

Sex Determination

BIOS 0802

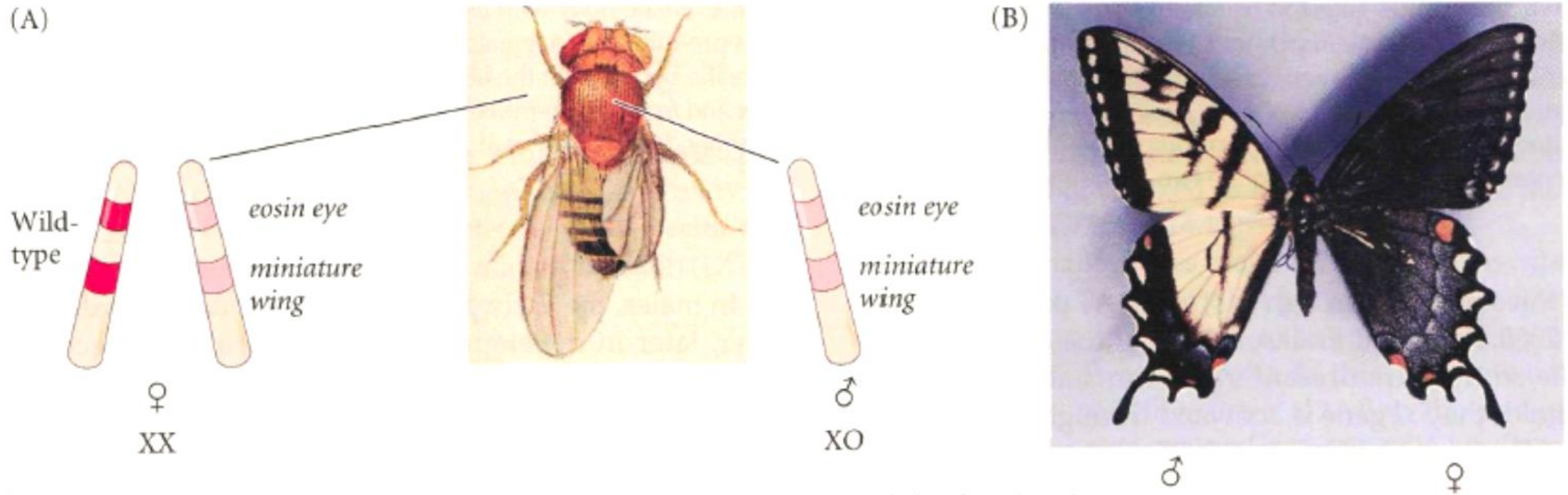
2018

Drosophila

- Drosophila sex is generally determined by 'X' chromosome
 - One copy in a diploid cell = male
 - Two copies in a diploid cell = female
- 'Y' chromosome plays no part in determination of sex
- Interestingly, each cell in Drosophila (and many other insects) determines its own sex
 - In one fly one cell can be male (XO) while the neighbouring cell female (XX)

Gynandromorphs

- Morgan and Bridges (1919) concluded, "Male and female parts and their sex-linked characters are strictly self-determining, each developing according to its own aspiration,"



