Sex linkage

Sex linked traits

- Sex-linked phenotypes are influenced by genes on sex chromosomes
- Leads to different genotypes and phenotype expression

Different types of chromosome systems

Mammals

- Most females XX
- Most males XY

Amphibians and some reptiles (including birds)

- Most females ZW
- Most males ZZ

Other systems (many insects)

- Absence of chromosome produces males
- Males develop haploid from unfertilised eggs

Sex determination

- Huge simplification of more complex process
- Some individuals vary in sex chromosome number (e.g., XO or XYY in humans)
- Some individuals have intermediate sexual characteristics (ca 2-4% in humans)[1]
- Sexual characteristics are different from gender[2]

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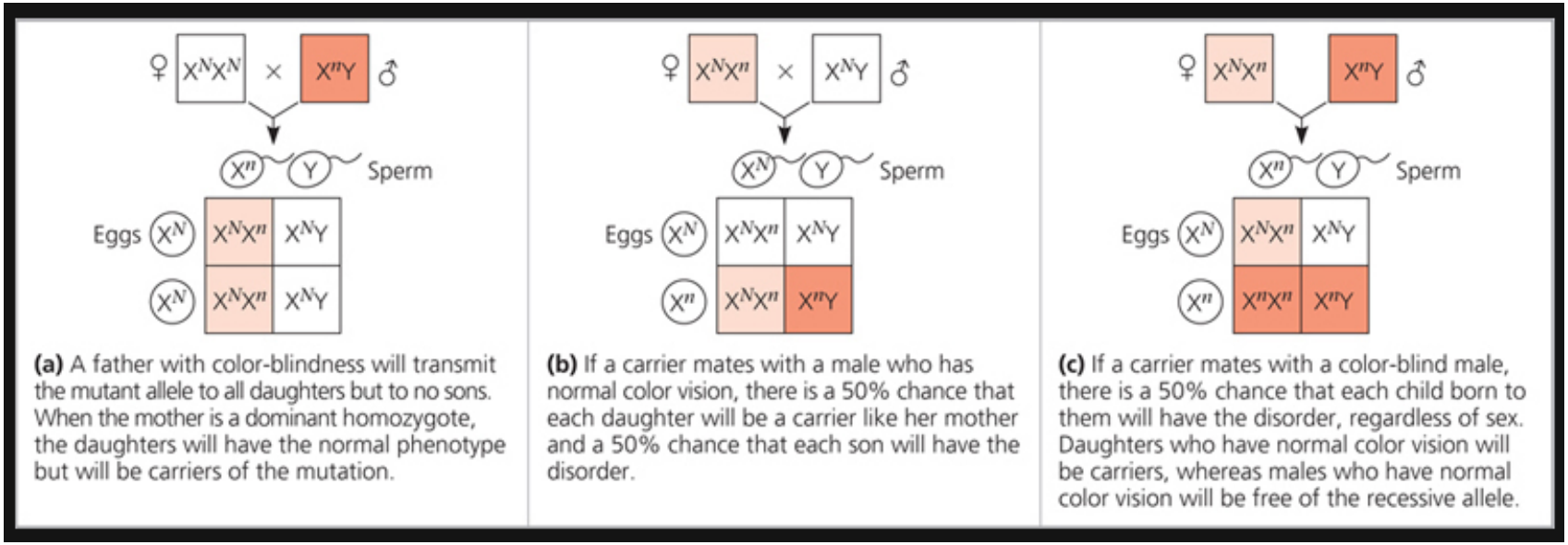
[1] Zeeman, L., & Aranda, K. (2020). A systematic review of the health and healthcare inequalities for people with intersex variance. *International Journal of Environmental Research and Public Health*, 17:6533. [PDF]

[2] Torgrimson, B. N., & Minson, C. T. (2005). Sex and gender: What is the difference? *Journal of Applied Physiology*, 99:785-787. [PDF]

