed.

So, have brain scans shown differences based on gender? Despite years of research, the verdict is still out. Soon after one study makes a claim, the next study disputes it.

The gender that a person feels "fits" them is called their **gender identity.** A person's gender identity does not always match their body. Many people consider themselves to be "straight" (attracted to the opposite gender); some people consider themselves to be "gay" (attracted to the same gender). And some people refer to themselves as **non-binary;** they feel that they do not fully fit only one gender.

Scientists certainly know that the brain is incredibly complex, and that all types of humans exist. Like scientists, all of us need to strive to be unbiased about each other.

➢ Do you think that better brain imaging machines will someday confirm brain differences based on people's gender identity?

Genes and Gender

"Is it a girl or a boy?" This is the first thing everyone wants to know about a new baby. We don't know exactly how the brains of girls and boys are different. But we do know why some babies are born with female body parts and others are born with male body parts. The reason is found in the chromosomes' genes.

You know that you have 46 chromosomes in your body cells. In a lab, all of the chromosomes in a body cell can be lined up into 23 *pairs*.

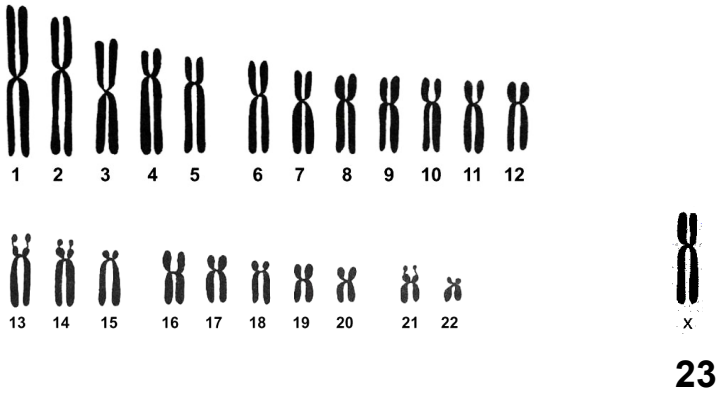
Scientists give each chromosome pair a number. Whether you have female or male body parts depends on chromosome pair number 23 - often called the **sex chromosomes**.

Sex chromosomes come in two possible shapes. One shape is an "**X chromosome**." The other shape is called a "**Y chromosome**." Females' body cells have two **X** chromosomes (**XX**). Males' body cells have one **X** chromosome and one **Y** chromosome (**XY**).

On the next page, look at a diagram of **all** of the chromosomes in the nucleus of one human body cell. Keep in mind that humans receive 23 chromosomes from **each** parent. Therefore, humans have a total of 46 chromosomes. Count them in the illustration! Pay special attention to chromosome # 23.

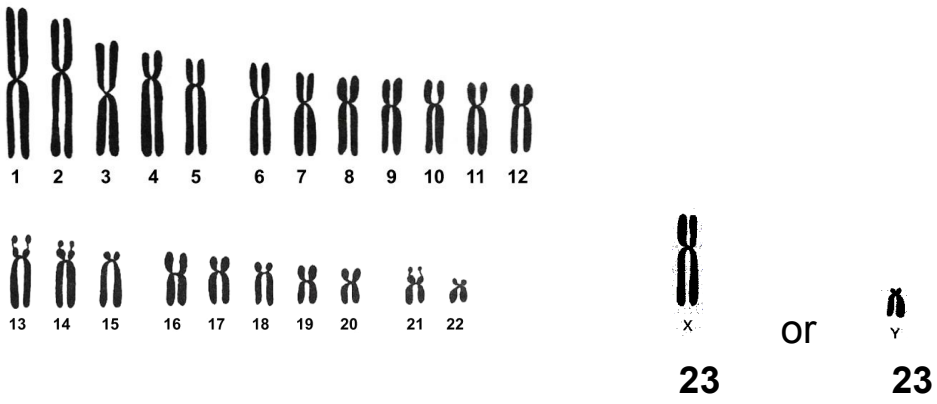
Below are the chromosomes that this person received **from their mother**.

- Note: From their mother, humans can only receive a chromosome # **23** that looks like an "**X.**"



Below are the chromosomes that the same person received **from their father**.

- If this person is a female, from her father she received a chromosome # **23** that looks like an "**X.**"
- If this person is a male, from his father he received a chromosome # **23** that looks like a "**Y**"



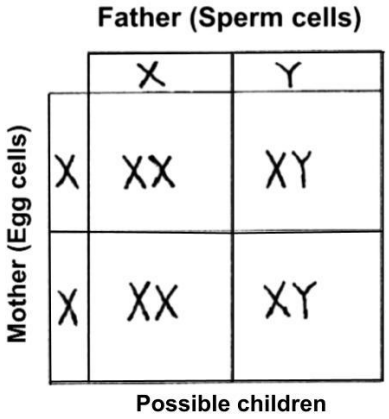
From what you just read, do you see that every egg cell has one **X** chromosome, but only half of the sperm cells have an **X** chromosome? The other half of the sperm cells have a **Y** chromosome.

