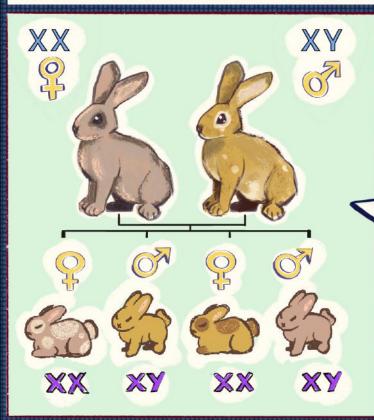


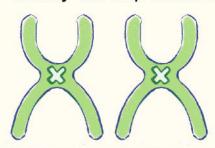
For most vertebrates, the sex of an animal is determined by its genes, we call that Genetic Sex Determination or **GSD.** A major Sex Determining Gene (**SDG**) on a sex chromosome regulates ovary or testis development.



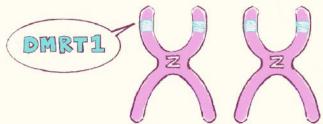
The **SDG** in mammals is SRY, located on the Y chromosome. Individuals with an **X** and a **Y** chromosome usually develop testes.



Individuals with two X chromosomes usually develop ovaries.

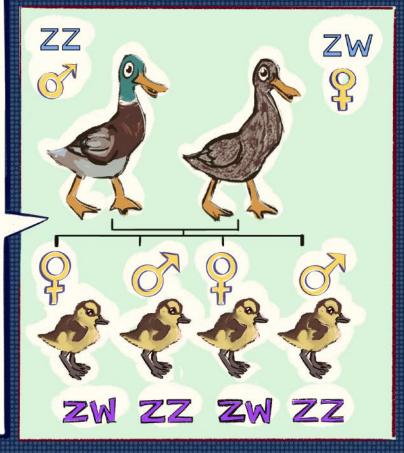


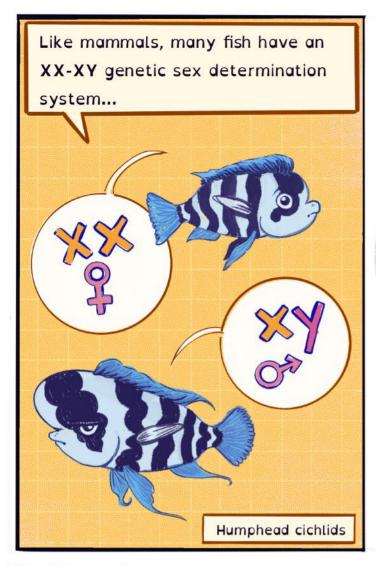
Birds have the opposite system: their SDG is DMRT1 located on the Z chromosome. Males have two Z chromosomes and two DMRT1 genes.

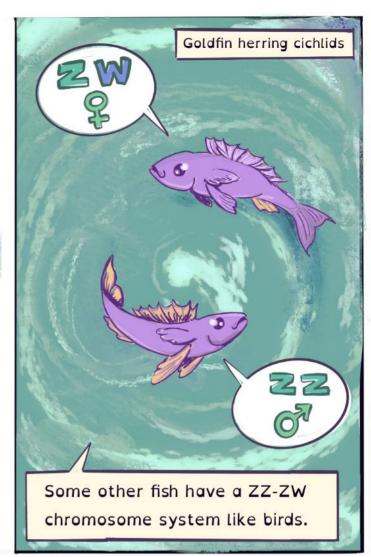


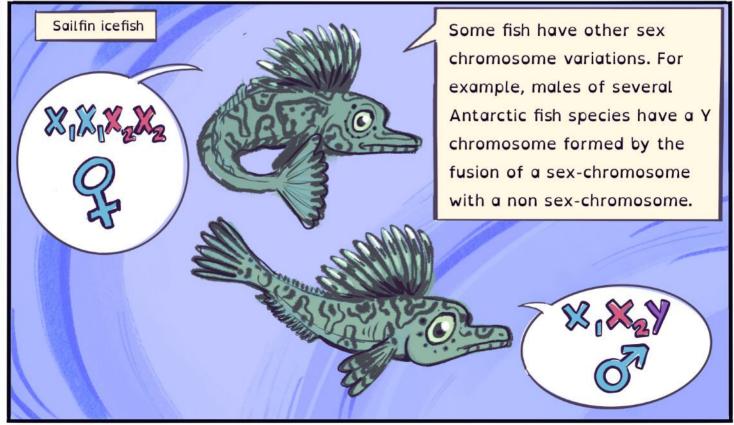
Females have one Z and one W chromosome, and so have only one DMRT1 gene.

