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## Sex Determination in Drosophila and human

## Sex Determination in Drosophila

The sex chromosomes of the fruit fly Drosophila melanogaster have played a particularly important role in our understanding of heredity. Therefore, it may come as a surprise that fruit flies use a relatively rare mechanism to determine sex. In fact, in *Drosophila,* sex is primarily determined by the X:A ratio, or the ratio of the number of X chromosomes to the number of sets of autosomes (Cline & Meyer, 1996). The balance between female-determining factors encoded on the X chromosome and male-determining factors encoded on the autosomes determines which sex-specific pattern of transcription will be initiated. Thus, XX, XXY, and XXYY flies are females, while XY and XO flies are males. Flies are unable to survive with more than two copies of an X chromosome because of the mechanism that they use for dosage compensation. (Dosage compensation refers to the processes by which animals equalize the amount of gene products generated from X-linked genes in males and females. Unlike in mammals, all of the *Drosophila* X chromosomes remain active, and flies adjust the levels of X-linked gene products by doubling expression from the X chromosome in males. An extra copy of the X chromosome, which contains close to one-third of fly genes, creates an aneuploid condition that greatly disrupts the equilibrium in cells.)

*Drosophila* sex determination also differs from mammalian sex determination in several other ways. First, sex determination begins immediately at fertilization, and there is no indifferent period. Furthermore, hormones are not responsible for sex-specific traits; instead, each cell in the embryo senses the X:A ratio, triggering either the female- or male-specific pattern of transcription. Microarray experiments indicate that the sex-specific differences in gene expression are quite extensive. In fact, roughly 30% of *Drosophila* genes were found to show sex-specific biases in expression (Parisi *et al.*, 2004).

| X chromosomes | Autosome sets (A) | X:A ratio | Sex |
|---|---|---|---|
| 3 | 2 | 1.50 | Metafemale |
| 4 | 3 | 1.33 | Metafemale |
| 3 | 3 | 1.00 | Normal female |
| 2 | 2 | 1.00 | Normal female |
| 2 | 3 | 0.66 | Intersex |
| 1 | 2 | 0.50 | Normal male |
| 1 | 3 | 0.33 | Metamale |

