

Course website:
bio393.andersenlab.org

Problem set #1 is out.

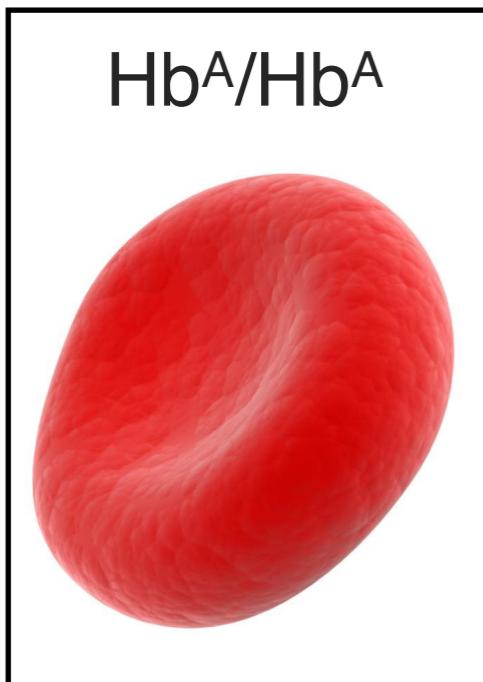
Genetics terms are online.

Law of dominance

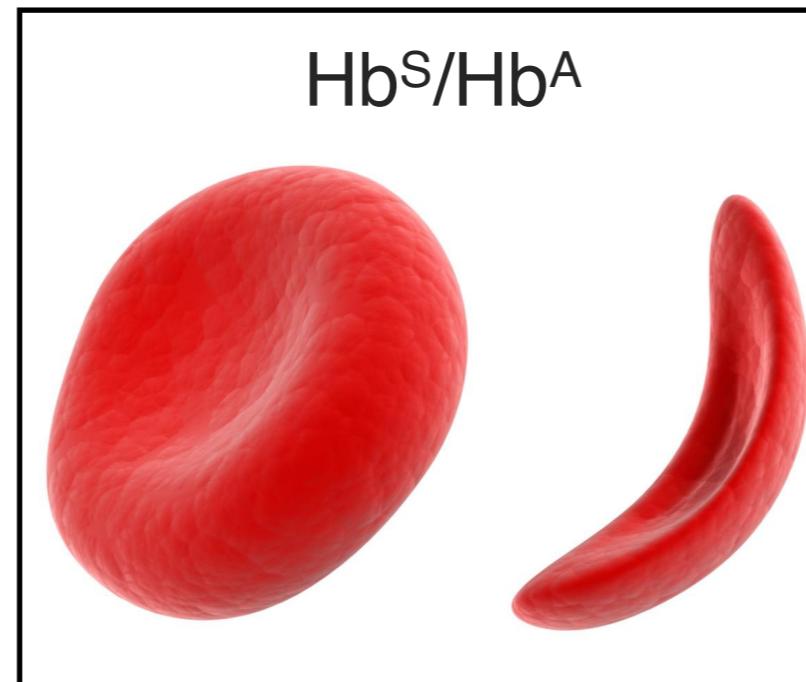
Law of segregation

Law of independent assortment

Co-dominance: Phenotypes caused by different alleles that are visible at the same time