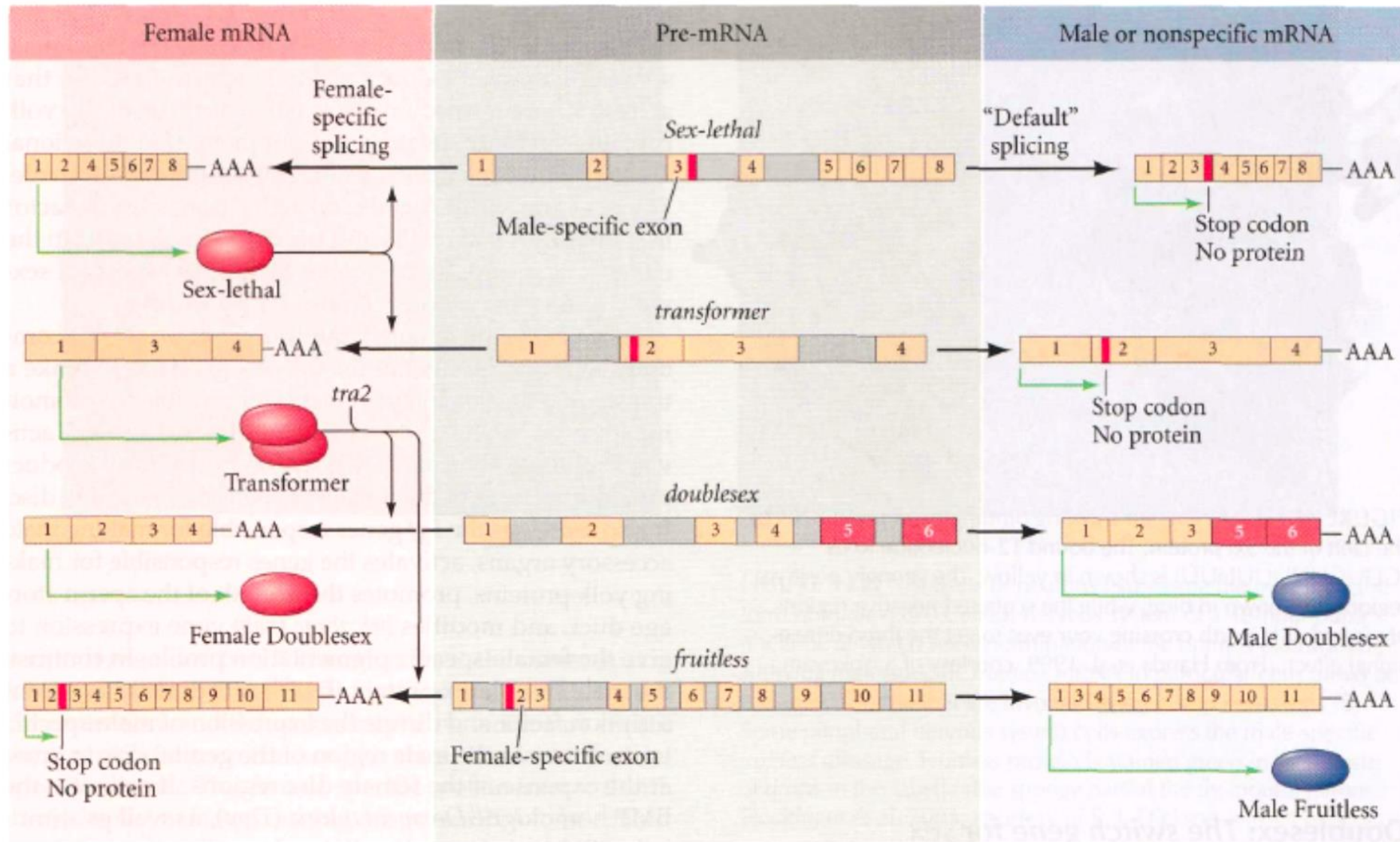
X-to-autosome ratio

- Although it had long been thought that a fruit fly's sex was determined by the X-to-autosome (X:A) ratio (Bridges 1925), this assessment was based largely on the fact that flies have aberrant numbers of chromosomes.
- But recent molecular analyses suggest that X chromosome number alone is the primary sex determinant in normal diploid insects (Erickson and Quintero 2007).
 - Lets see how

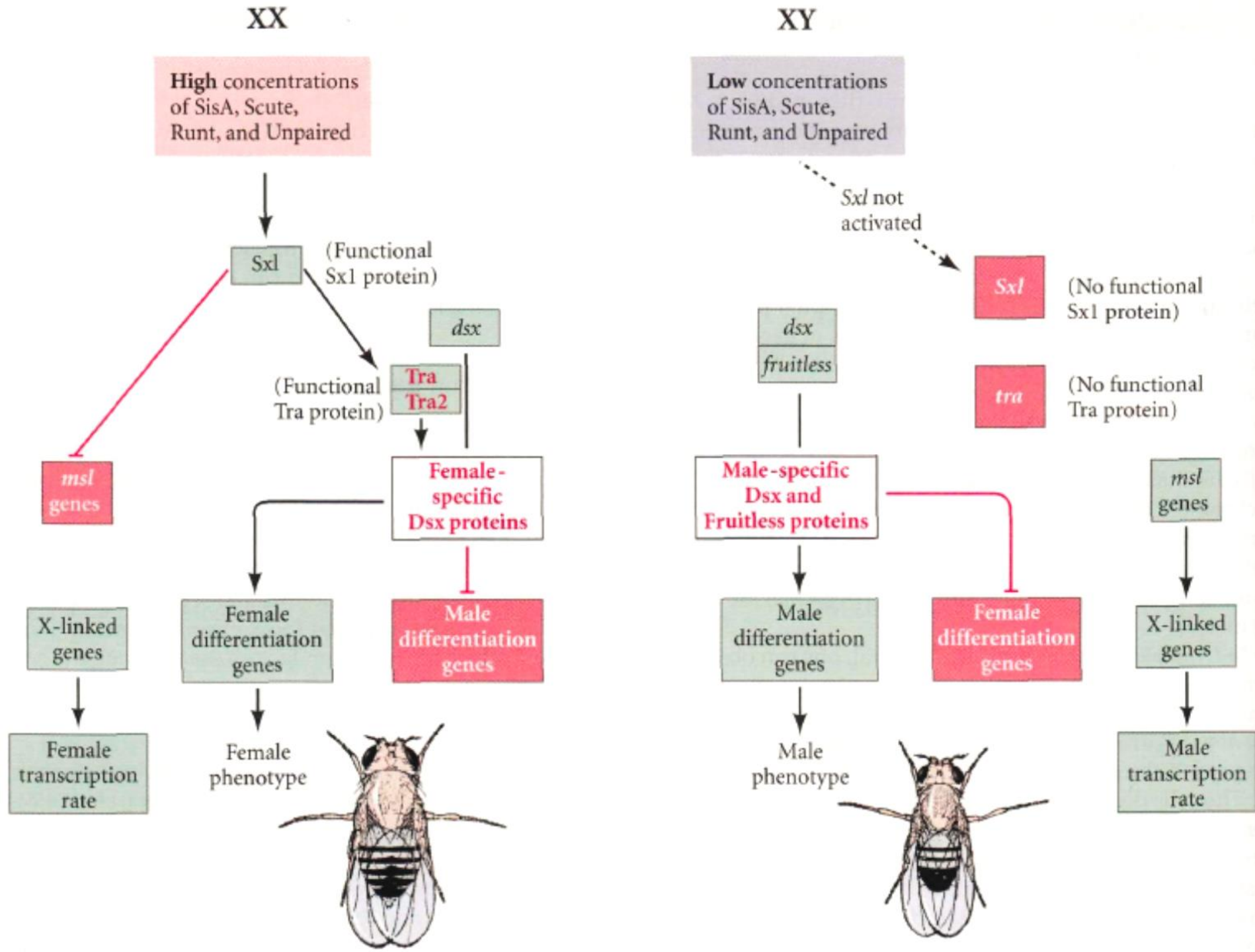
Sex-lethal (Sxl) gene

- X chromosome contains genes encoding transcription factors that activate the critical gene in *Drosophila* sex determination, the autosomal locus *Sex-lethal (Sxl)*
- The *Sxl* gene has two promoters. The early promoter is active only in XX cells; the later one is active in both XX and XY cells.
- The X chromosome appears to encode four protein factors that activate the early promoter of *Sxl*.
- Three of these proteins are transcription factors
 - *SisA*, *Scute*, and *Runt*—which bind to the early promoter to activate transcription
 - *Unpaired*, reinforces other 3 by JAK/STAT pathway

