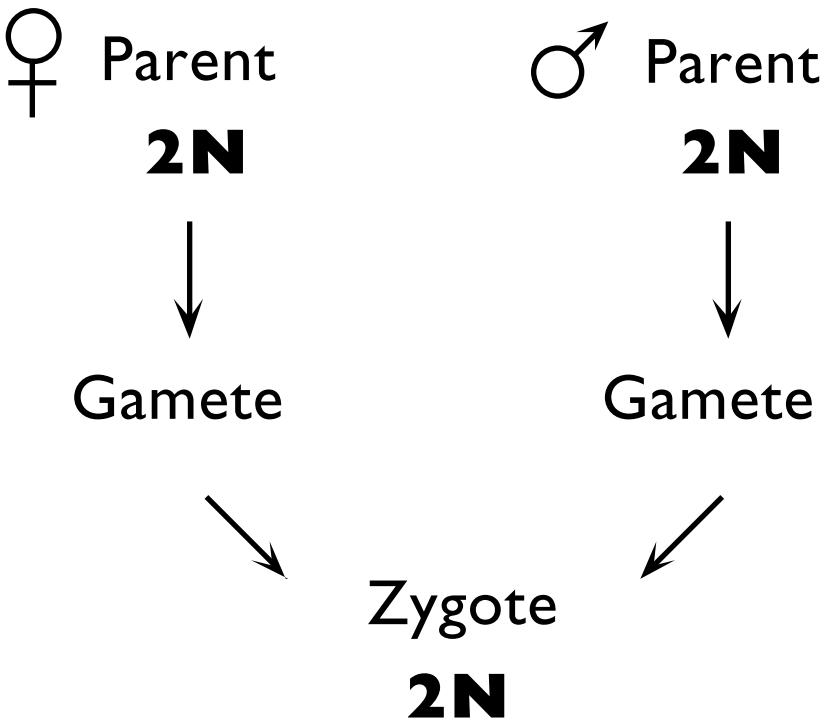
Meiosis and the Chromosome theory

Genetics 371B Lecture 5 4 Oct. 1999

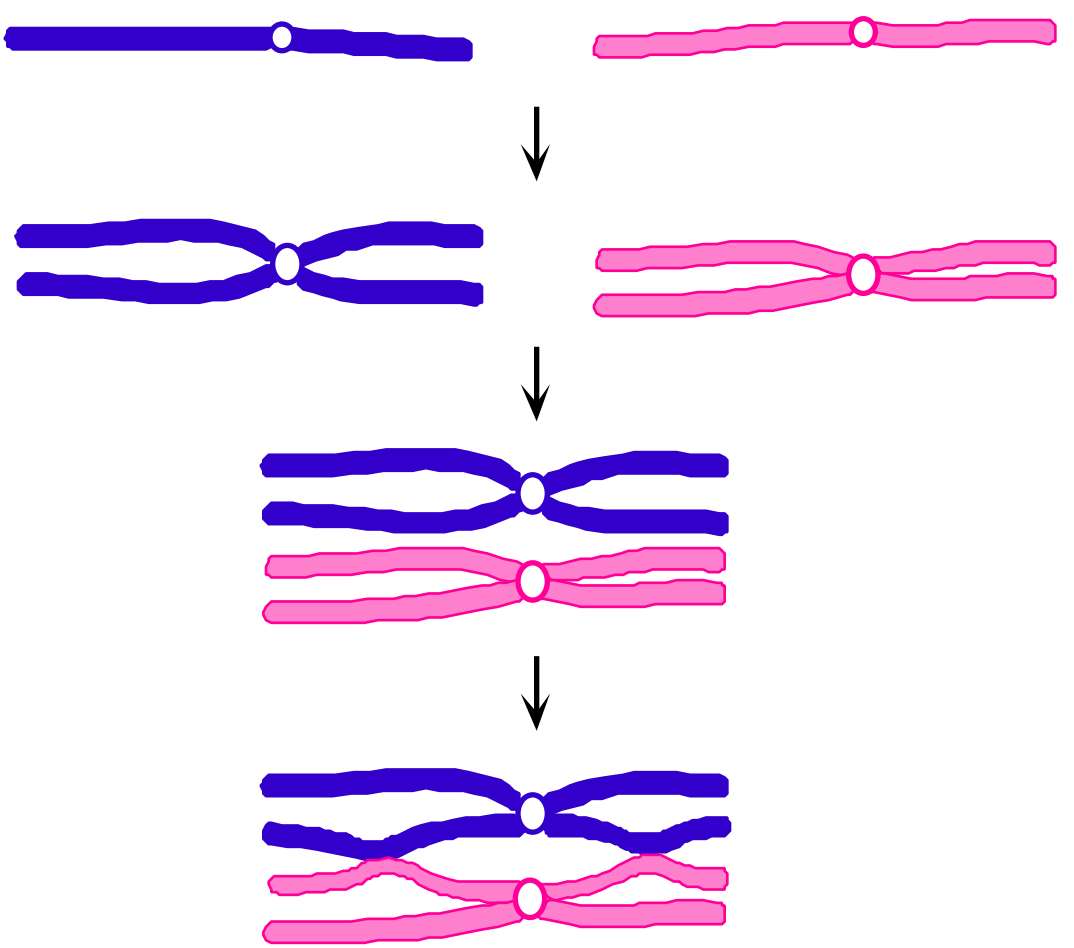
Meiosis - making **haploid** gametes from **diploid** cells