Hb^A/Hb^A



Hb^S/Hb^A



Hb^S/Hb^S

Co-dominant
Dominant
Recessive

Normal
RBCs

Both normal and sickle
RBCs

Mostly sickle
RBCs

Malaria-sensitive

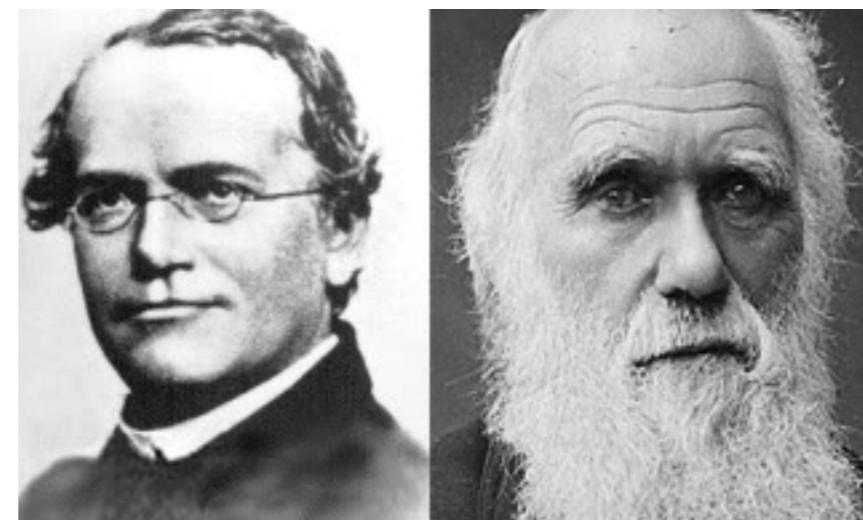
