

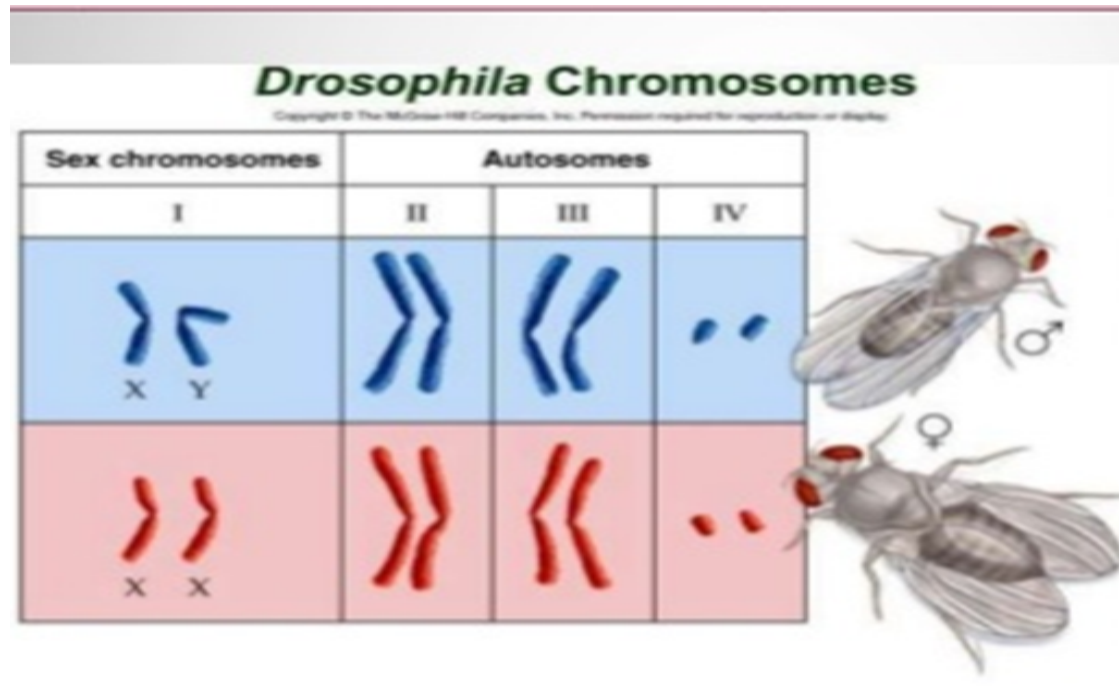


**GENIC BALANCE THEORY**  
*of*  
**Sex Determination in *Drosophila***  
[www.easybiologyclass.com](http://www.easybiologyclass.com)

5<sup>th</sup> Sem Hons. (CC-12)  
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# GENIC BALANCE THEORY



C.B BRIDGES (1921)



# CHROMOSOME THEORY OF SEX DETERMINATION

- ▶ Male and females have 2 different sets of chromosome –
  - Autosomes (A)
  - Sex chromosomes (X, and Y).
- ▶ Generally in Females, sex chromosomes are homo-morphic( eg. XX if X is designated as sex chromosome ).
- ▶ While in Males these sex chromosomes are heteromorphic, ( eg. XY, where both are designated as sex chromosome)
- [except in Birds where females are heteromorphic and males are homo-morphic ]



# THE RESULT from EXPERIMENT of nondisjunction(1916)

The example below suggested that in *Drosophila* Y-chromosome does not help in determining sex.

$2A + XX$  (Female)                      X                       $2A + XY$  (Male)  
 (non disjunction of X chromosome in female)                      male gametes

female gametes	A+X	A+Y
A+XX	2A + XXX Super female	2A + <b>XXY</b> <b>female</b>
A+O	<b>2A + XO</b> <b>Male</b>	2A + Y dies

- **Y chromosome** does not carry any sex determination factor,
- Presence of 1 or 2 X-chromosome is more important for *Drosophila* sp

# GENIC BALANCE THEORY OF SEX

## DETERMINATION

- C.B. Bridges 's experiment demonstrated that Y-chromosome is not important for determination of sex in *Drosophila*, again it did not indicate whether X-chromosome alone takes part in sex determination or Autosomes play any role in it.
- During experimentation in *Drosophila* he found individuals having 2 X-chromosomes but were intersexes. And each of these intersexes have extra set of Autosomes (A) indicating that **autosomes definitely play some role in sex determination.**
- Bridges in the year 1922 came across certain *Drosophila* individuals which were Triploid females and has 3 sets of chromosomes (**3A + XXX**). **These triploid individuals were found to be normal females.**
- He crossed them with normal diploid males (2A + XY). From this cross he found **normal diploid males and females, superfemales, supermales and intersexes.**
- The presence of **Triploid intersexes (3A + XX)** proves that **autosomes also play role in sex determination.**

# THE EXPERIMENT

3A+ XXX FEMALE

2A+ XY MALE

	A+X	A+Y
2A+XX	3A + XXX Normal Female X/A ratio=1.0	3A + XXY Triploid Intersex X/A ratio=0.66
A+X	2A + XX Normal Female X/A ratio=1.0	2A + XY Normal Male X/A ratio=0.5
2A+X	3A + XX Triploid Intersex X/A ratio=0.66	3A + XY Super Male X/A ratio=0.33
A+2X	2A + XXX Super Female X/A ratio=1.5	2A + XXY Normal Female X/A ratio=1.0

## FINAL INTERPRETATION

According to this theory **the ratio between number of X-chromosomes and number of complete sets of autosomes will determine the sex – i.e. a balance** between autosome and sex chromosome.

- ❖ The X-chromosome believed carry female tendency genes while autosomes carry male tendency genes.
- ❖ X/A ratio determines **maleness** and **femaleness** in *Drosophila*.

**If X/A ratio** < 0.5 than individual will be -

**Metamale/Supermale (Sterile)**

= 0.5 than individual will be **Normal male (Fertile)**

> 0.5 and < 1.0 yield **Intersex/ Gynandromorphs (Sterile)**

= 1.0 than individual will be **Normal Female (Fertile)**

>1.0 than individual will be **Metamale/ Super-female**

(Sterile)



# BRIDGES' S PROPOSAL FOR DROSOPHILA IS -

## GENIC BALANCE THEORY:

- ③ It states that sex of an individual is determined by a ratio called **sex index**.



- ③ **Sex Index =  $\frac{\text{No. of X chromosomes}}{\text{Autosomal sets}} = \frac{X}{A}$**

- ③ Autosomal sets  $\longrightarrow$  diploid or triploid or tetraploid.







## SUMMARY

### (c) Genic Balance System

- This system was developed by Bridges (1922) in *Drosophila*.
- According to this theory “the sex of an individual is determined by a balance between the genes for maleness and those for femaleness present in the individual,”
- Genic balance theory states that sex determining genes are present on both X chromosome as well as autosomes.
- The male sex determining genes are present on autosomes and female sex determining genes on X chromosome.
- The sex expression is determined by the balance of genes on autosomes and X chromosome.
- In other words, the expression of sex depends on the ratio of X chromosomes to that of autosomes. This ratio is represented as X/A ratio.

