

# Sex Determination

Zoology (Hons) 6th Semester  
CC-Xiii Unit4

- What do you mean about determination of sex?
- We learn about Sexual Diamorphism in animal
- We found male and female animals in our text.

**In this chapter we learn how male and female Fruit fly(*Drosophila sp.*) are formed and developed.**

- In human male possess XY and female have XX chromosome so male and females are distinguished only by a single Y chromosome.
- Fruit flies also have XX females and XY males. However the sex determination in *Drosophila* differs from that in mammals. Unlike human Y chromosome has a role on fertility rather than maleness.

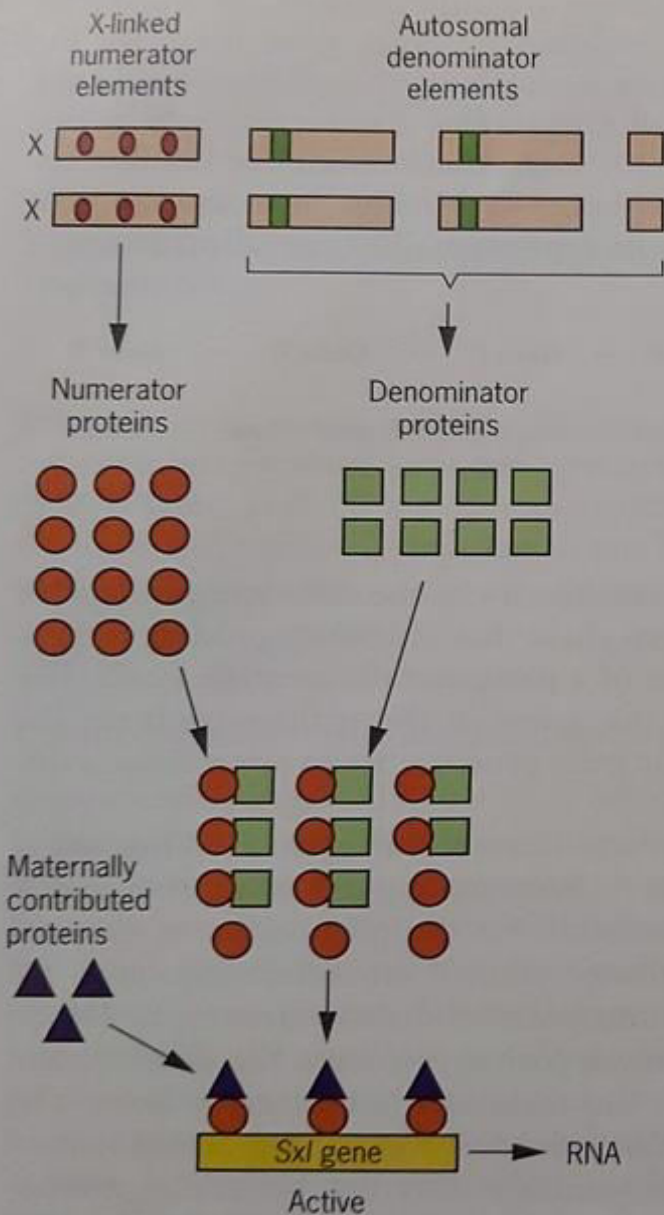
- C.B Bridges suggested in 1921 that sex in *Drosophila* is determined by the balance (ratio) of autosomal alleles that favour maleness and alleles on the X chromosomes that favours femaleness.
- A normal diploid male contains 2 sets of autosomes and XY chromosomes. Similarly , a normal diploid female has 2 sets of autosome and two X- chromosomes.

Number of X chromosome	Number of autosomal sets (A)	Total Number of Chromosomes	X/A ratio	Sex
3	2	9	1.5	Meta female
2	2	8	1.0	Female
1	1	4	1	Female
2	3	11	0.67	Intersex
1	2	7	0.5	Male
1	3	10	0.33	Metamale

**Table: Sex determination by genic balance in *Drosophila***

- Numerator proteins are produced by X-linked genes and denominator proteins are produced by autosomal genes.
- Denominator proteins antagonize numerator proteins.
- In XX embryos, numerator proteins are in excess and are available for activity. In XY embryos, numerator proteins are not in excess and are unavailable for activity.
- Excess numerator proteins combine with maternally contributed proteins to activate transcription of the X-linked *Sxl* gene.
- In XY embryos, lack of numerator proteins prevents activation of the *Sxl* gene and form an inactive transcript.