Malaria-resistant

Malaria-resistant

No sickling disease

No sickling disease

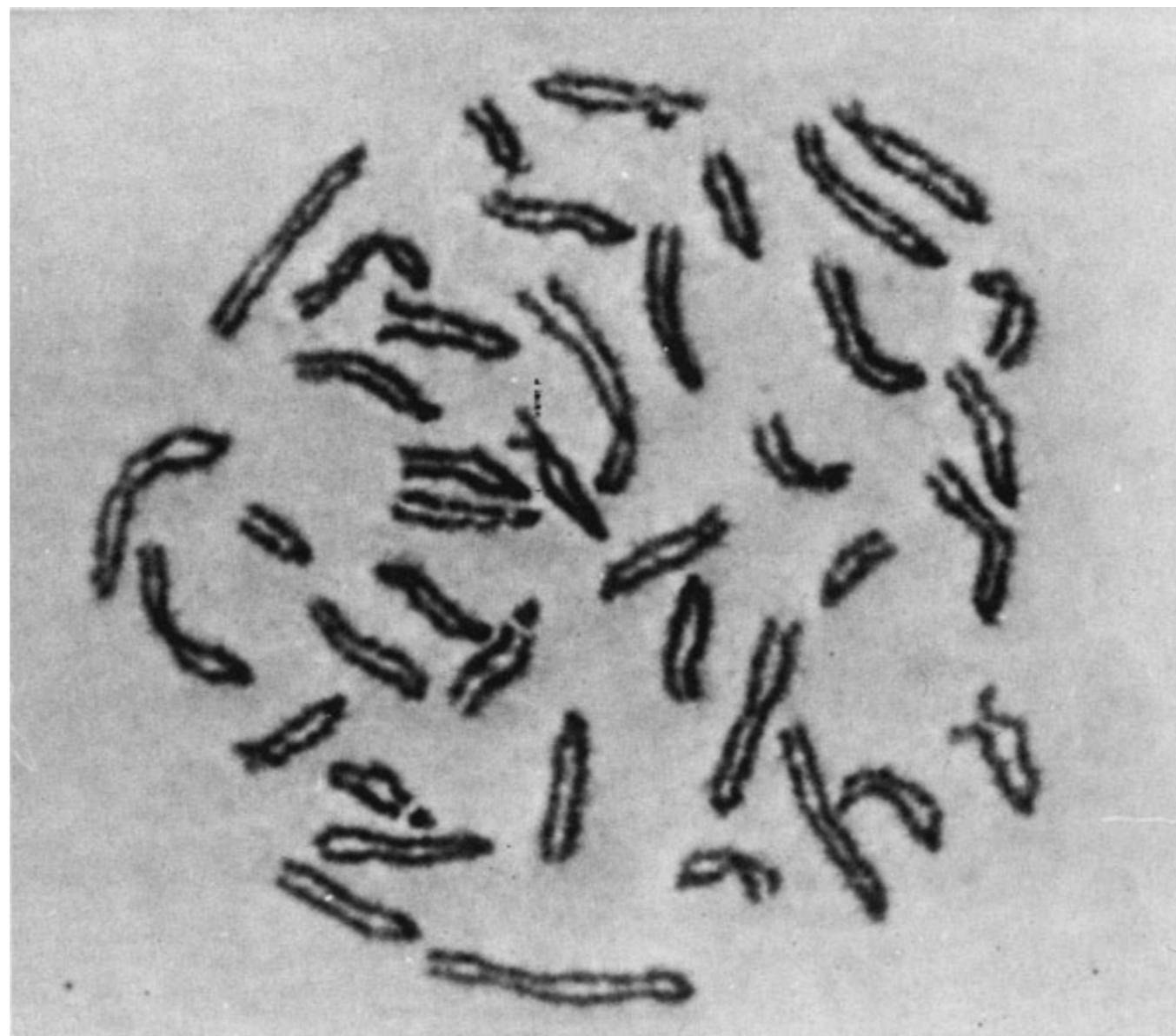
Severe sickling disease



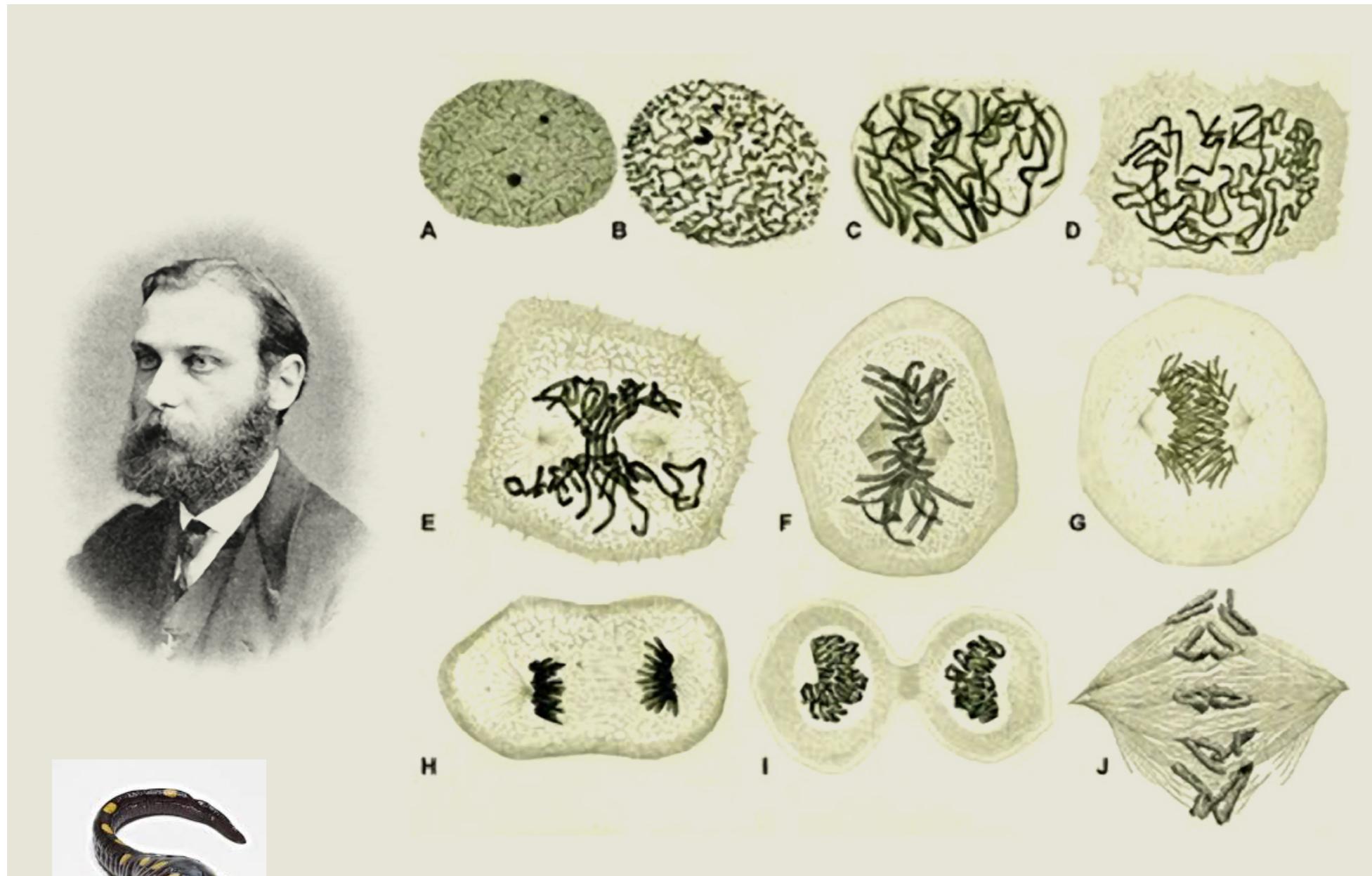
???