The problem: ensuring that homologs are partitioned to separate gametes

The solution

- hold homologous chromosomes together by **synapsis** and **crossing over**
- target homologs to opposite poles
- then separate the homologs

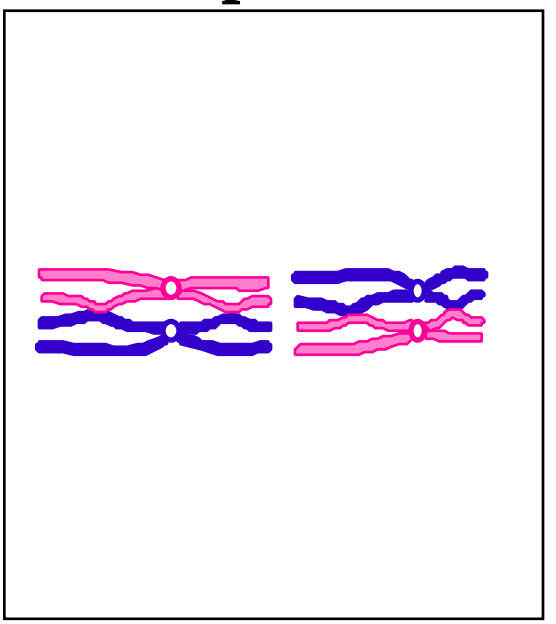


Meiosis proceeds in two steps:

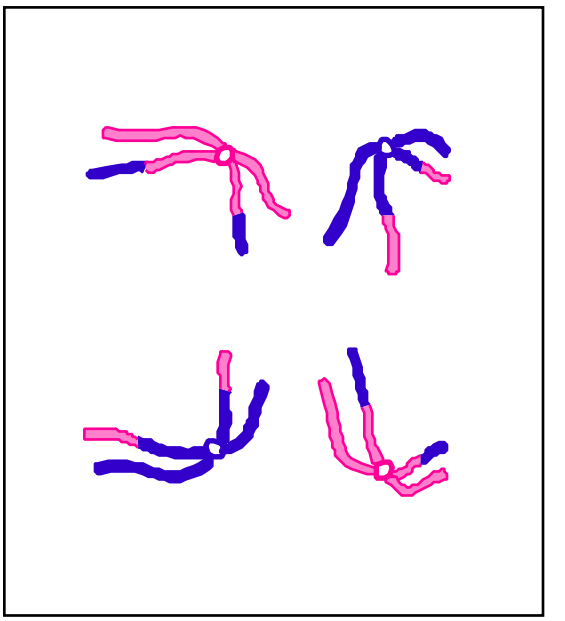
- Meiosis I — **"reductional division"**