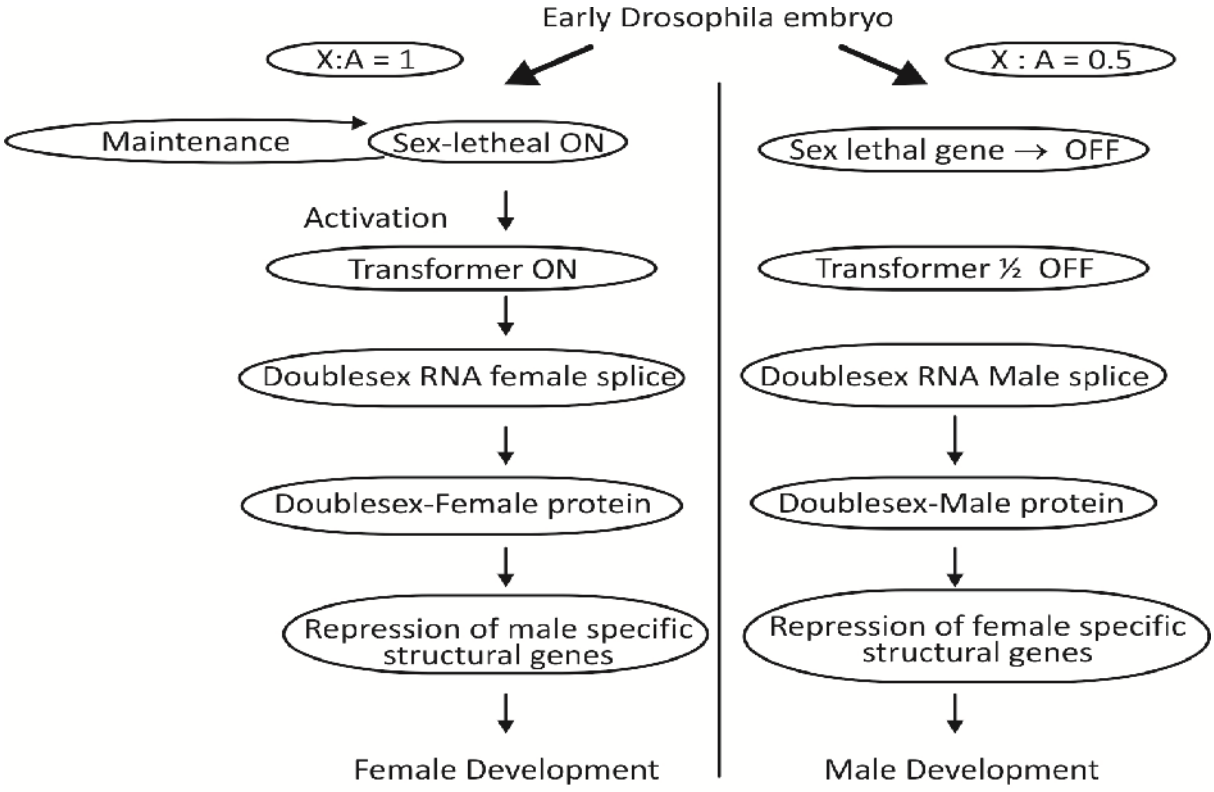


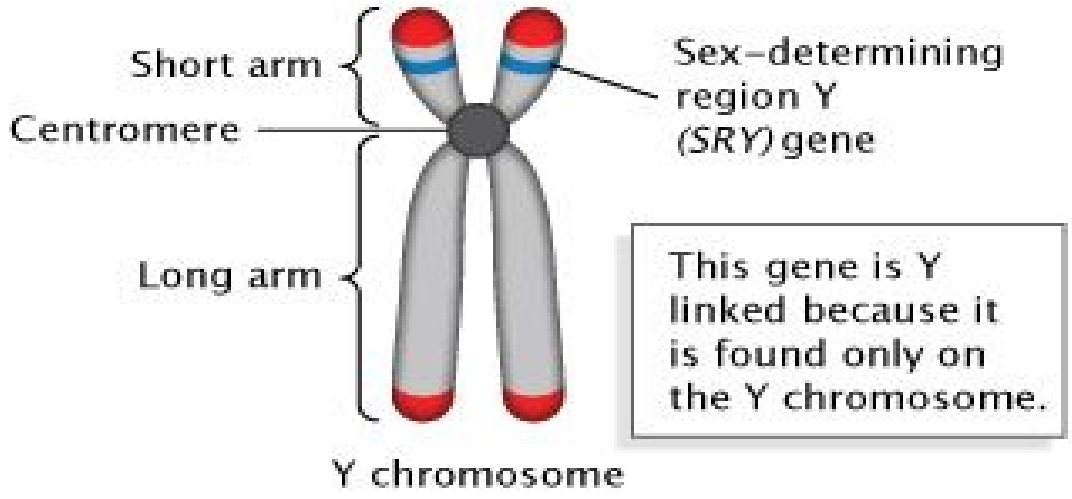

Fig. : Development of male and female in drosophila

**Sex determination in human**

In placental mammals, the presence of a Y chromosome determines sex. Normally, cells from females contain two X chromosomes, and cells from

males contain an X and a Y chromosome. Occasionally, individuals are born with sex chromosome aneuploidies, and the sex of these individuals is always determined by the absence or presence of a Y chromosome. Thus, individuals with 47,XXY and 47,XYY karyotypes are males, while individuals with 45,X and 47,XXX karyotypes are females. Humans are able to tolerate supernumerary numbers of sex chromosomes because of X inactivation and the fact that the human Y chromosome is quite gene-poor.

Although the role of the Y chromosome in mammalian sex determination has been known since the early twentieth century, it was not until 1959 that scientists were able to identify the region of the Y chromosome that controlled this process (McLaren, 1991). Later, researcher David C. Page analyzed the chromosomes of sex-reversed XX men, rare individuals who look like men but have two X chromosomes instead of one X chromosome and one Y chromosome. Using DNA hybridization with probes corresponding to different regions of the Y chromosome, Page discovered that sex-reversed males carried genes from a 140-kilobase region on the short arm of the Y chromosome (Figure 1). Presumably, this region had been transferred to the X chromosome during a translocation (Page et al., 1985). Subsequent experiments narrowed down this region (McLaren, 1991) and found that one gene, the sex-determining region of the Y, or SRY, was the master regulator of sex determination. The presence of just this region from the Y chromosome is thus sufficient to cause male development (Koopman et al., 1991).



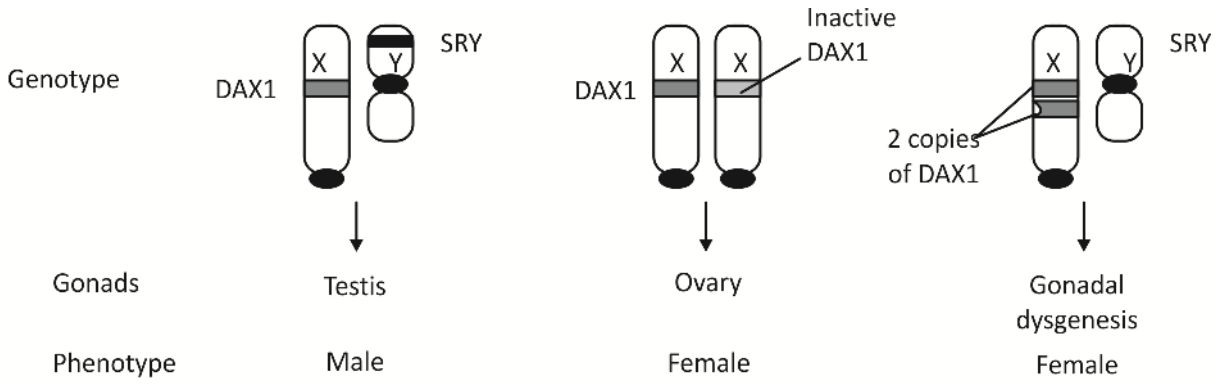



Fig. : DAX gene in the involvement of ovary development.