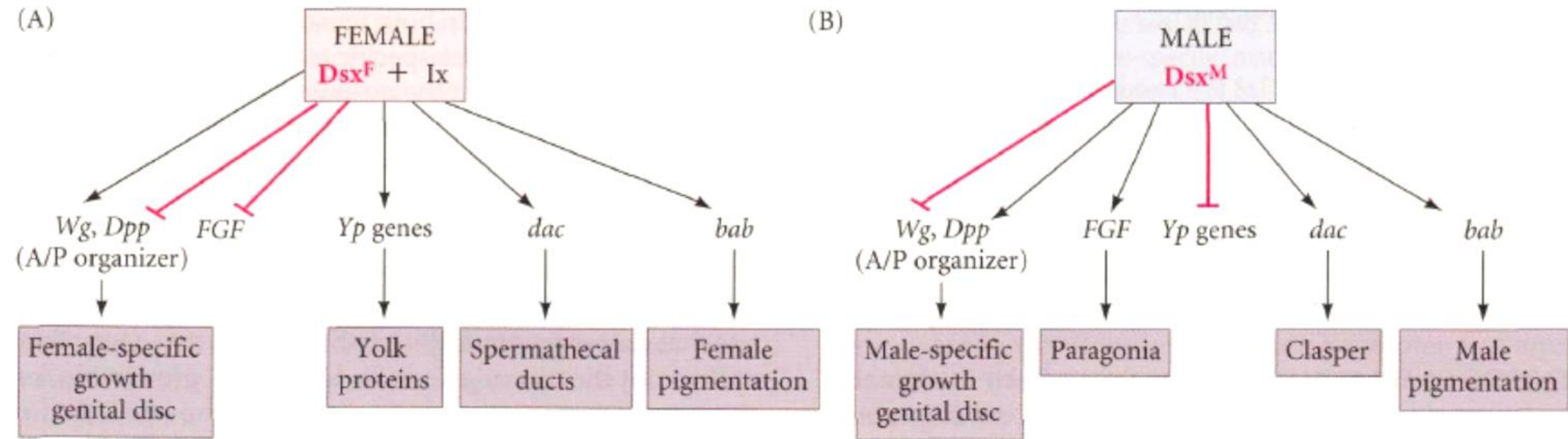
Sx/ mRNA



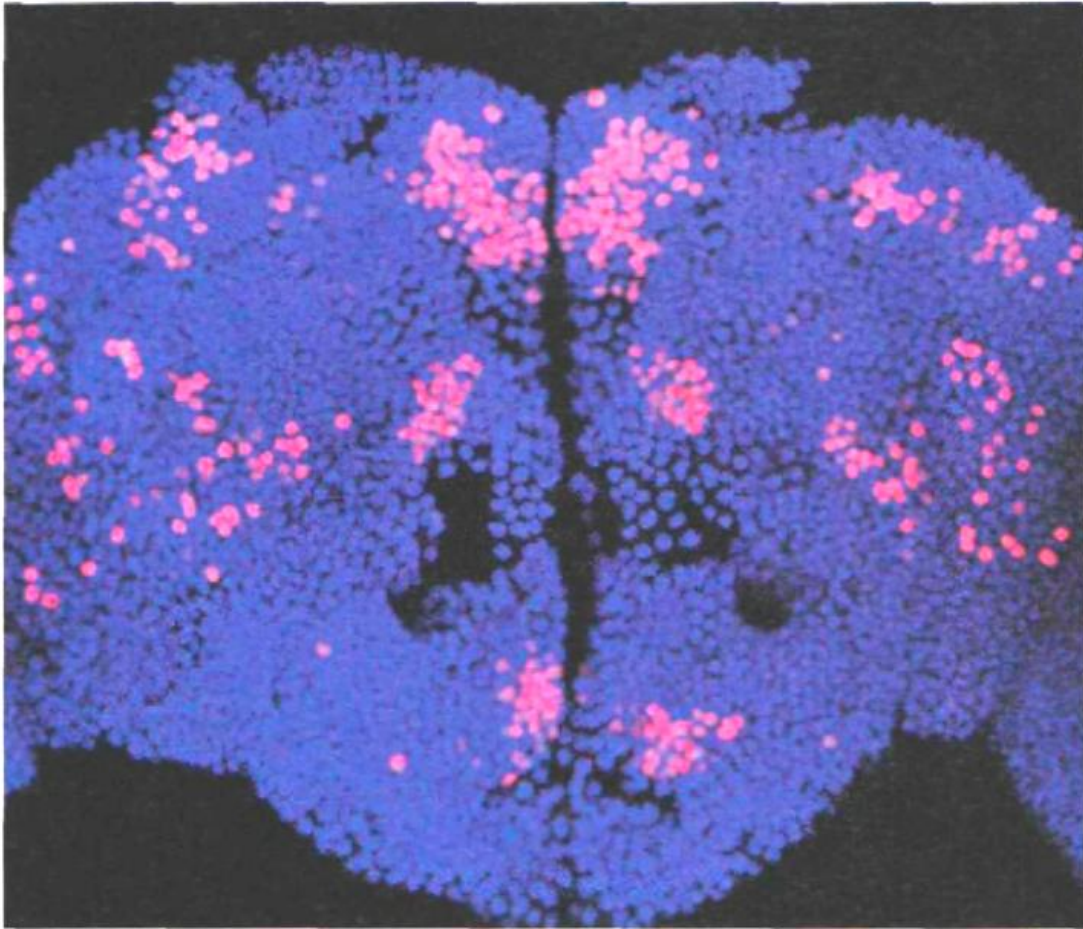
Regulatory cascade