- Meiosis II — **"equational division"**

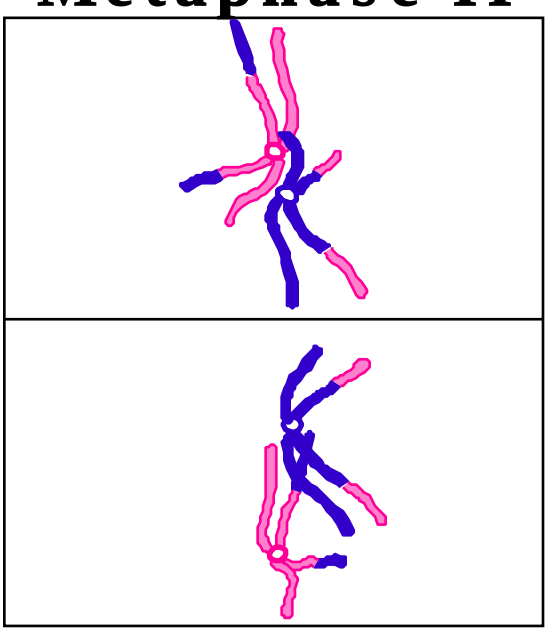
Metaphase I

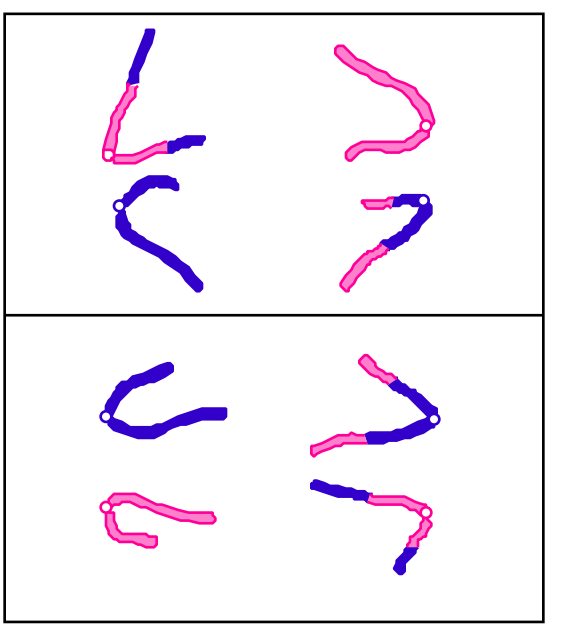


Anaphase I



Metaphase II





The chromosome theory of inheritance

Based on the congruence of **determinant behavior** (Mendel) and **chromosome behavior** (cytology)

The essence of the theory:

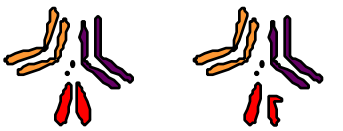
Proof- Based on tests of **predictions**:

- transmission of traits should parallel the segregation of specific chromosomes

- if chromosome segregation is altered the transmission of determinants should be altered also

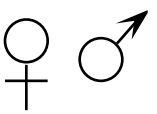
Thomas Hunt Morgan, 1909: Test of the first prediction - in *Drosophila*

