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 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 **MRI**s - tools that could "see" brain parts, were invented. By 1991, special MRI machines called **f**MRIs could even tell which part of the brain was "**f**unctioning" at a specific time.

Thanks to fMRIs and other imaging tools, the evidence is now strong that there *are* significant differences in the brains of boys and girls, as well as in people who *feel* that they fit a certain gender. What does the phrase "fit a certain gender" mean?

The gender that a person feels *fits* them is called their **gender identity.** Some people feel they fit the gender of their birth; those born as boys feel comfortable being male, and those born as girls feel comfortable being female.

Other people feel they fit the *opposite* gender of their birth. Finally, some people don't identify as entirely male or entirely female. Since binary means one of only two possibilities, people in this last group refer to themselves as **non-binary.**

Likely, you have also heard the words **straight** (heterosexual) and **gay** (homosexual)**.** Straight refers to people who are *attracted* to people of the opposite gender, and gay to people who are attracted to the same gender.

Scientists will continue to learn about our complex brain. Whatever they learn, all of us must simply be unbiased - and kind - towards each other!

➢ Want more? Note this page's last paragraph. Research some exceptions, such as Turner's Syndrome (where one X chromosome is missing or altered), or conditions where XXY and XYY occur, or the presence of the SRY genes.

Genes and Gender

We don't know exactly how the brains of people differ. 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.

On the next page, look at the diagram of **all** of the chromosomes in the nucleus of one human body cell. [You might want to review (from page 220) why chromosomes are shown as Xs.]

Keep in mind that humans receive 23 chromosomes from **each** parent. The 23 chromosomes that this person received from their mother are shown at the top; the 23 chromosomes that this person received from their father are shown at the bottom.

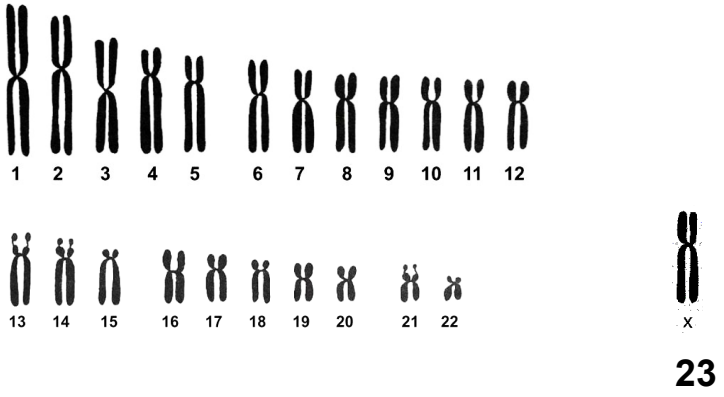
Scientists give each of these chromosomes a number - from 1 to 23. So, every human body cell has 23 pairs of chromosomes - a *total* of 46 chromosomes.

At the bottom right of the diagram, note that chromosome #23 (referred to as the **sex chromosome)** comes in two possible shapes. One shape is called an **X chromosome**; the other shape is called a **Y chromosome**.

The body cells of females have two **X** chromosomes (**XX**). Males' body cells have one **X** chromosome and one **Y** chromosome (**XY**).

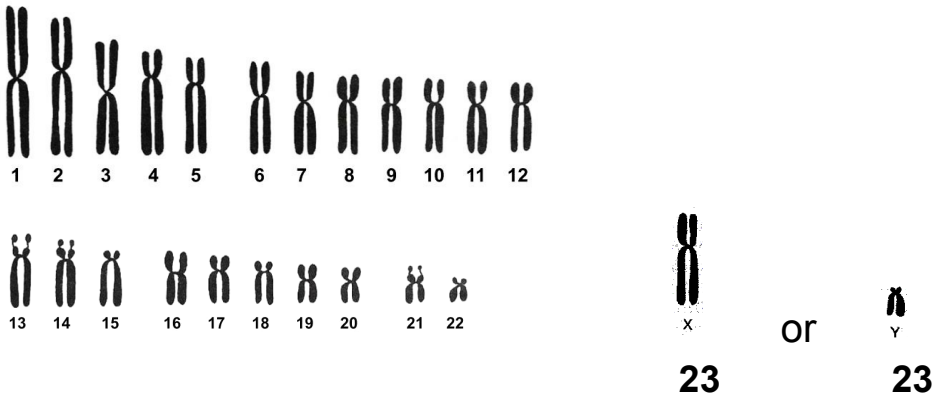
Below are the chromosomes that this person received **from their mother**.

- 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.**"



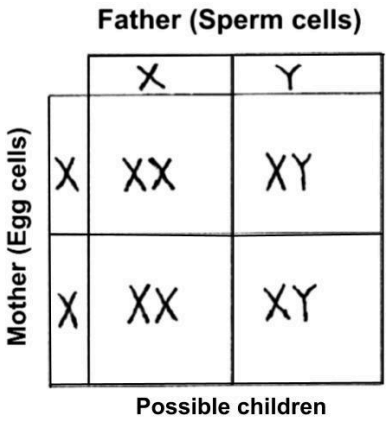
From what you just read, do you see that *every* human **egg** cell has one **X** chromosome, but only *half* of the human **sperm** cells have an **X** chromosome? The other half of the sperm cells have a **Y** chromosome.

