## *Chapter 17 – Sex Chromosomes, Linkage, & Organelles*

### I. Sex-Linked Genes

**A.** Sex chromosomes have small areas of homology (same genes) at their tips

**B. X-Chromosome**

1. Has over 1000 genes, Y has 50
2. X chromosome genes are "x-linked"
3. Males only pass X-linked genes onto their **daughters**
4. Males only need one copy of an X-linked recessive to show the recessive phenotype
   - **a.** *I.e.* If a male has one X-chromosome with the recessive allele for color blindness, there is no "normal" other X-chromosome containing the dominant allele for normal vision. In a female, the other X chromosome would "block" the one with the recessive allele.
   - **b.** Red-green color blindness is a recessive X-linked trait

**C. Y Chromosome**

1. The SRY gene on the Y chromosome sets the human embryo on the male development pathway
2. Only sons inherit Y-linked genes
3. Fathers pass Y-linked genes to all sons
4. Only maleness & some male fertility traits are known to follow a Y-linked pattern of inheritance

## II. Linked Genes

**A.** Genes that are located close to each other on the same chromosome

**B.** Tend to be inherited as a group

**C.** Thomas Morgan's Fruit Fly Experiment

**1.** Uses different notation for dominant recessive for fruit flies

**a.** $b^+/c^+$ = dominant

**b.** $b/c$ = recessive

| | **bc** | **Phenotype** |
|---|---|---|
| **$b^+c^+$** | $b^+c^+bc$ | Gray/Straight |
| **$b^+c$** | $b^+cbc$ | Gray/Curved |
| **$bc^+$** | $bc^+bc$ | Black/Straight |
| **bc** | bcbc | Black/Curved |

**Gray Body**
**Straight Wings**

$b^+b^+c^+c^+$ x

**Black Body**
**Curved Wings**

bbcc

**Gray Body**
**Straight Wings**

$b^+ b\ c^+ c$ x

**Test Cross**

bbcc

*Expect what from this cross (^) if genes are* ***unlinked****? Punnett Square:*

**Test Cross**

**Gray Body/Straight Wings**

**Expected outcome**: 1:1:1:1 ratio of phenotypes

*Expect what if genes are* ***linked****? (Inherited together)*

$b^+ b\ c^+ c$ x bbcc

**Test Cross**

**Gray Body/Straight Wings**

| | **bc** | **Phenotype** |
|---|---|---|
| **$b^+c^+$** | $b^+ c\ ^+b\ c$ | Gray/Straight |
| **bc** | b c b c | Black/Curved |

**Expected Outcome**: 1:1 ratio of phenotypes

**Actual Findings from Experiment:** Some new phenotypes (supports first cross, meaning genes are unlinked), but also found lots of parental phenotypes (supports second cross, meaning genes are unlinked)

**III. <u>Morgan's Experiment With Linked Genes (continued)</u>**

**A.** Morgan proposed new phenotypes are due to **<u>crossing over</u>** ***(fig. 17.10)***

**1.** Used this to figure out relative location of genes on a chromosome

**a.** Frequency of recombination is a measure of the distance between genes ***(Fig. 17.10a)***

**b.** Use **recombination frequencies** to estimate distance between genes

**i. Map Distance** between 2 linked genes = (# recombinant offspring/total # of offspring) x 100

**ii. One map unit (aka centimorgans) = 1% recombination frequency**

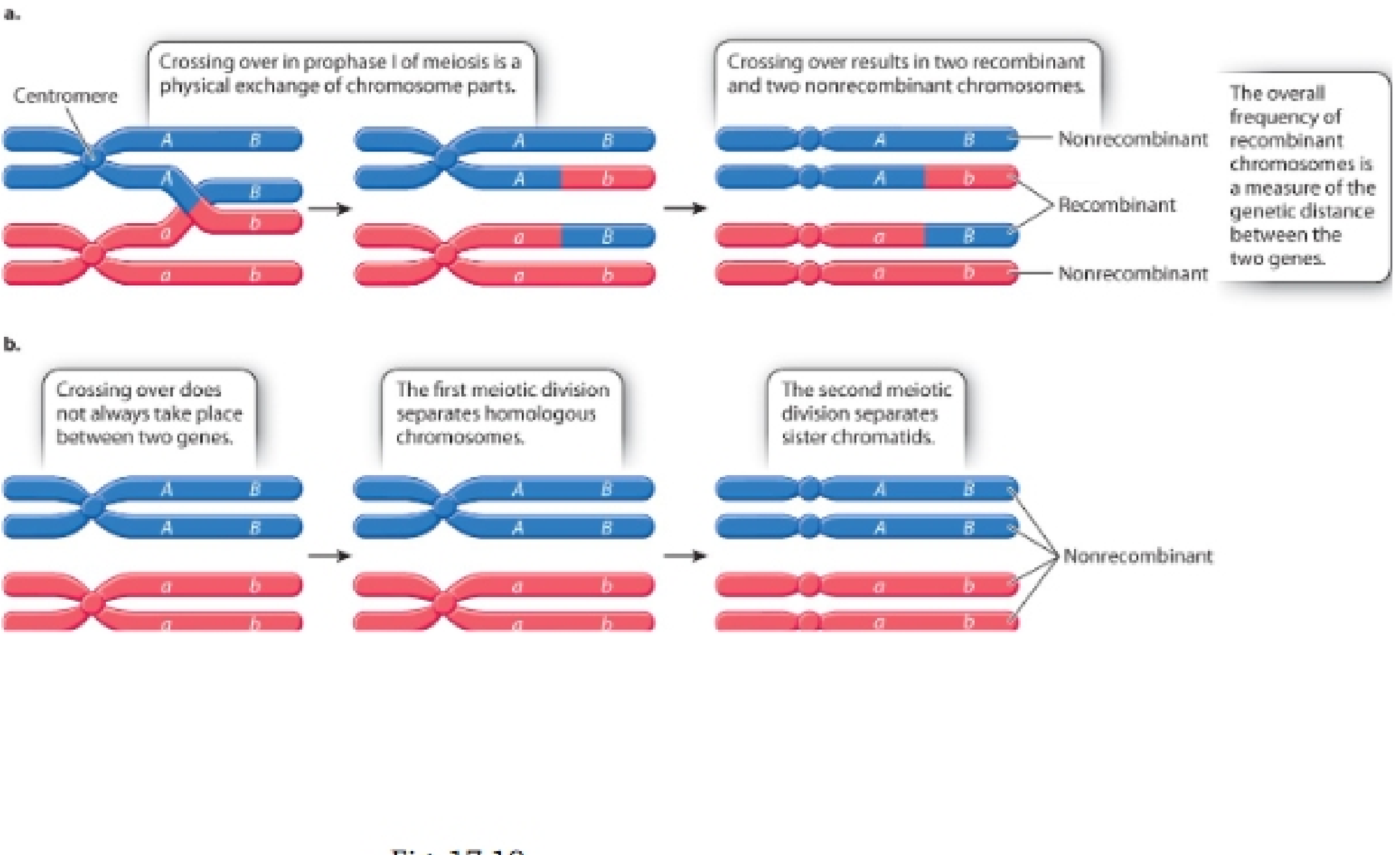


Fig. 17.10