Chromosomes of *Drosophila melanogaster:*



Red eyes white eyes

♀ x ♂



F_1

F_2

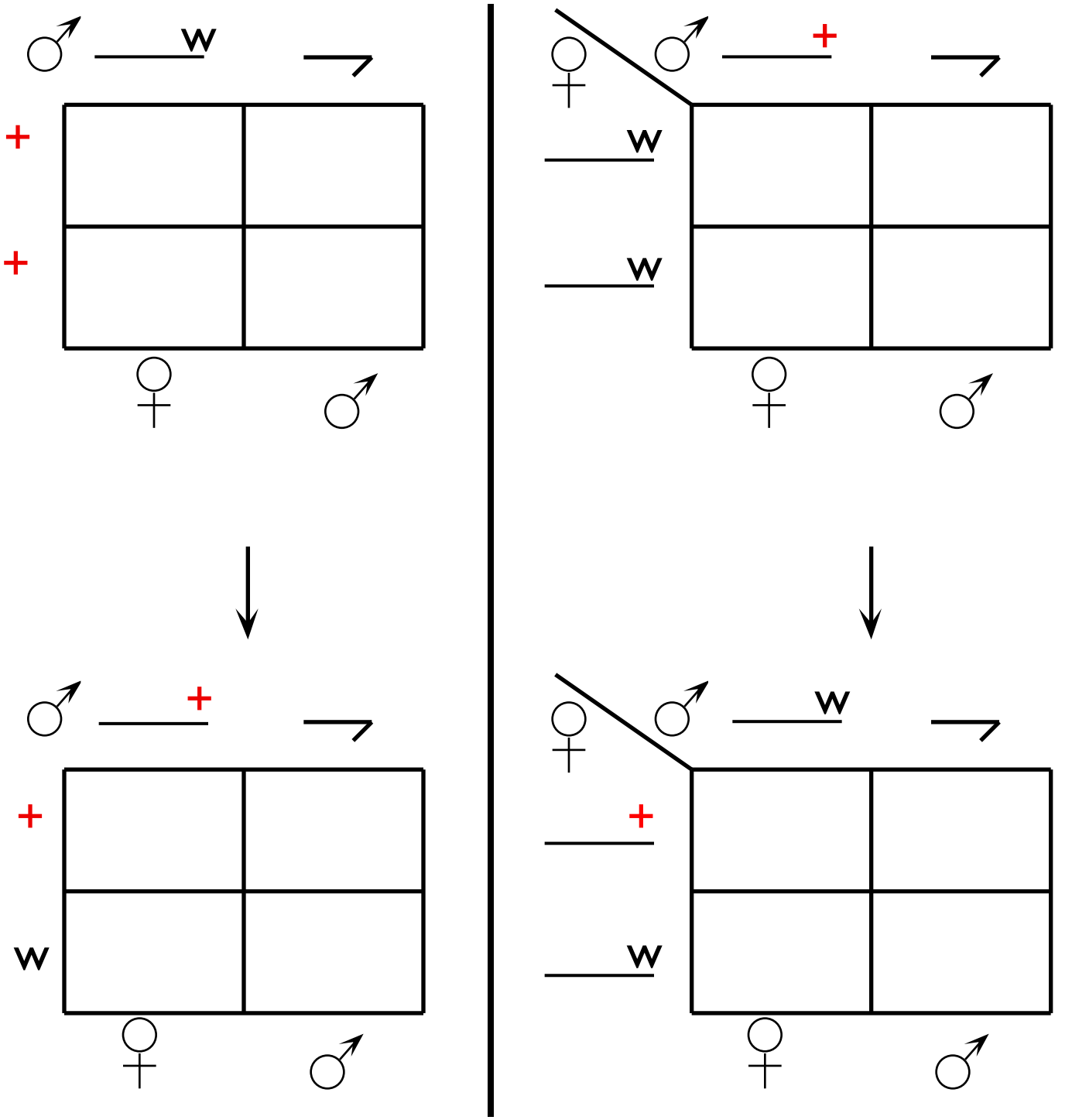
white eyes Red

♀ x ♂

F_1

F_2

Morgan's interpretation:



Conclusion:

Calvin Bridges' experiments with *exceptional progeny*: Test of the 2nd prediction

white eyes ♀ x Red ♂

↓

Expect:

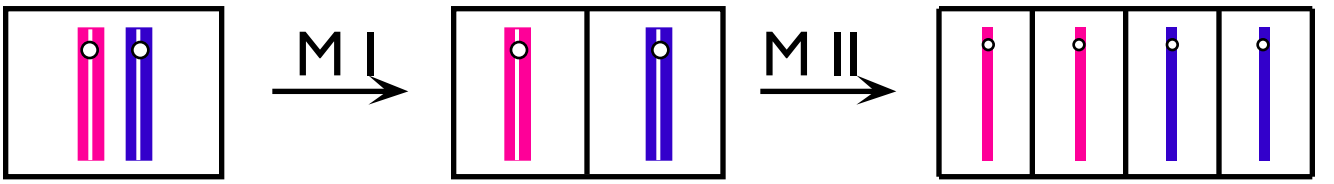
Occasionally got:

["primary exceptional progeny"]

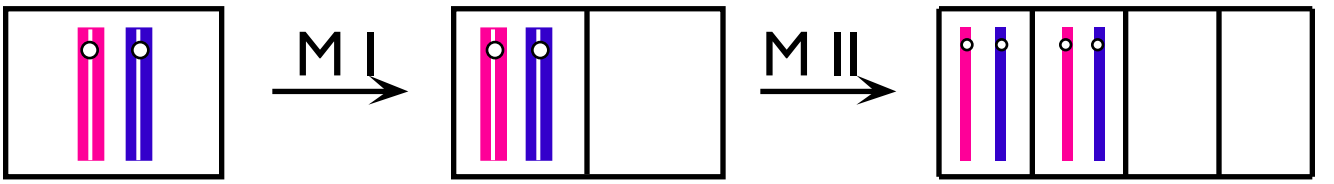
Explanation?

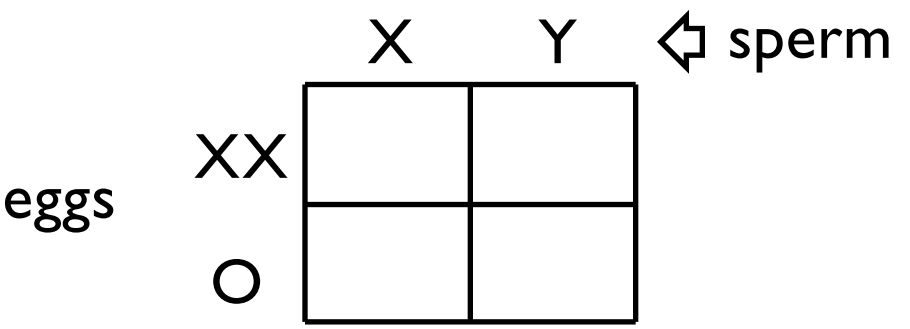
Rare errors in meiosis ⇨ mis-segregation of chromosomes

Normal



Abnormal





Conclusions

1. Determinants are on chromosomes

2. In Drosophila, two X = female
   (one X = male)