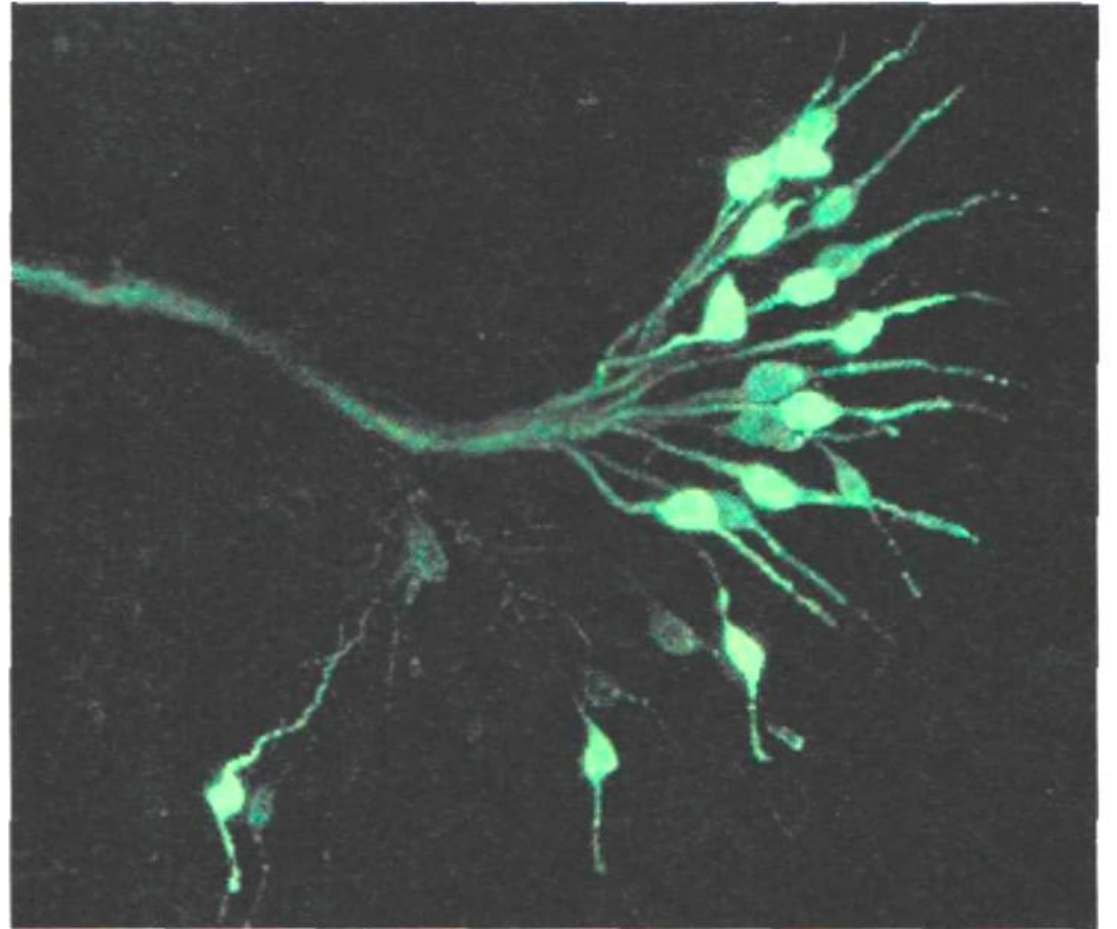
Doublesex function



Behaviour and fruitless



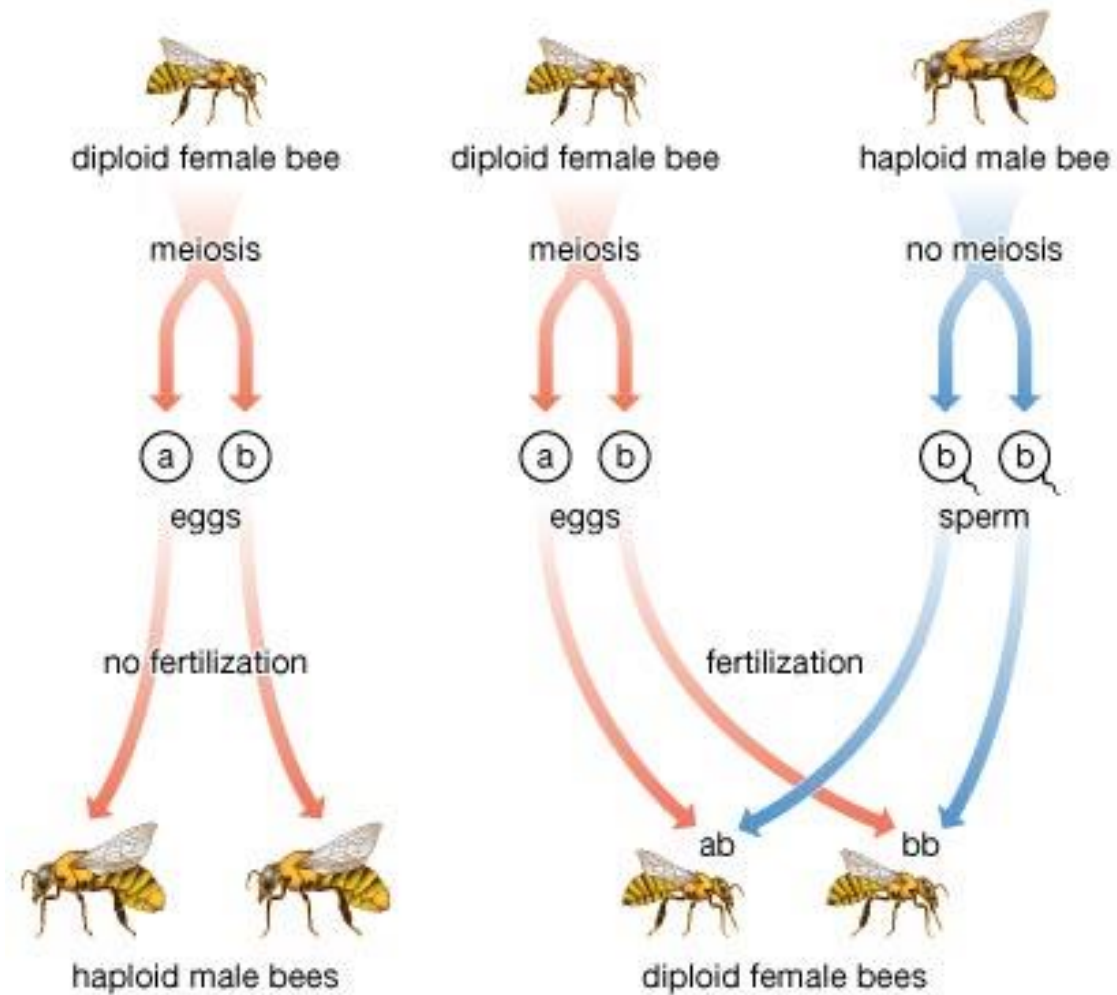
(B)