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



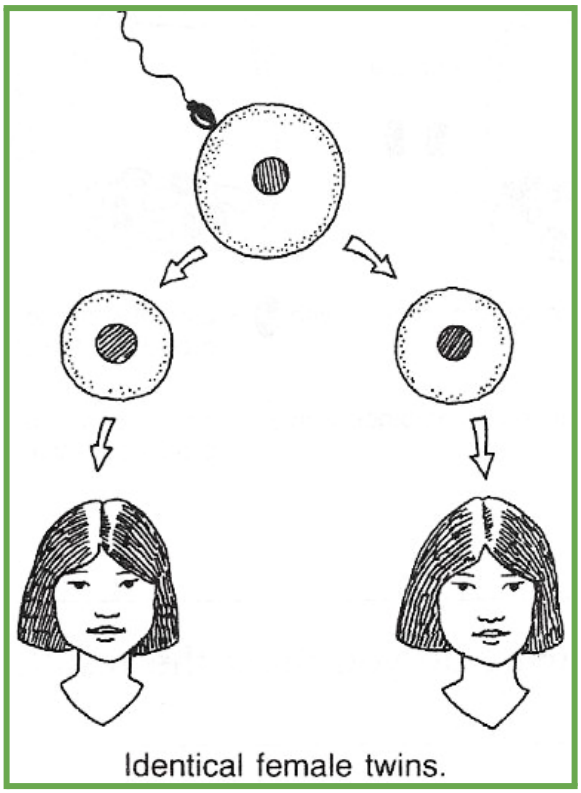
Notice that a Punnett square only shows the *chances* of having girls or boys. In reality, in any one family, most, or even all, of the children can be of one gender. But in the whole population of humans on Earth, the number of girls and boys are about equal. (See page 247 for an unusual example).

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.

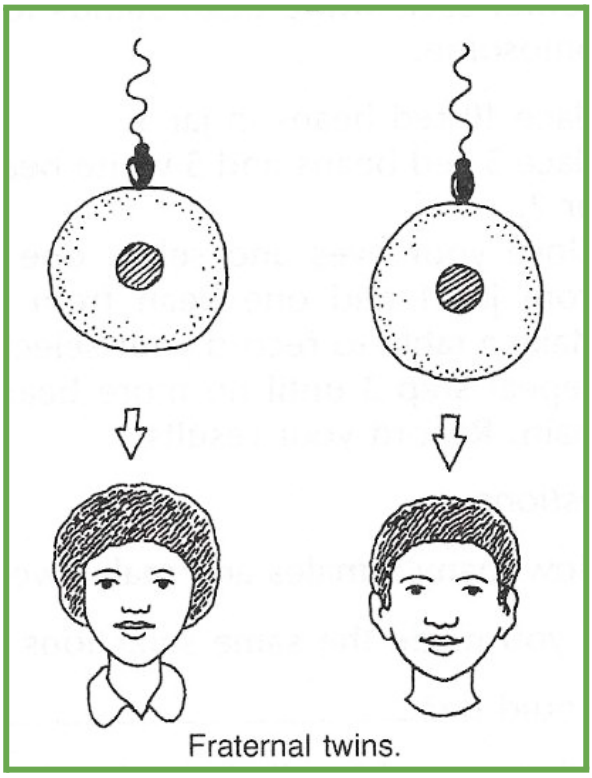
Having all of the same chromosomes means that these twins have all of the same genes. And because these twins have the same genes, they have the same traits. Therefore, they are always of the same gender. Do you see why twins that develop from one fertilized egg are called **identical** twins?



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?

To make a model of the way **X** and **Y** chromosomes pass from parents to offspring, you will need:

15 red beans; 5 white beans;
2 wide-mouthed jars.

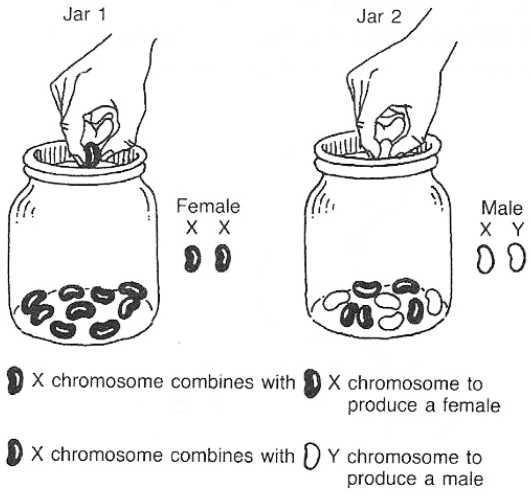
- Each red bean stands for an **X** chromosome.
- Each white bean stands for a **Y** chromosome.

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.]

REVIEW U-9 L-6

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.

_____

_____

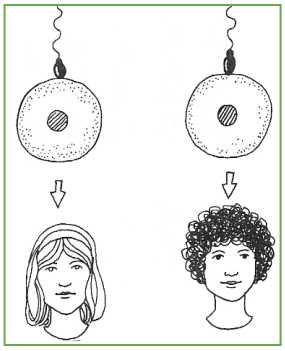
IV. The Kienasts family includes a famous set of quintuplets consisting of three girls and two boys. Each child has traits that are different from all of the other children. Can you explain how they were formed?

_____

_____

_____

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



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