Does having a Y chromosome make someone a man?

A lot of unintended harm happens when people assume a Y chromosome makes a person a boy or a man and the lack of a Y chromosome makes a person a girl or a woman. For example, one physician educator on our [**Medical Advisory Board**](http://www.isna.org/about/medicalboard) had the challenging experience of trying to calm a 23-year-old patient who had just been told by a resident that she was “really a man” because the resident had diagnosed the patient as having a Y chromosome and complete [**androgen insensitivity syndrome**](http://www.isna.org/faq/conditions/ais) (CAIS).

It is true that in typical male development, the SRY gene on the tip of the Y chromosome helps to send the embryo down the masculine pathway. But more than the SRY is needed for sex determination and differentiation; for example, women with CAIS have the SRY gene but lack androgen receptors. In terms of hormone effects on their bodies (including their brains), women with CAIS have had much less “masculinization” than the average 46,XX woman because their cells do not respond to androgens.

Moreover, the SRY gene can be translocated onto an X chromosome (so that a 46,XX person may develop along a typical masculine pathway), and there are dozens of genes on chromosomes other than the X and the Y that contribute to sexual differentiation. And beyond the genes, a person’s sex development can be significantly influenced by environmental factors (including the maternal uterine environment in which the fetus developed).

So it is simply incorrect to think that you can tell a person’s sex just looking at whether he or she has a Y chromosome.

Want to know more? The following comes from ISNA’s Medical Advisory Board member Dr. Charmian Quigley:

SRY, discovered in 1989, is a small gene located at the tip of the short arm of the Y chromosome. So what does it do? Actually, like all genes, it does nothing except to act as a blueprint for a protein. In this case, the protein of the same name does funky things to DNA, like bending it and unwinding the 2 strands, so that other proteins can get in and attach themselves to other genes that are then turned on. So how did this gene get its reputation (and its name) as the “sex determining” gene?

As is pretty common in the world of genetics, this was because of some errant mice. Researchers in England took a laboratory-made copy of this gene and inserted it artificially into a female (XX) mouse embryo at a very early stage of development. The mouse was “converted” from female to male, so the gene must have been responsible – right? Well, maybe not. A few years later, a similar gene was found on human chromosome 17. When the important part of this gene was inserted into a female mouse embryo, the same thing happened. Voila! A male.

So now we have 2 genes that can turn a female into a male, and one of them is not located on the Y chromosome! How can that be? It turns out that SRY is probably just a facilitator that allows a more critical gene (or genes) to function, by blocking the action of another opposing factor. Can the magic of genetics do the opposite – turn a male into a female? Indeed it can. A gene on the X chromosome (the chromosome one typically associates with “femaleness”) called DAX1 when present in double copy in a male (XY) mouse, turns it into a female.

So now we have genes on the Y that can turn females with XX chromosomes into males and genes on the X that can turn males with XY chromosomes into females… wow! Maleness and femaleness are NOT determined by having an X or a Y, since switching a couple of genes around can turn things upside down.

In fact, there’s a whole lot more to maleness and femaleness than X or Y chromosomes. About 1 in 20,000 men has no Y chromosome, instead having 2 Xs. This means that in the United States there are about 7,500 men without a Y chromosome. The equivalent situation - females who have XY instead of XX chromosomes - can occur for a variety of reasons and overall is similar in frequency.

For these 15,000 or more individuals in the US (and who knows how many worldwide), their chromosomes are irrelevant. It is the total complement of their genes along with their life experiences (physical, mental, social) that makes them who they are (or any of us, for that matter). The last time I counted, there were at least 30 genes that have been found to have important roles in the development of sex in either humans or mice. Of these 30 or so genes 3 are located on the X chromosome, 1 on the Y chromosome and the rest are on other chromosomes, called autosomes (on chromosomes 1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 17, 19).

In light of this, sex should be considered not a product of our chromosomes, but rather, a product of our total genetic makeup, and of the functions of these genes during development.

<http://www.isna.org/faq/y_chromosome>