Dosage compensation

- Sxl binds to the 5' UTR of msl2 mRNA
- That inhibits msl2 attachment with ribosome
- Therefore no msl2 protein
- Without Sxl msl2 proteins are made
- msl2 proteins (it's part of a complex) acetylates histone 4 and unwinds 'X' chromosome
 - Therefore hypertranscription of 'X' in males

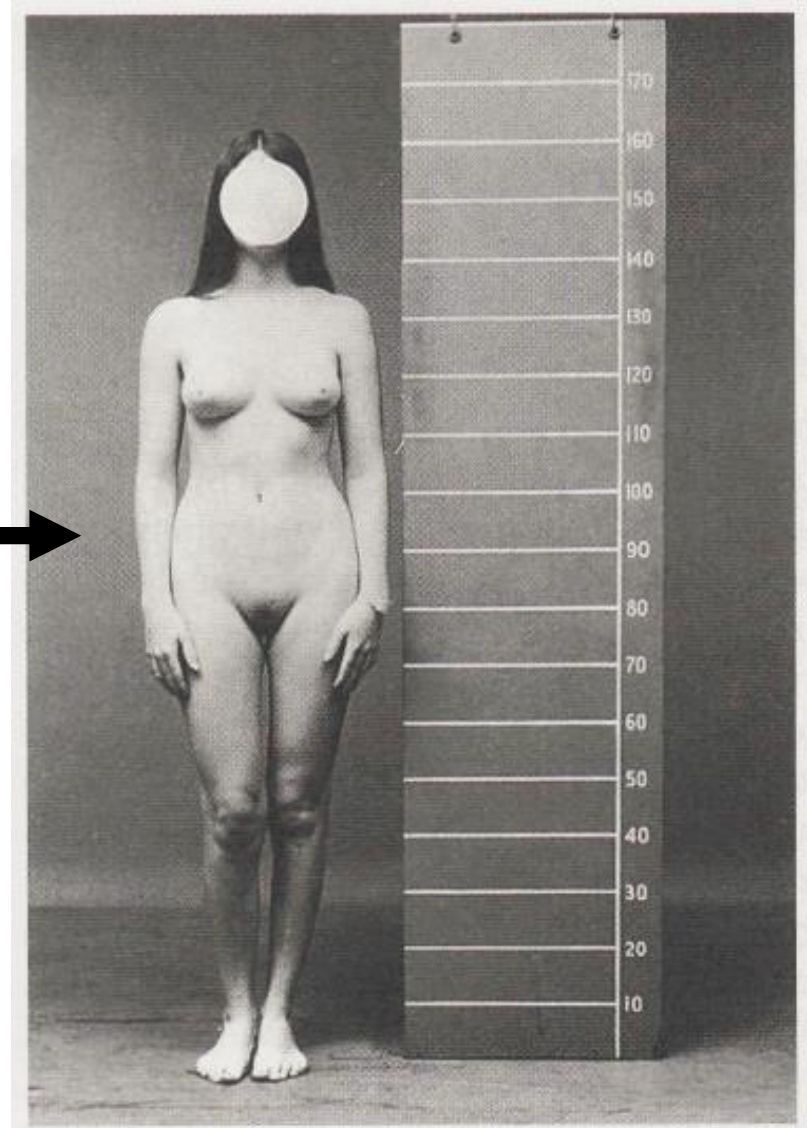
Sex determination in bees



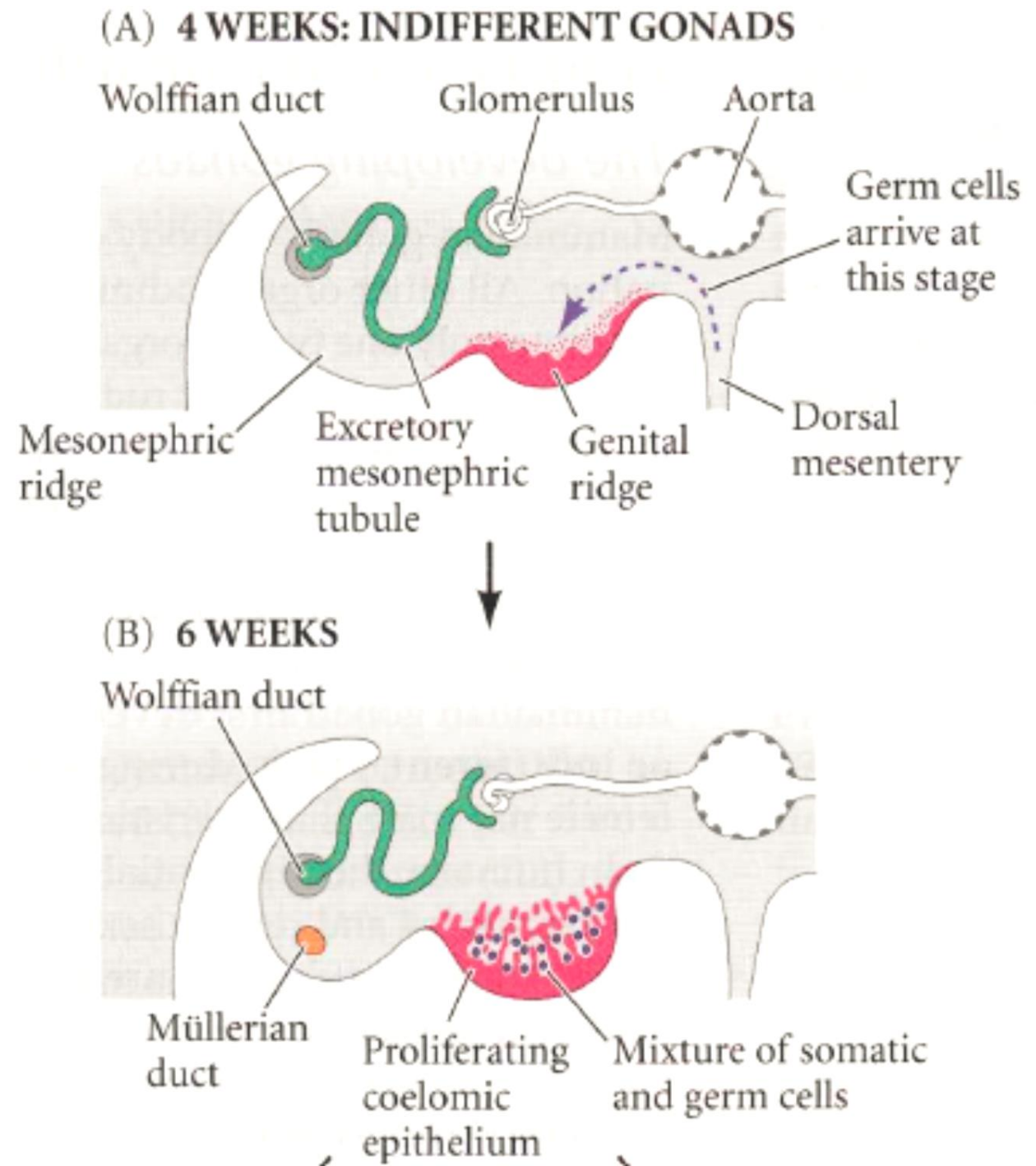
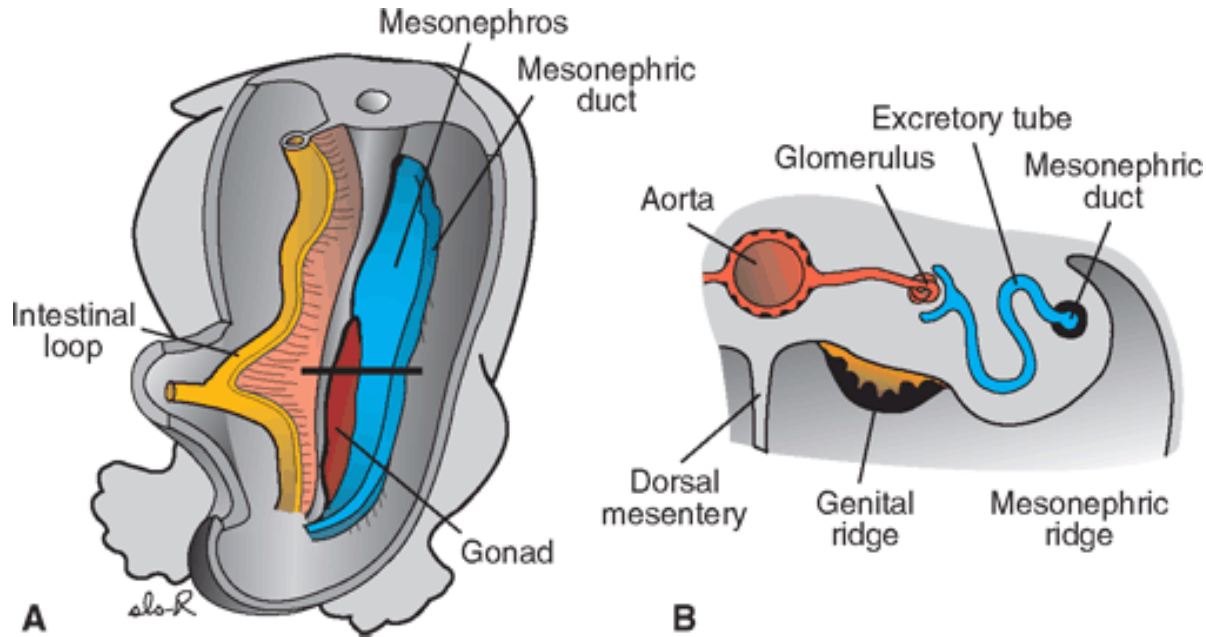
In mammals

- XX = female
- XY = males

Define this individual

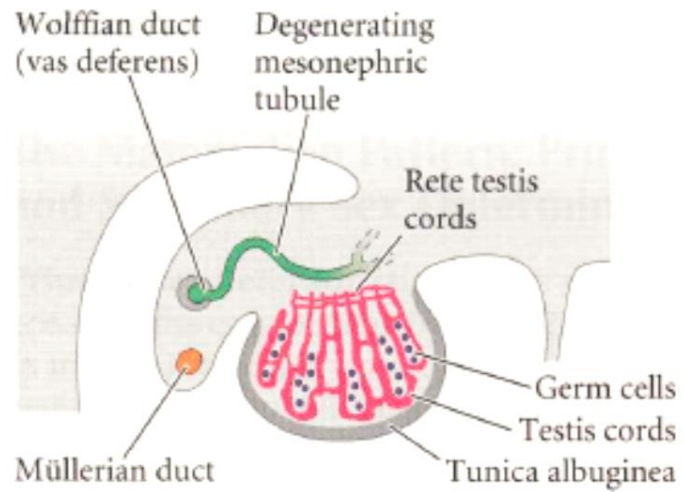


Its all starts with

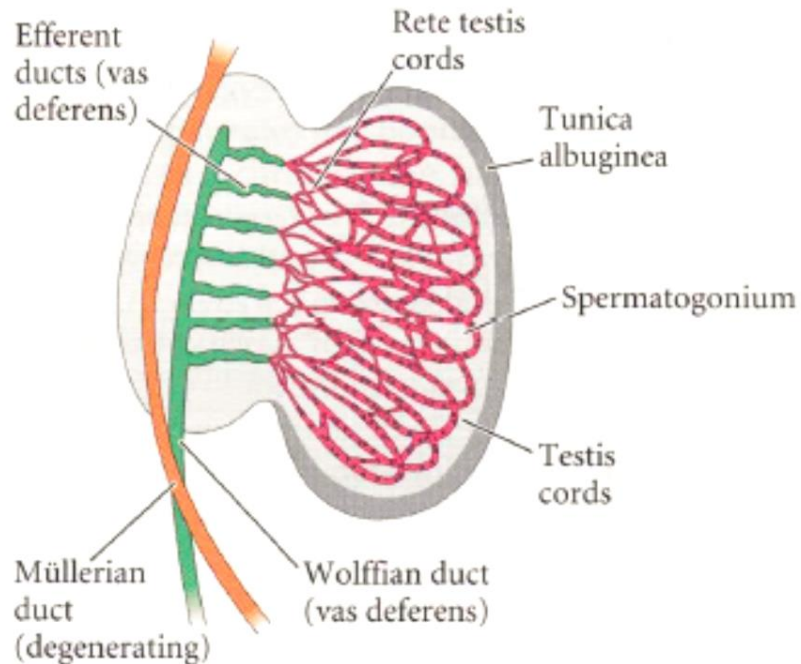


If one has 'Y'