# XX embryo



STEP

1 Numerator proteins are produced by X-linked genes; denominator proteins are produced by autosomal genes.

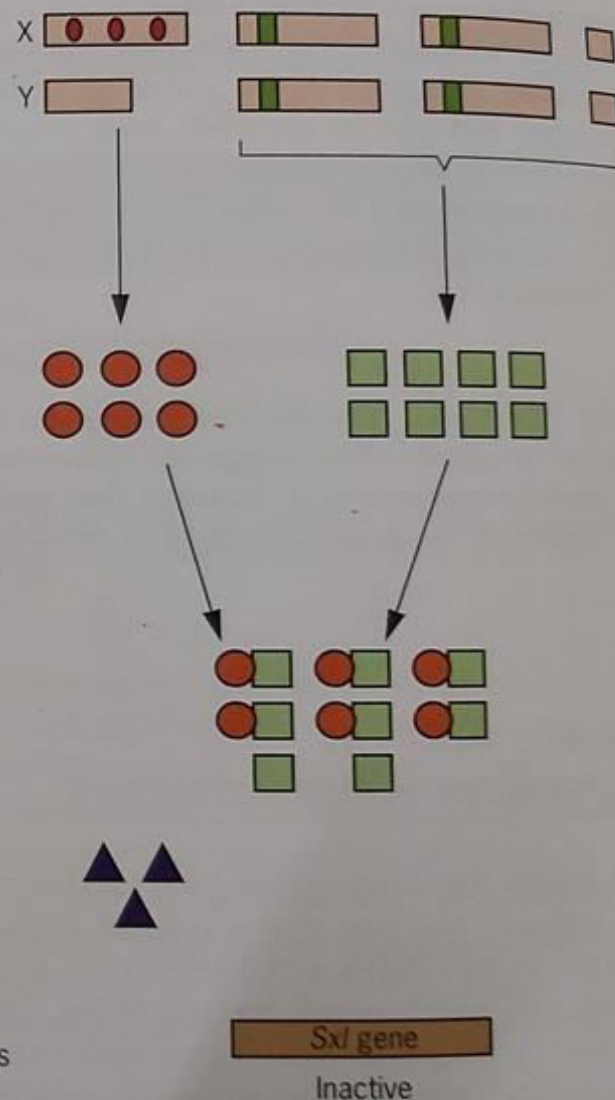
STEP

2 Denominator proteins antagonize numerator proteins. In XX embryos, numerator proteins are in excess and are available for activity. In XY embryos, numerator proteins are not in excess and are unavailable for activity.

STEP

3 In XX embryos, excess numerator proteins combine with maternally contributed proteins to activate transcription of the Sxl gene. In XY embryos, lack of numerator proteins prevents activation of the Sxl gene.

# XY embryo



**Figure 25.7** Ascertainment of the X:A ratio by numerator and denominator elements in *Drosophila*. The ratio of X chromosomes to sets of autosomes is ascertained by interactions between the protein products of these genes.

- SXL protein in XX embryo activates the transcription of two genes tra and tra2 gene.
- TRA and TRA2 protein regulate the splicing of the mRNA of dsx gene that form the DSX protein.
- DSX protein ultimately represses the genes for male development.
- In case of male SXL protein cannot be formed as a result though it activates TRA2 but cannot activate the TRA so fly develops maleness activating gene.

