Why Sex Is Binary (New)

A binary is a system composed of two parts—a duality, a pair. In developmental biology, sex is binary. Here’s why. An organism’s sex is defined as the type of gamete their reproductive anatomy is organized to produce: Male bodies develop towards the production of small gametes (sperm), whereas female bodies develop towards the production of large gametes (ova). Because there are no intermediate gametes between sperm and eggs (such as the often joked about sperg or speggs), there are therefore only two sexes. In humans, this sexual dimorphism is so consistent that 99.98% of births are unambiguously male or female. As developmental biologist Dr. Emma Hilton and evolutionary biologist Dr. Colin Wright note, “The evolutionary function of these two anatomies is to aid in reproduction via the fusion of sperm and ova. No third type of sex cell exists in humans, and therefore there is no sex ‘spectrum’ or additional sexes beyond male and female. Sex is binary.”

To understand how this binary system is produced, let’s explore the process of sex determination. Sex in humans is genetically determined at conception, solely by the presence or absence of a functioning SRY gene, which is located on the short arm of the Y chromosome. With SRY activation, the gonads differentiate into testes, and the fetus develops anatomy to support the production of small gametes. In the absence of SRY activation, the gonads differentiate into ovaries, and the fetus develops anatomy to support the production of large gametes. This is why developmental biologists refer to SRY as the “master switch” gene for mammalian sex determination, because without its activation, the fetus develops as a female.

The critical importance of SRY for sex determination can be seen in differences of sex development. Here’s 3 examples:

1) On very rare occasions, a fetus may develop with two X chromosomes and one Y, or three Xs and one Y, or even four Xs and one Y. Despite the extra X chromosomes, all these cases develop as males thanks to the presence of SRY on the Y chromosome.

2) Sometimes, a translocation of the SRY gene results in it being placed on an X chromosome in a fetus with two X chromosomes. Thanks to the presence of SRY, the fetus develops testicular tissue despite having no Y chromosome.

3) In exceptional cases, a fetus may develop a female phenotype with an XY karyotype. Because the SRY gene remained inactive, they developed as females.

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Thanks to the master switch SRY gene, we can see that sex determination is entirely dimorphic. However, this does not exclude variation within the binary system. Sex differences between males and females are commonplace. There is variation of chromosomes, gene expression, gonadal tissue, hormone production, genital morphology, height, weight, voice pitch, muscle mass, bone density, and more.

But, no matter the variation of traits, the principle remains: sex is defined by the type of gamete your anatomy is organized to produce. Two gamete types, two sexes. As Hilton and Wright note, “Not everyone needs to be discretely assignable to one or the other sex in order for biological sex to be functionally binary. To assume otherwise--to confuse secondary sexual traits with biological sex itself--is a category error.”

Such boundaries in biology can be fuzzy, but the boundaries of gametes are clear. Or, as evolutionary biologist Dr. Heather Heying writes, “The boundaries between species are almost always fuzzy. The moment of change, when one species becomes two, is rarely known. It is this fuzziness, in part, that explains why we have so many species concepts. So many species concepts, but only two types of gametes. In animals, the borders between gamete types aren’t fuzzy. Gametes are always male or female. There is no in between.”

This is why sex is binary—not because there is no spectrum of human body types, there is. Sex is binary because there are only two gamete types bodies can be organized around: sperm and eggs. If, however, you happen to find the mythical intermediate gametes spergs or speggs, let us know.

I’m Zach, for the Paradox Institute.

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