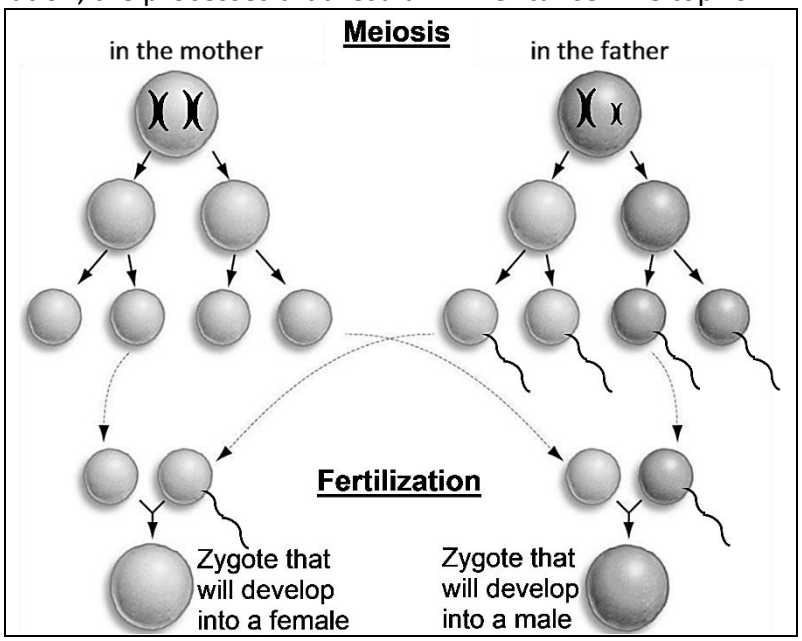
Genetics and Probability – Sex Ratios of Births[1]

Approximately equal numbers of boys and girls are born in the US each year. In contrast, some families have only boys or only girls. You will learn the reasons why in this activity.

As you probably know, the sex chromosomes are called the **X** and **Y** chromosomes. The **Y** chromosome has a crucial gene that stimulates the development of testes. As a result, a person with an **X** and a **Y** chromosome in each cell (**XY**) has male anatomy. A person with two **X** chromosomes in each cell (**XX**) has female anatomy.

This figure shows meiosis and fertilization, the processes that result in inheritance. The top row shows cells at the beginning of meiosis. Each cell has a pair of sex chromosomes with sister chromatids. Since the real **Y** chromosome is much shorter than the real **X** chromosome, the symbol for the **Y** chromosome is shorter.



1a. Label the row of sperm with an S and the row of eggs with an E.

1b. In each cell, draw the symbol(s) for the sex chromosome(s) that cell would have.

2. Complete this Punnett square to show the inheritance of sex chromosomes. Use **X** and **Y** to indicate the genetic makeup of:

- the father's sperm and mother's eggs (produced by meiosis)
- the possible zygotes (produced by fertilization).

3a. Based on your Punnett square, what percent of children are expected to be male?

0% ___ 25% ___ 50% ___ 75% ___ 100% ___

3b. Explain your reasoning.

4a. If a couple's first child was male, what is the probability that their second child will be male?

0% ___ 25% ___ 50% ___ 75% ___ 100% ___

4b. Explain your reasoning.

[1] By Dr. Ingrid Waldron, Dept. Biology, Univ. Pennsylvania, © 2024. This Student Handout (including a GoogleDocs version) and Teacher Notes (with background information and instructional suggestions) are available at https://serendipstudio.org/exchange/bioactivities/geneticsSRB

The chart below shows the sexes of the children in each family of one woman's descendants (her children, three families of grandchildren, and eight families of great-grandchildren). The ♀ and ♂ symbols indicate the sequence of female and male births in each family.

Percent male	0-14%	15-24%	25-34%	35-44%	45-55%	56-65%	66-75%	76-85%	86-100%
One child family	♀								
Two child families	♀♀				♂♀				♂♂ ♂♂ ♂♂
Three child families							♂♂♀		♂♂♂
Four child families	♀♀♀♀		♂♀♀♀		♀♂♂♀				
5+ child families				♀♀♂♀♂♂♀					
All 36 descendants					✓				

5a. Is your prediction about the percent male (in question 3a) accurate for the individual families in the chart above?

5b. Is your prediction about the percent male accurate for all 36 descendants?

6a. Based on the sex of the first child in a family, can you predict that the second child will be the opposite sex? yes ___ no ___

6b. What evidence supports your conclusion?

7a. Explain why the percent male in individual families often differs from the Punnett square prediction. (A complete answer will include fertilizes or fertilization.)

7b. Approximately half the babies born in the US are male. Explain why the Punnett square prediction is accurate for large samples, even though the Punnett square prediction is not accurate for many individual families.

8a. Fill in each blank in these sentences with the best match from the list below.

A Punnett square can accurately predict ___ and ___.
A Punnett square can <u>not</u> accurately predict ___ and ___.

a. the percent male for all the babies born in the US
b. the percent male for one mother's children
c. the probability that the next child in a family will be a boy
d. whether or not the next child in a family will be a boy

8b. Explain your reasoning.