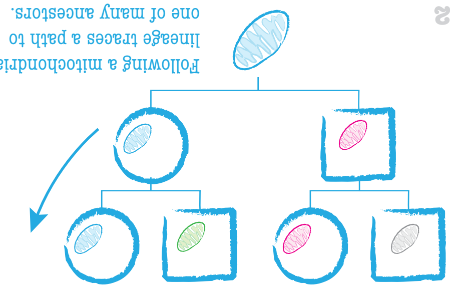
Did *y-chromosome* Adam ever meet *mitochondrial* Eve?

And what's the big deal, anyway?

"Mitochondrial Eve" (mt-Eve) is a catchy name for the most recent common female ancestor who's mitochondria (a cellular organelle which contains it's own small set of genes) was in turn the common ancestor of all mitochondria in humans alive today. mt-Eve was not the first female *homo sapiens*, nor was she the only woman of her time who has descendants today.

In most animal species mitochondria in sperm are destroyed during fertilization. All mitochondria in each new generation are therefore descended only from maternal mitochondria found in the egg cell.



Following a mitochondrial lineage traces a path to one of many ancestors.

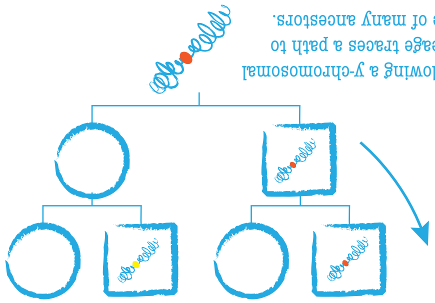
Tracing a mitochondrial lineage backward follows one specific path, through mothers only, to one specific ancestor. mtEve's friends may also have living descendants, but because those lineages include generations with only sons, we no longer inherit their mitochondria (see pink mitochondrial line at left). Specific genes from their nuclear DNA, however likely do survive in some, but not all of us.

Likewise, *"y-chromosome Adam"* (yc-Adam) is the (slightly less catchy) name referring to the most recent common male ancestor of all human males alive today (plus the fathers of all women alive today). He was not the first male *homo sapiens*, nor was he the only male of his time who has descendants living today.

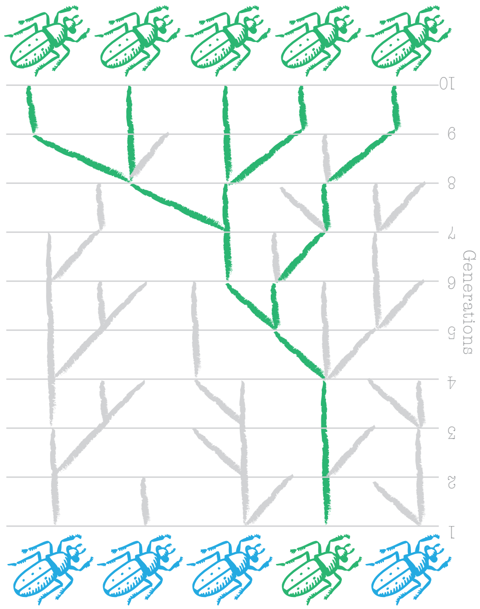
Tracing the lineage of a y-chromosome backward from father to father will lead to one specific ancestor. Other males of Adam's time may have living descendants, but

because their lineages included generations with only daughters along the way, their descenants no longer inherit Adam's y-chromosome. Men and women today, however, have likely inherited some genes from the other chromosomes of Adam's friends.

Why would the mitochondria of only one woman, or the y-chromosome of any one man, be the only one surviving today? Lineages of either can easily die out when generations with only sons or only daughters occur. All species



Following a y-chromosomal lineage traces a path to one of many ancestors.



Tracing the lineage of a mitochondria (or y-chromosome, or gene variant) forward, it is possible for one lineage to randomly outlast other lineages. The rate at which this can happen depends on population size, number of generations, and random drift.

with two sexes, plant and animal, will have Adams and Eves for genes with sex-related inheritance.

All gene variations in a population have the potential to die out due to genetic drift–the random extinction or survival of a genetic liniage. The further back in history a gene occurs, the more likely that it will have died out by the present, leaving fewer and fewer lineages. Using a combination of methods to calibrate the mutation-rate "clock", population geneticists can determine a range of time in which the most recent common ancestor lived. We are reasonably sure that mt-Eve lived about 200,000 years ago, give or take a few tens of thousands of years. yc-Adam is likely to have lived more recently, probably about 70,000 years ago, with the same margin of error.

So the answer to our question–did the twain ever meet?–is most certainly **no.**

Because this method only identifies a most recent common ancestor for one genetic unit, it is not sufficient by itself to identify the primary ancestral populations for an individual. A coalescence of many different gene histories must be found in order to determine the most likely deep ancestral tree. Just because you share mt-DNA with a specific African tribe or Mediterranean population, does not necessarily mean that you are most closely related to that group.

One final interesting thing to think about regarding mt-Eve and yc-Adam: at the time our mt-Eve and yc-Adam lived, the human species had a different mt-Eve and yc-Adam deeper in its past. At some point in history, mt-Eve and yc-Adam would predate the appearance of *homo sapiens*. And, it is only by chance that they do not do so today.

In a few thousand years, the human species will have a new yc-Adam and mt-Eve–the most recent common mt- and yc- ancestors will no longer trace to the same individuals that they do today. Mind-bending stuff, isn't it!

Learn more:

www.pbs.org/wgbh/nova/neanderthals/mtdna.html

http://evolution.berkeley.edu/evolibrary/news/071101_genealogy

The Ancestor's Tale: A Pilgrimage to the Dawn of Evolution, by Richard Dawkins, 2005, "Eve's Tale"

Darwinian detectives: revealing the natural history of genes and genomes, by Norman A. Johnson, 2007. Chapter 6: Finding Our Roots: Did "Eve" Know "Adam"?

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Beetle courtesy of Discovery Education's Clip Art Gallery, created by Mark A. Hicks

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by C.A.G. 2009