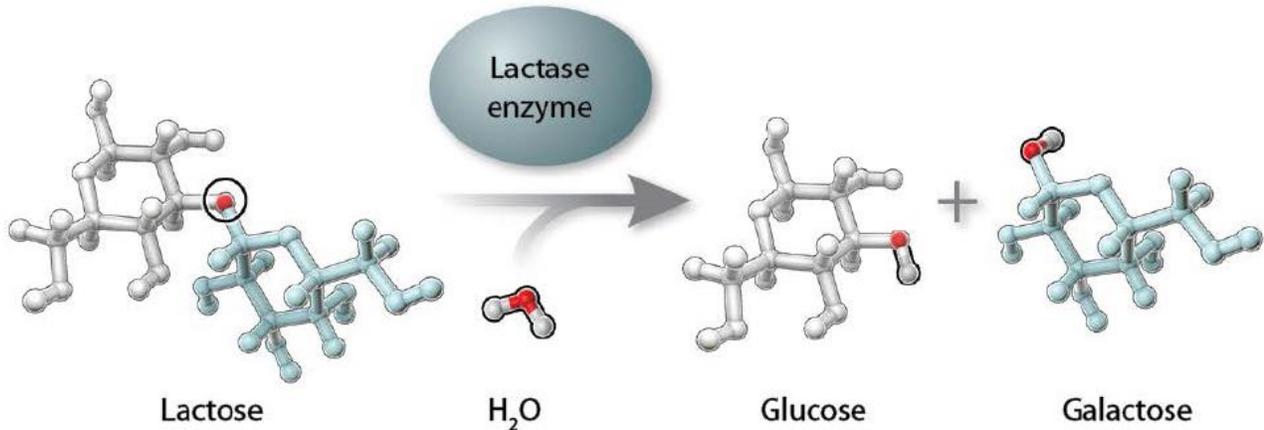


# HHMI: GOT LACTASE? THE CO-EVOLUTION OF GENES AND CULTURE

## INTRODUCTION

“Mother’s milk” is packed with the proteins, fats, and carbohydrates that support the growth, development, and survival of baby mammals. The sugar lactose is the main carbohydrate in milk. Lactose can be cleaved into two simpler sugars, glucose and galactose, by lactase, an enzyme produced in the small intestine. The two smaller sugars are readily absorbed through the intestinal wall into the bloodstream for delivery to the cells of the body, where they are used for energy.



After infant mammals are weaned from their mother’s milk, lactase production shuts down, presumably because it is no longer needed. This condition is called lactase nonpersistence—meaning that production of the lactase enzyme does not *persist* into adulthood. The general condition for mammals is not to consume milk after weaning and to be lactase nonpersistent. Some populations of humans are unusual in that adults continue to consume milk from other mammals, such as cows.

If a person who is lactase nonpersistent drinks milk, undigested lactose passes from the small intestine to the large intestine, where it is fermented by bacteria. Fermentation produces various gases in the large intestine, which can cause abdominal pain, bloating, flatulence, and diarrhea—all symptoms of lactose intolerance. Worldwide, most adults are lactose intolerant, although some people may not know it because their symptoms are mild. Only a minority of human adults (about 35% of the global human population) continues to produce lactase into adulthood and can drink milk without any problems. These individuals are said to be lactase persistent or lactose tolerant. There are several ways to test whether someone is lactase persistent. In the short film, *Got Lactase? The Co-evolution of Genes and Culture*, the narrator, Dr. Spencer Wells, takes a blood glucose test to deduce his lactase status. In this activity you will examine the results of blood glucose tests conducted on six different adults to determine who is lactase persistent (lactose tolerant) or lactase nonpersistent (lactose intolerant).

## PROCEDURE

### PART A:

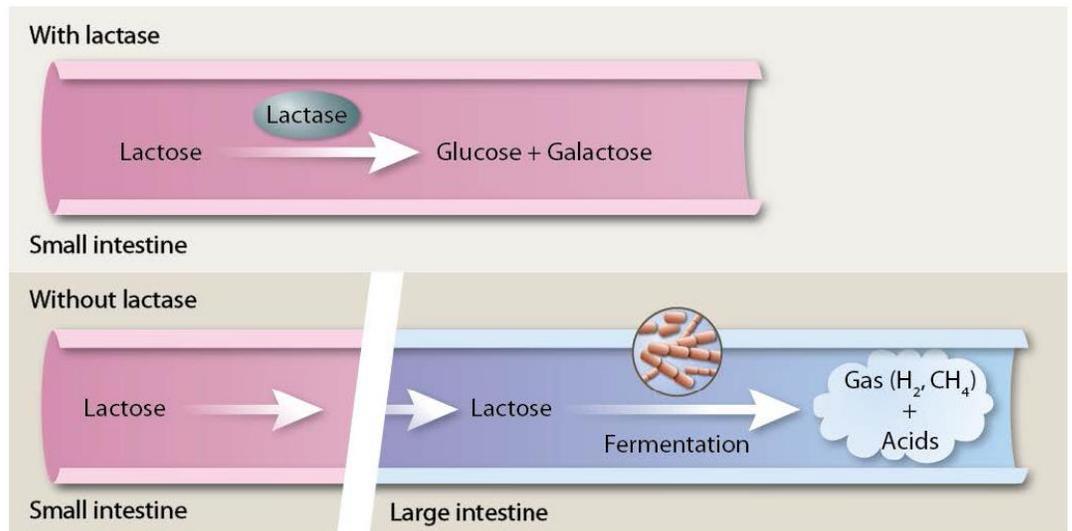
1. Examine the data in the table on the next page. It shows the blood glucose levels of six individuals tested in Dr. Sarah Tishkoff’s laboratory. After baseline (i.e., time 0 minutes) blood glucose levels were measured and recorded, each person drank a liter of milk. Blood glucose levels were again measured at 15, 30, 45, and 60 minutes after drinking the milk. Glucose levels were measured using glucose strips and a glucose reader similar to the one Dr. Wells used in the film.

Individual	Glucose (mg/dL)				
	0 minutes	15 minutes	30 minutes	45 minutes	60 minutes
Spencer Wells	117	128	146	160	152
Peter	97	111	135	154	143
Rachel	96	99	105	101	98
Katherine	95	97	99	101	102
Sarah	108	116	129	141	139
Michael	94	109	128	143	140
Arthur	97	96	94	83	88

- Plot the results from the six individuals on a sheet of graph paper. On the X-axis plot the time (0, 15, 30, 45, and 60 minutes) and on the Y-axis plot the Glucose (in mg/dL). Make sure to include a legend for your graph, label your axis and include a title.

### PART B:

Another common test used to determine whether a person is lactase persistent is the hydrogen breath test. This test measures the amount of hydrogen in a person's breath. As you read in the introduction, undigested lactose is fermented by bacteria in the large intestine, producing several gases, including hydrogen. These gases exit the body through the anus; they can also be absorbed into the blood, circulated to the lungs, and eliminated through the breath.



- Review the data in the following table. It shows the hydrogen breath levels of four individuals tested for lactase persistence. Time 0 represents the time before drinking milk and the other times are times after drinking milk.

Individuals	Hydrogen Breath Levels (ppm)				
	0 minutes	30 minutes	60 minutes	90 minutes	120 minutes
Lisa	5	6	9	8	5
Dan	4	9	8	29	35
Cindy	6	8	10	31	32
Brian	4	7	6	9	6

- Graph the data for the individuals in the table above, including a title, labels for the x- and y-axes, and a legend.