Transmission and expression of sex-linked phenotypes

Alleles on the X chromosome always expressed in XY genotypes

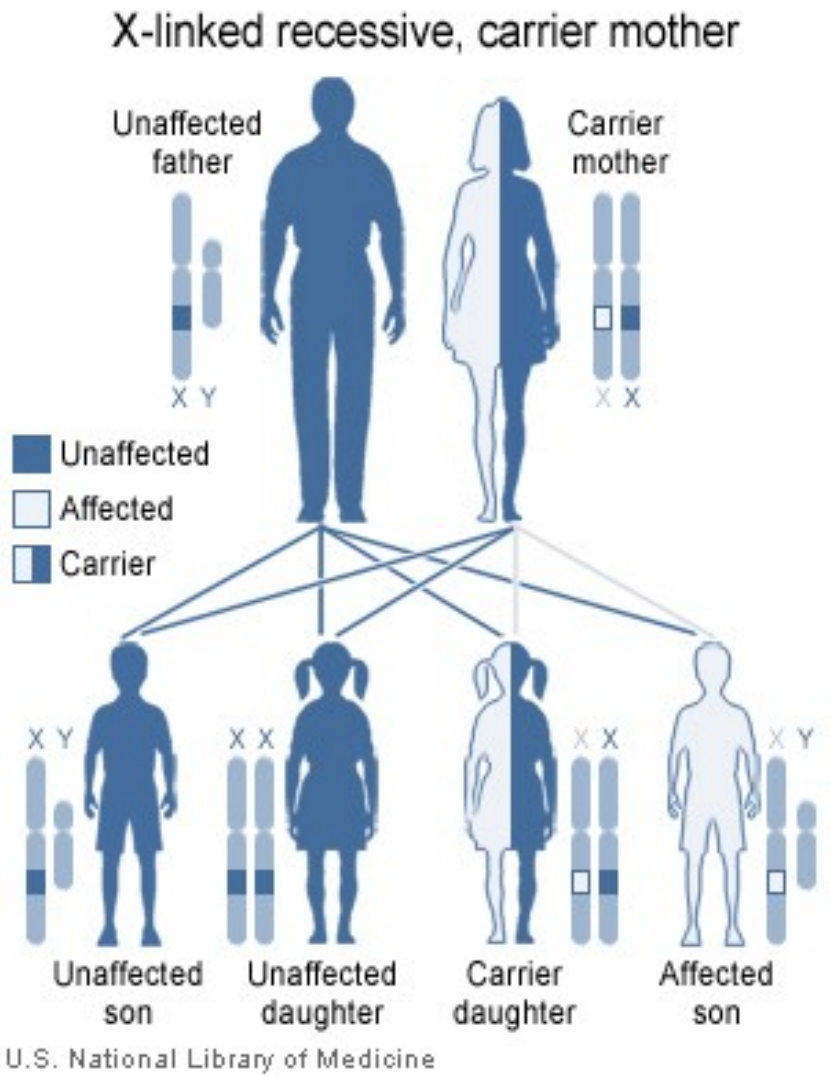


XY individuals generally transmit X to females and Y to males

- Only one X to give female offspring
- Does not give X to male offspring

[1]Image: Campbell N, et al. (2021). Biology: a global approach (12th edition global). Pearson Education Limited. Page 349.

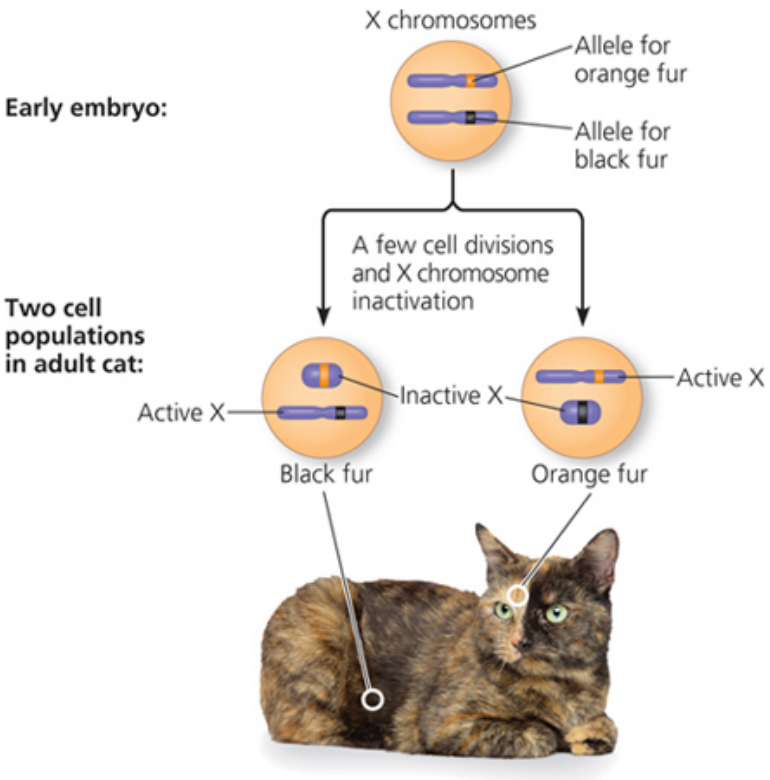
Haemophilia X-linked recessive



- Absence of blood clotting proteins
- Recessive allele on X chromosome
- Treated with protein injections

[1] Image: Public Domain

X inactivation and Barr bodies



- XX mammals do not make twice the amount of X-linked proteins as XYs
- One X chromosome inactivates, so both sexes get the same dose
- Inactive X condenses into a *Barr body*
- XX mammals are mosaics of cells with different active Xs

[1]Image: Campbell N, et al. (2021). Biology: a global approach (12th edition global). Pearson Education Limited. Page 350.