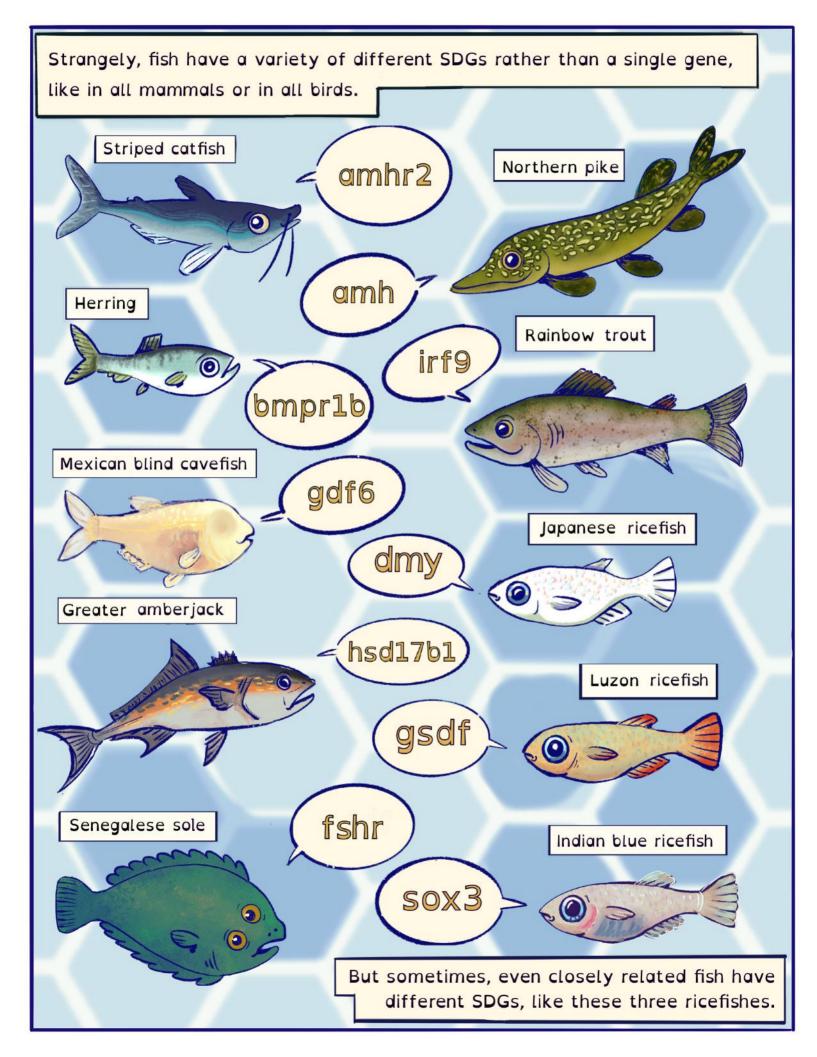


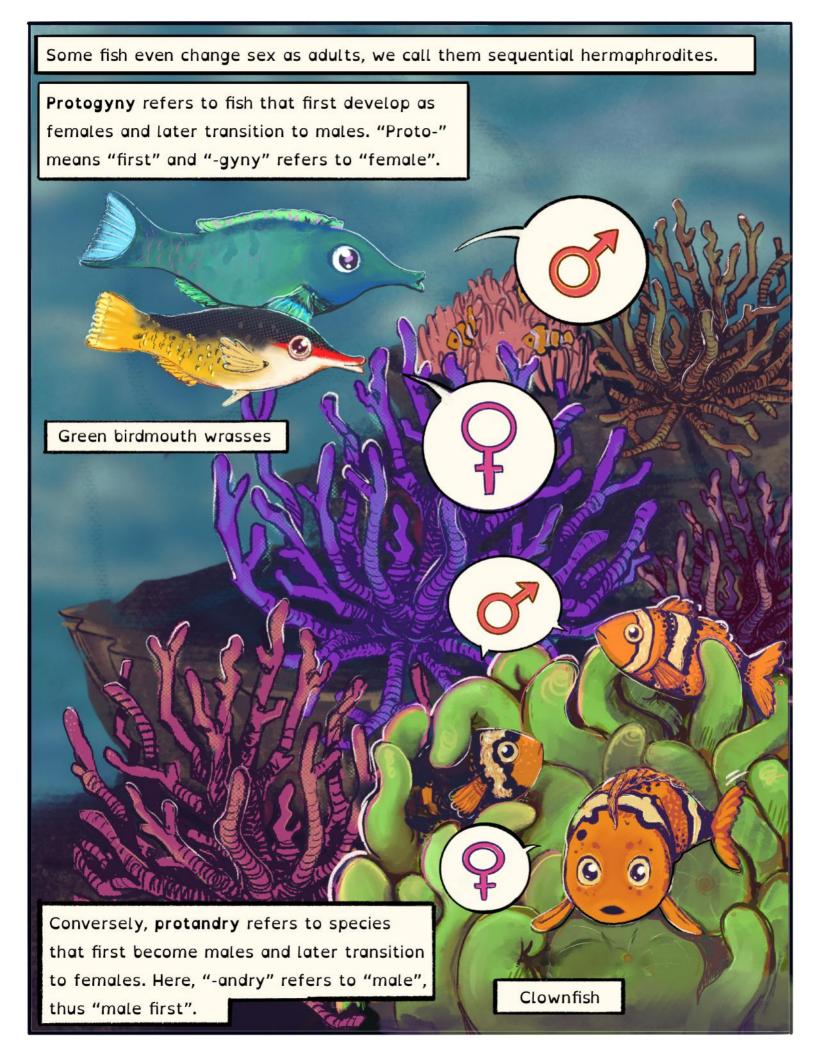












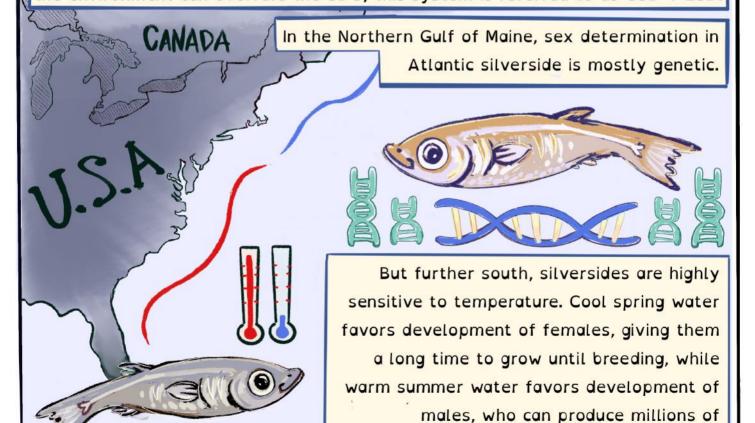


In some cases, genes don't determine the sex of a fish, instead their environment determines their sex, we call that Environmental Sex Determination or ESD.

For example, sometimes temperature can determine the sex of a fish.

And finally, genes and environment can interact: in some species, the effect of the environment can overrule the SDG; this system is referred to as GSD + ESD.

Umbrella cichlids



microscopic sperm even with small bodies.



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Font is OpenDislexic-Alta, a typeface designed for some common symptoms of dyslexia.

This comic was created as part of the University of Oregon Science and Comics Initiative.

This material is based upon work supported by the Office of Polar Programs at the National Science Foundation under NSF grant number OPP-2232891. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

This work was supported by the National Institute of General Medical Sciences (NIGMS) of the National Institutes of Health under award number R35GM139635. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.











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