Bio393: Genetic Analysis

Chromosome theory, Mitosis, and Meiosis



Walther Flemming stained cells

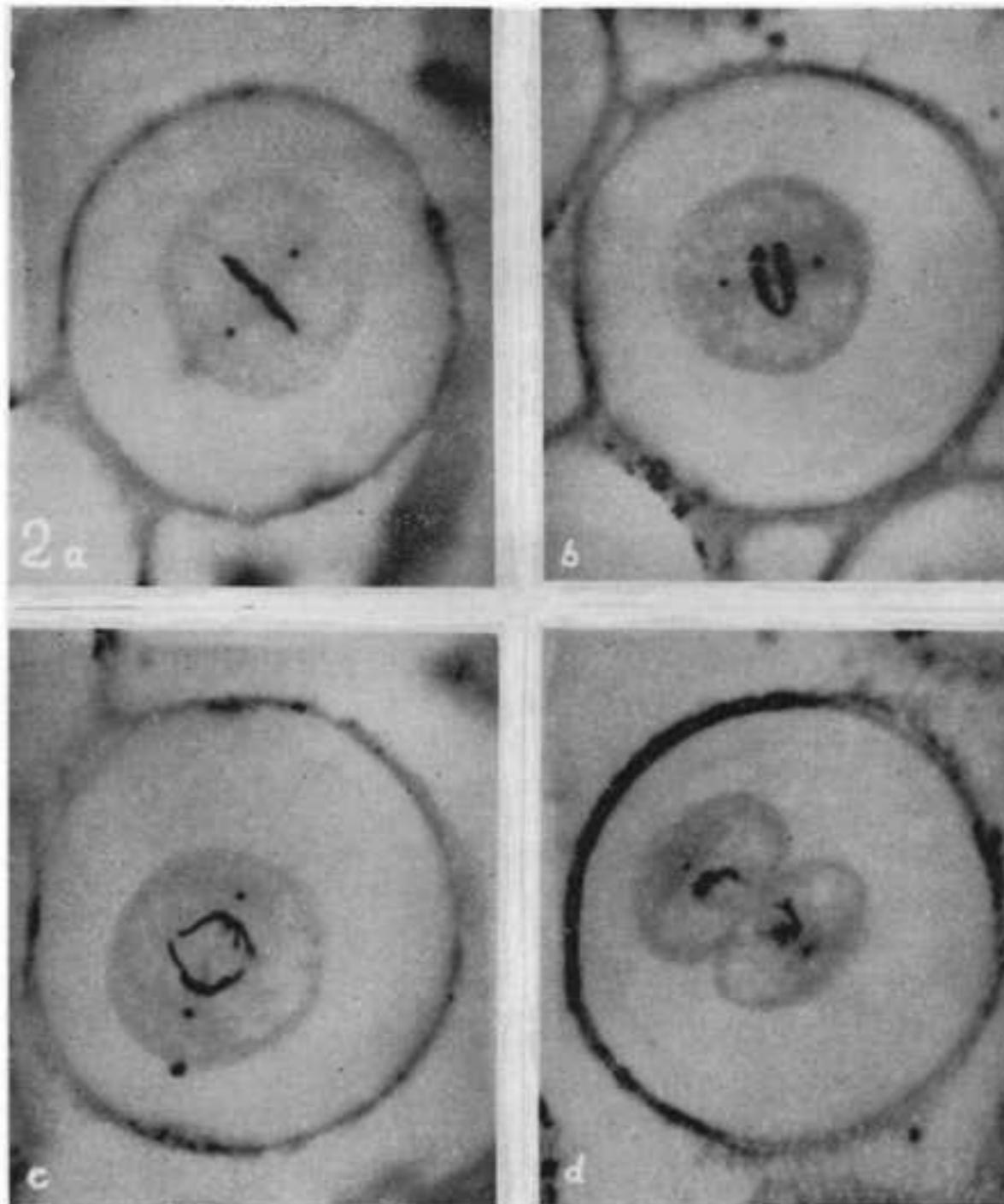


Walther Flemming, 1882

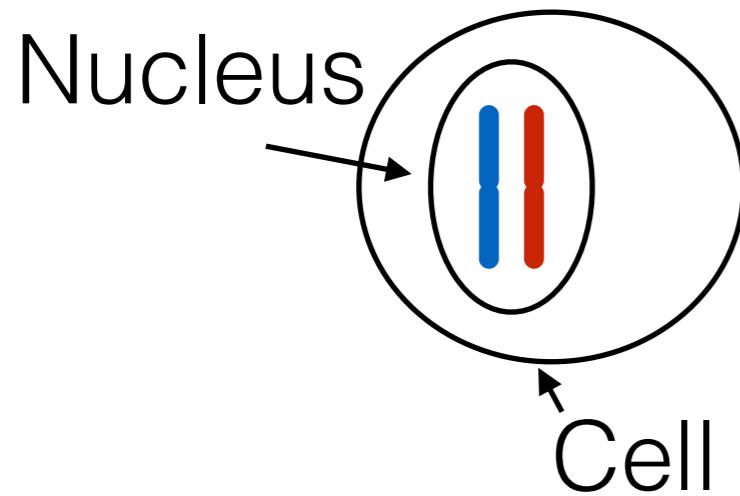
Cells divide their chromosomes with high fidelity