If a sperm with an **X** chromosome fertilizes an egg, the zygote has two **X** chromosomes (**XX**). This child will have female body parts.

If a sperm with a **Y** chromosome fertilizes an egg, the zygote has one **X** chromosome and one **Y** chromosome (**XY**). This child will have male body parts.

For each baby in a family, what are the chances that it will be female or male? The chances are even. To show why, we again use a Punnett square.

We see that half of the possible egg-sperm combinations will result in female offspring (**XX**). The other half will result in male offspring (**XY**).

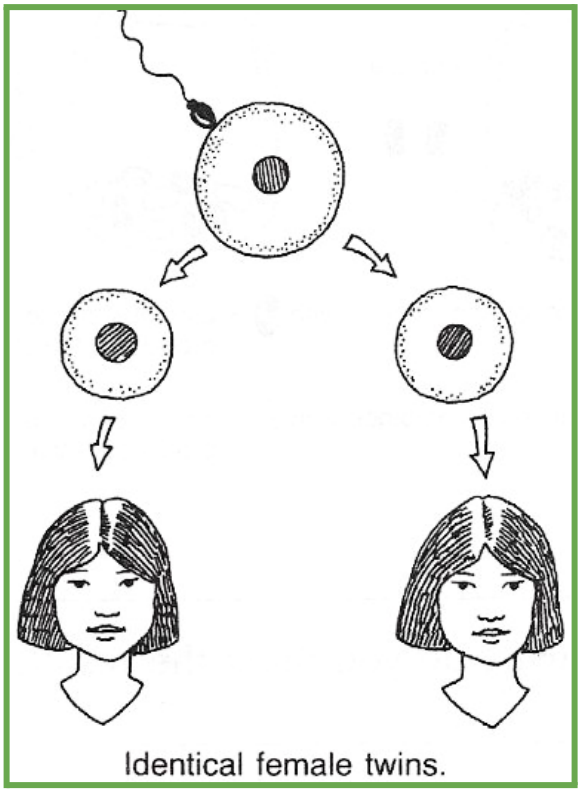


Keep in mind that a Punnett square only shows the *chances* of having girls or boys. In reality, in any one family, most, or even all, of the children can be of one gender. But in the whole population of humans on Earth, the number of girls and boys are about equal. (See page 247 for an unusual example).

WHAT ABOUT TWINS? We can use what we know about **X** and **Y** chromosomes to answer some other questions. Why are identical twins always the same gender? And why are nonidentical (**fraternal**) (fruh-TUR-nul) twins sometimes of different genders and sometimes of the same gender?

As you know, after a sperm fertilizes an egg, an embryo forms. On rare occasions, an embryo splits in half soon *after* fertilization. Each half becomes a separate embryo and, eventually, a separate individual. Since they came from the same sperm and egg, both embryos have all of the same chromosomes.

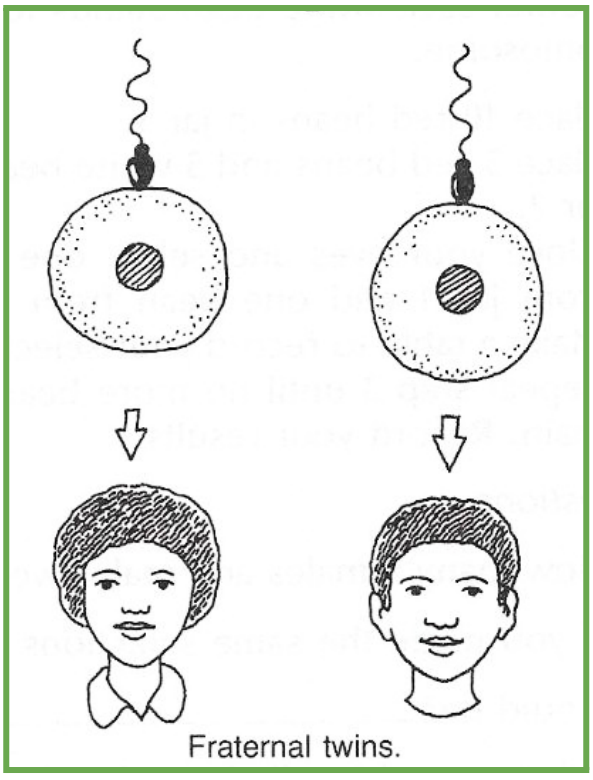
Having all of the same chromosomes means that these twins have all of the same genes. And because these twins have the same genes, they have the same traits. Therefore, they are always of the same gender. Do you see why twins that develop from one fertilized egg are called **identical** twins?