STEO

1 Alternate splicing of *Sxl* RNA produces SXL protein in XX embryos but not in XY embryos.

STEO

2 The SXL protein regulates the splicing of *Sxl* and *tra* RNAs.

STEO

3 Alternate splicing of *tra* RNA produces TRA protein in XX embryos but not in XY embryos.

STEO

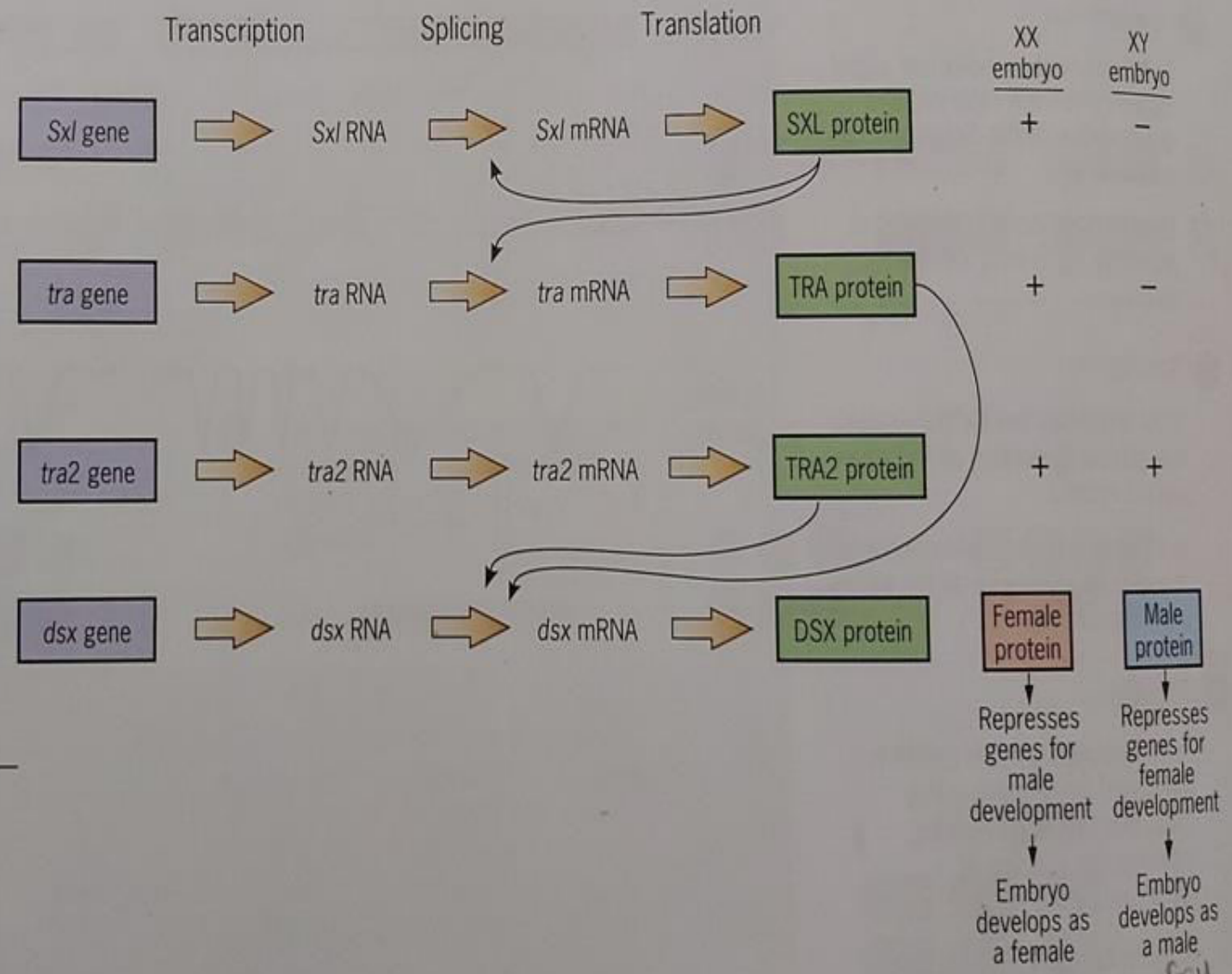
4 The TRA and TRA2 proteins regulate the splicing of *dsx* RNA.

STEO

5 Alternate splicing of *dsx* RNA produces two different proteins—one in each of the sexes.

STEO

6 The DSX proteins control somatic sexual development.



**Figure 25.9** Regulation of sex determination in *Drosophila* by the *Sex-lethal* (*Sxl*) gene. The *Sxl* gene regulates the expression of the *transformer* (*tra*) gene, which, in turn, regulates the expression of the *doublesex* (*dsx*) gene; the *transformer2* (*tra2*) gene also participates in the regulation of *dsx*. The + and - signs indicate the presence or absence of the various proteins.

Thank You

