

Does milk make you sick?

Pick allele papers from the boxes at each country's station (replacing the papers after each draw). Record the genotypes in the shaded boxes. Then fill out the Punnett square accordingly. **Answers will vary depending on the alleles drawn.**

Colombia		Father's Genotype	
Mother's genotype			

Ratio: LL _____ LI _____ II _____

Percentage: LL _____ LI _____ II _____

South Korea		Father's Genotype	
Mother's genotype			

Ratio: LL _____ LI _____ II _____

Percentage: LL _____ LI _____ II _____

U.S.		Father's Genotype	
Mother's genotype			

Ratio: LL _____ LI _____ II _____

Percentage: LL _____ LI _____ II _____

U.K.		Father's Genotype	
Mother's genotype			

Ratio: LL _____ LI _____ II _____

Percentage: LL _____ LI _____ II _____

Mexico		Father's Genotype	
Mother's genotype			

Ratio: LL _____ LI _____ II _____

Percentage: LL _____ LI _____ II _____

Native American		Father's Genotype	
Mother's genotype			

Ratio: LL _____ LI _____ II _____

Percentage: LL _____ LI _____ II _____

After completing the Punnett squares for each country, add your ratios to the class Google sheet. Record the group data in the table below. **This information will vary depending on your class results**

Lactose Intolerance					
	LL %	LI %	II %	Lactose Intolerance %	Lactase Persistence %
Colombia				These numbers should match the II%	These numbers should be LL% added to LI%
S. Korea					
U.S.					
Native American					
Mexico					
U.K.					

- What patterns do you notice in the data?
Students should notice 100% lactose intolerant in South Korea, high lactose intolerance in Native Americans, more lactase persistence in the UK.
- Using the patterns in the data, determine whether lactose intolerance is a recessive or dominant trait.
Some students will remember from the video that East Asia is over 90% lactose intolerant, which will lead them to recognize that South Korea's genotype of II must be recessive. Answers will vary; below is an example.
Claim:
Lactose intolerance is a recessive trait
Evidence:
90% of East Asia is lactose intolerant; South Korea is 100% lactose intolerant
Reasoning:
South Korea is in East Asia. If there were a dominant allele present, then the person would be lactase persistent. Since 100% came out lactose intolerant, lactose intolerance must be a recessive trait.
- How do our class numbers compare to the worldwide data?
Answers will vary depending on your class data compared to the worldwide maps and statistics.
- Why might we see differences between our numbers and actual worldwide statistics?
Some reasons could include a small sample size or if the students drew without replacement.

Read the article and answer the following questions:

- How might lactase persistence (being able to digest lactose) be beneficial?
It provides more protein, fat and other nutrients. Nutrients can be used for survival and strength.
- What might be the reason for differences in lactose intolerance frequency between countries?
The early domestication of cattle in the Middle East and moving toward northern Europe provided opportunities to use milk products throughout adulthood. Other countries that didn't have domesticated cattle wouldn't benefit from lactase persistence.
- Choose a country from the [list](#)
 - What percentage of the population is lactose intolerant?
 - What percentage is lactase persistent?
 - Infer the possible genotypes from the data. **Answers will vary.**

Hardy Weinberg Principle

$$p^2 + 2pq + q^2 = 1 \quad \text{and} \quad p + q = 1$$

Your mission is to calculate the number of recessive alleles and the number of dominant alleles found in a population of your choice.

8. Which country did you choose?

9. What percent of that country is lactose intolerant?

This percentage (from #9) will be equal to q^2

	Write your numbers as a decimal		
	USA	Your Country <i>Australia is used as an example</i>	
$q^2 =$	<i>.52</i>	<i>.44</i>	This is the number of homozygous recessive genotypes in a population.
Take the square root to find $\sqrt{q^2} =$	<i>.72</i>	<i>.66</i>	This number is q , the number of recessive alleles found in a population.
Now subtract q from 1 to find p $1 - q =$	<i>.28</i>	<i>.34</i>	This number is p , the number of dominant alleles found in a population.
Now find $p^2 =$	<i>.08</i>	<i>.12</i>	This is the number of homozygous dominant genotypes in a population.
Take 2 times p times q $2pq$	<i>.4</i>	<i>.45</i>	This is the number of heterozygous genotypes in a population.

10. Use the Hardy Weinberg equation to identify each of the following for your country (see table above):

a. The percentage of people in your chosen country with a homozygous dominant genotype (p^2). *8%*

b. The percentage of people in your chosen country with a heterozygous genotype ($2pq$). *40%*

c. The percentage of people in your chosen country with a homozygous recessive genotype (q^2). *52%*

The three answers above in a, b, c, should add up to 100% (99% - 101% depending on the rounding)

11. Using everything you've learned, make a prediction about lactose intolerance in the United States.

What do you think will happen over the next 50 years? What patterns have helped you make this decision?

Accept any prediction as long as it is backed up with evidence and patterns seen in the exploration.