Identical twins come from the same egg cell and sperm cell. The zygote then splits.

What about fraternal twins? Sometimes, a woman's ovaries release *two* eggs at once. These may both get fertilized. Each egg is fertilized by a *different* sperm. In such cases two embryos develop, each from its own egg and sperm. These are **fraternal** twins. Another way to describe fraternal twins is to say that they are siblings who were born at the same time.

Suppose that one egg is fertilized by an **X** sperm and the other egg by a **Y** sperm. These twins consist of a girl and a boy. Can you explain why? Of course, both eggs could be fertilized by **X** sperm cells, or both by **Y** sperm cells. What gender would the twins be in each case? Is it clear that these twins can be of the same gender, but still not be identical - that is, not have all of the same traits?



Fraternal twins come from different egg cells and sperm cells.

➢ To Do Yourself

What are the chances of producing a male or a female?

You will need:

15 red beans, 5 white beans, 2 jars.

You will make a model of the way **X** and **Y** chromosomes pass from parents to offspring.

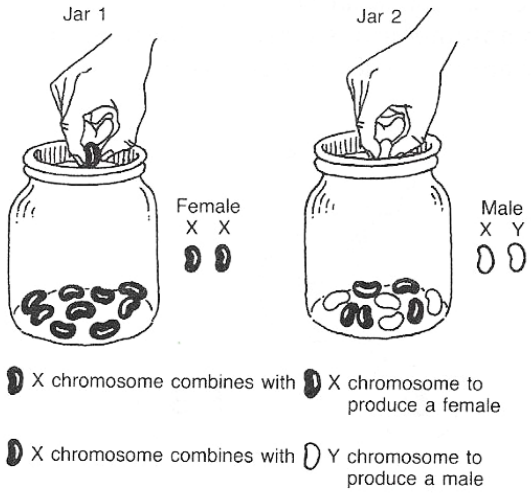
- Each red bean stands for an **X** chromosome.
- Each white bean stands for a **Y** chromosome.

1. Place 10 red beans in jar 1.

2. Place 5 red beans and 5 white beans in jar 2.

3. Close your eyes and select one bean from jar 1 and one bean from jar 2. Make a table to record your selections.

4. Repeat step 3 until no more beans remain. Record your results.



Questions

1. How many females and males were produced?_____

2. If you made the same selections 100 more times, what would be the results?

_____

3. What does this tell you about the chances of producing a female or a male?_____

_____

*** From 1952 - 1967, Tancy and Jack (from KY) had six children - all boys.**
Their first six grandchildren were all girls!

Each child born has a 50% chance of being male, and a 50% chance of being female.
In the population as a whole, the genders are nearly balanced.

(Note: In the mid 1900s, large families were more common than they are today!)

I. In each blank, write the term that fits best. Choose from the terms below, but use one twice.

identical	**male**	**fraternal**	**female**	**Y**
sex chromosomes		**hormone**	**sex cells**	**X**

Your body cells contain 23 pairs of chromosomes including one pair of _____

_____. The chromosome pair **XX** is found in _____

body cells, and the pair **XY** is found in _____ body cells. A sperm cell may have

either an _____ chromosome or a _____ chromosome. An egg cell always has

a(n)_____ chromosome. Twins that come from one egg are _____.

Twins that come from two eggs are _____ .

II. Jacob and Sarah are brother and sister. They are also twins.

A. Are they identical or fraternal? Explain. _____

_____

B. Which twin came from a sperm with a **Y** chromosome? _____

C. Which twin came from a sperm with an **X** chromosome? _____

III. A family has two boys and one girl. They are expecting another child. What are the chances that it will be a boy or a girl? Explain.

_____

_____

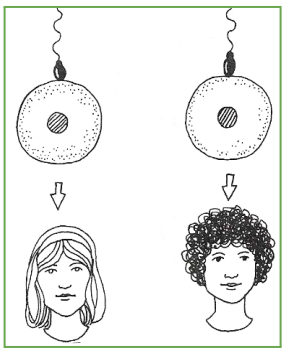
IV. The Kienasts family includes a famous set of quintuplets consisting of three girls and two boys. Each child has traits that are different from all of the other children. Can you explain how they were formed?

_____

_____

_____

V. In the diagram below, are these twins fraternal or identical? Explain.



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