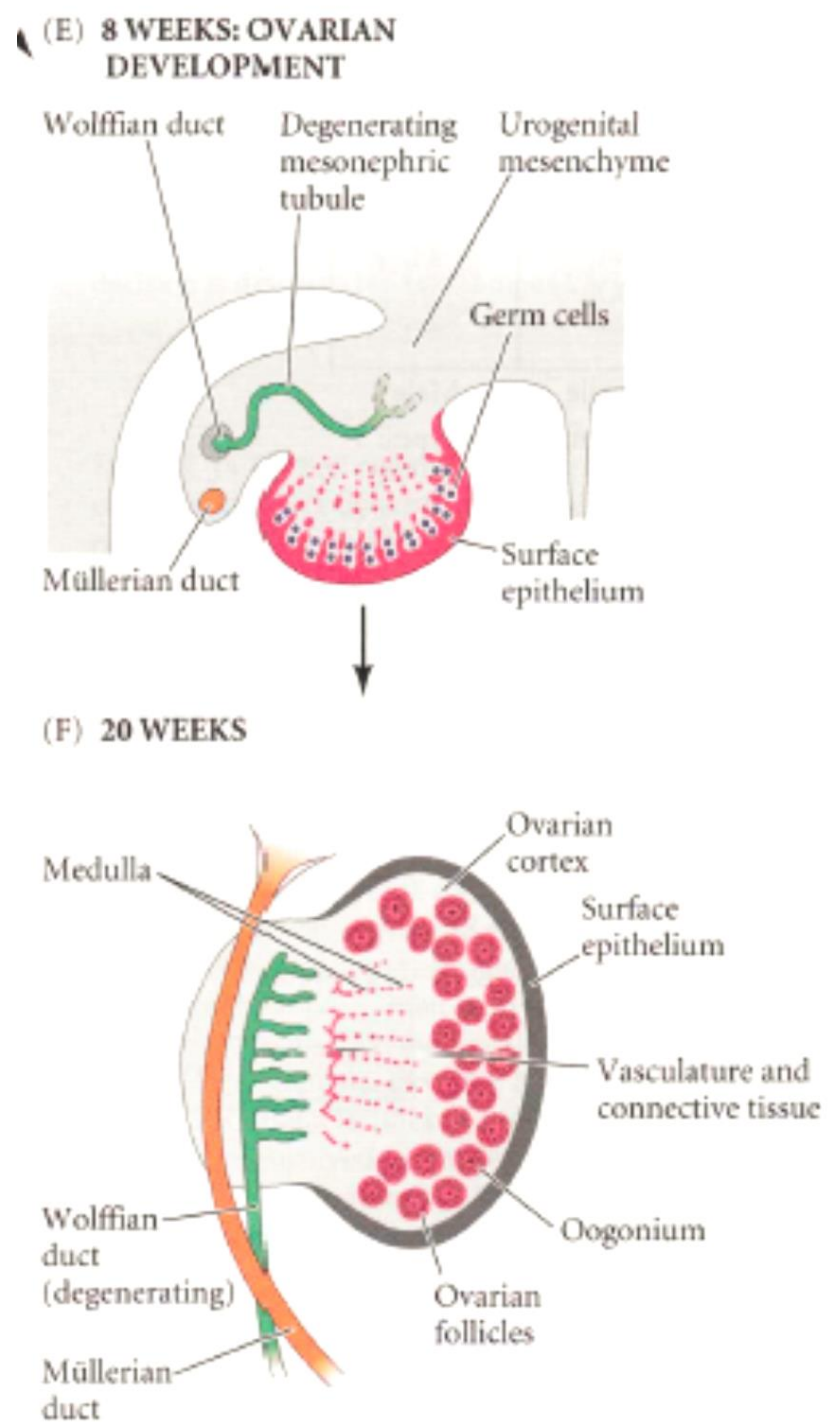
(C) 8 WEEKS: TESTIS DEVELOPMENT



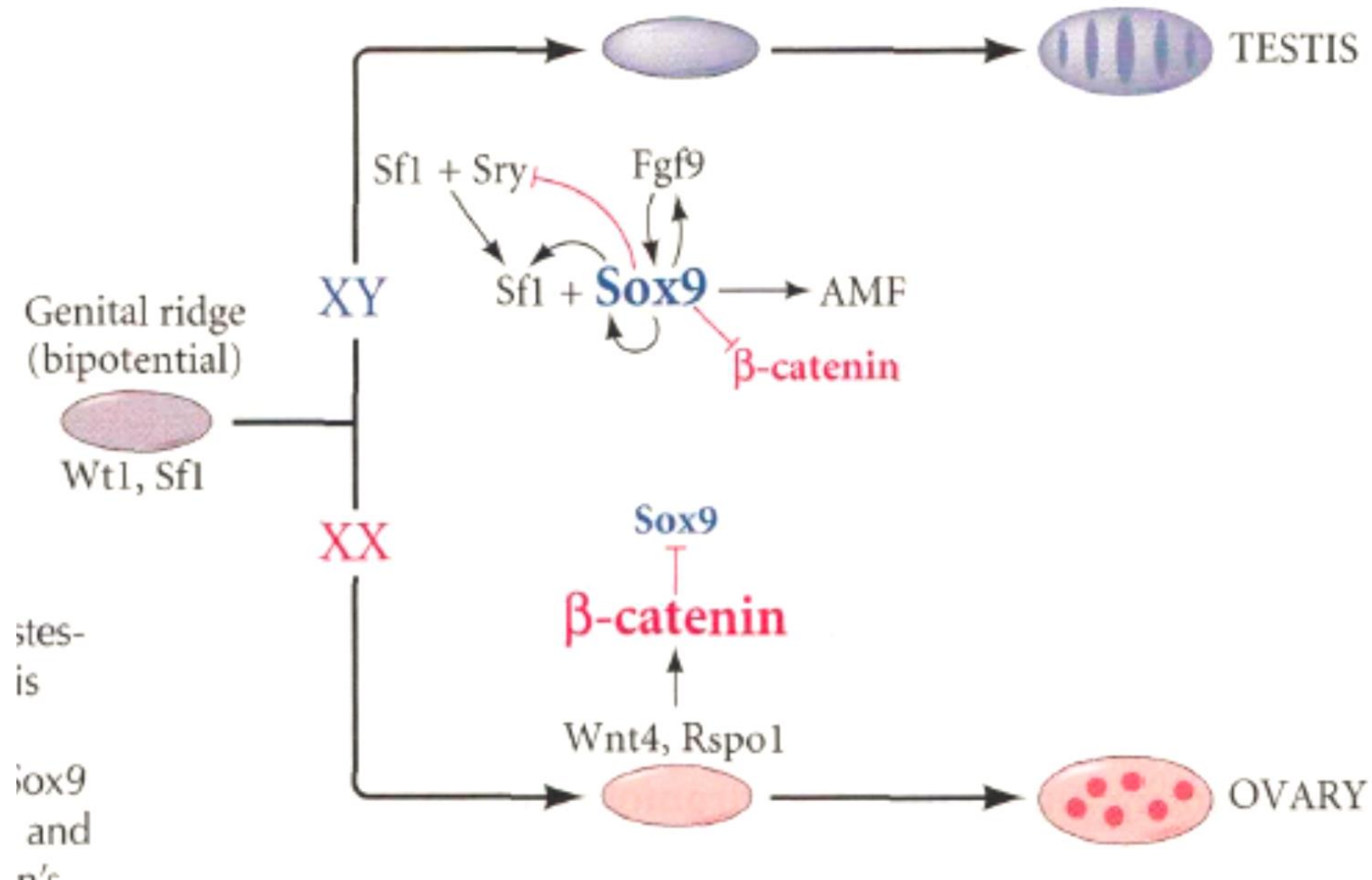
(D) 16 WEEKS



If one has no 'Y'

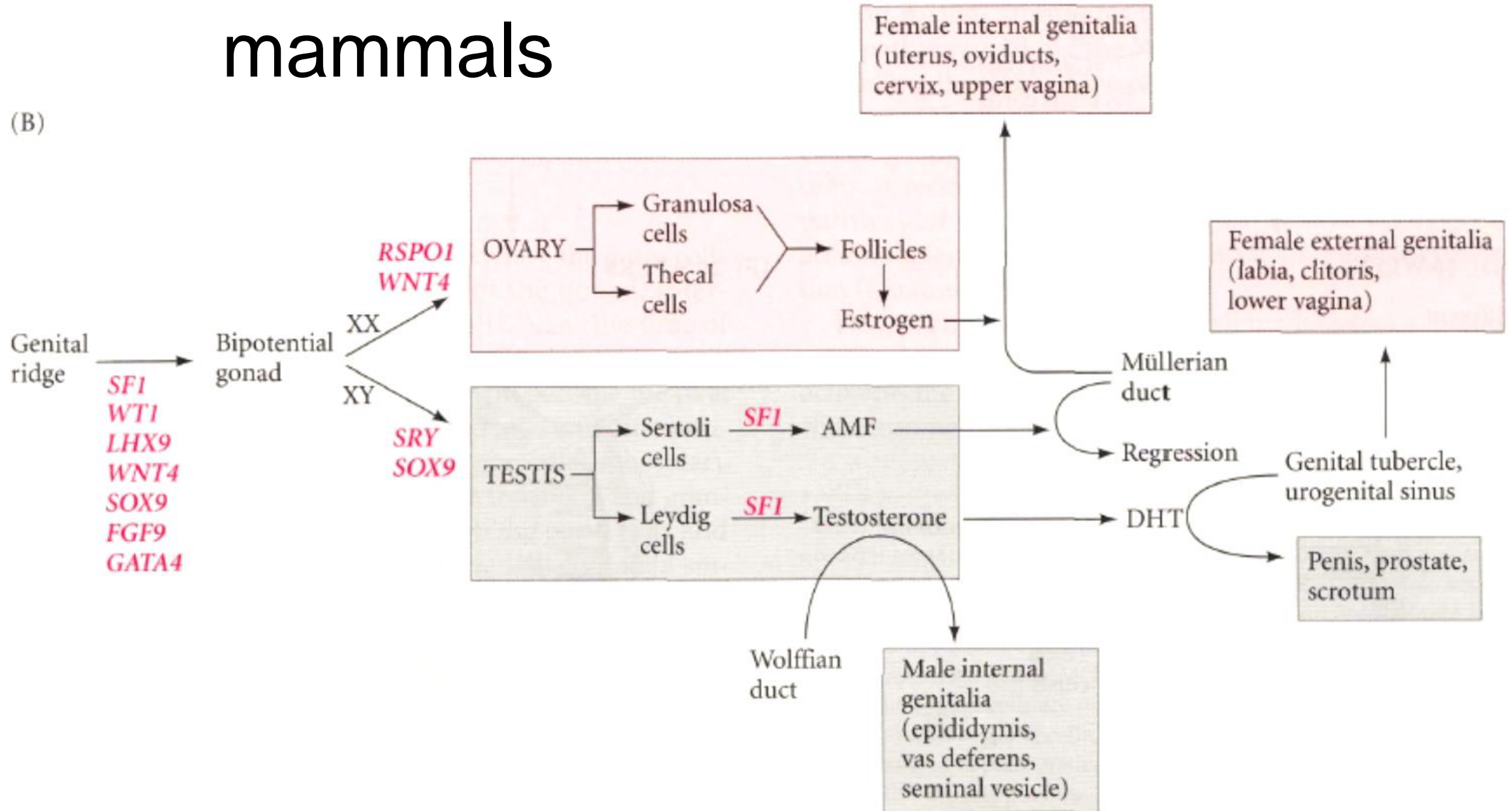


Make 'A' and don't make 'B'



Sex determination in mammals

(B)



Dosage compensation

- each mammalian somatic cell, whether male or female, has only one functioning X chromosome. This phenomenon is called X chromosome inactivation.
 - Inactive chromosome converted into heterochromatin