Theodor Boveri



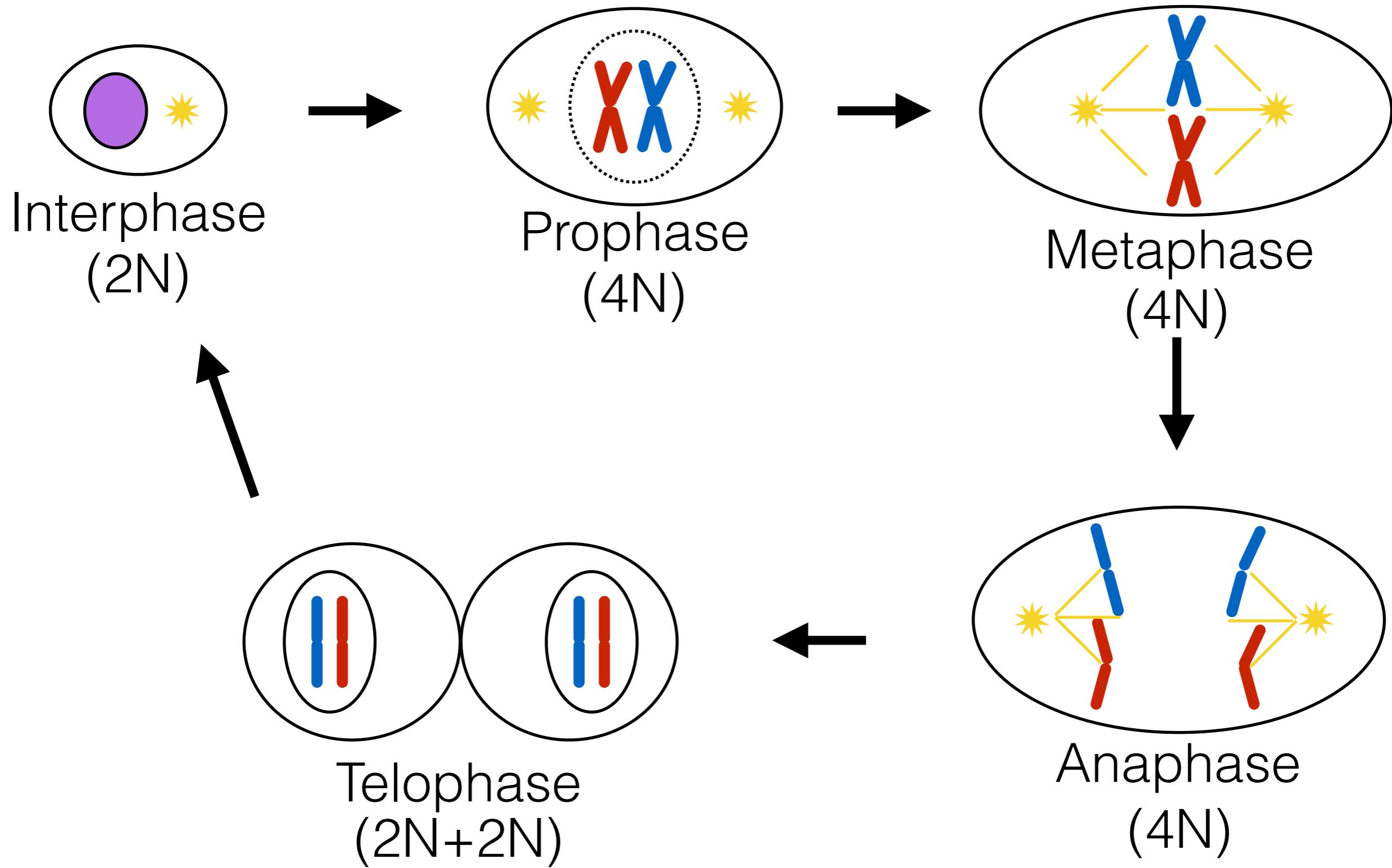
Terms for mitosis and meiosis



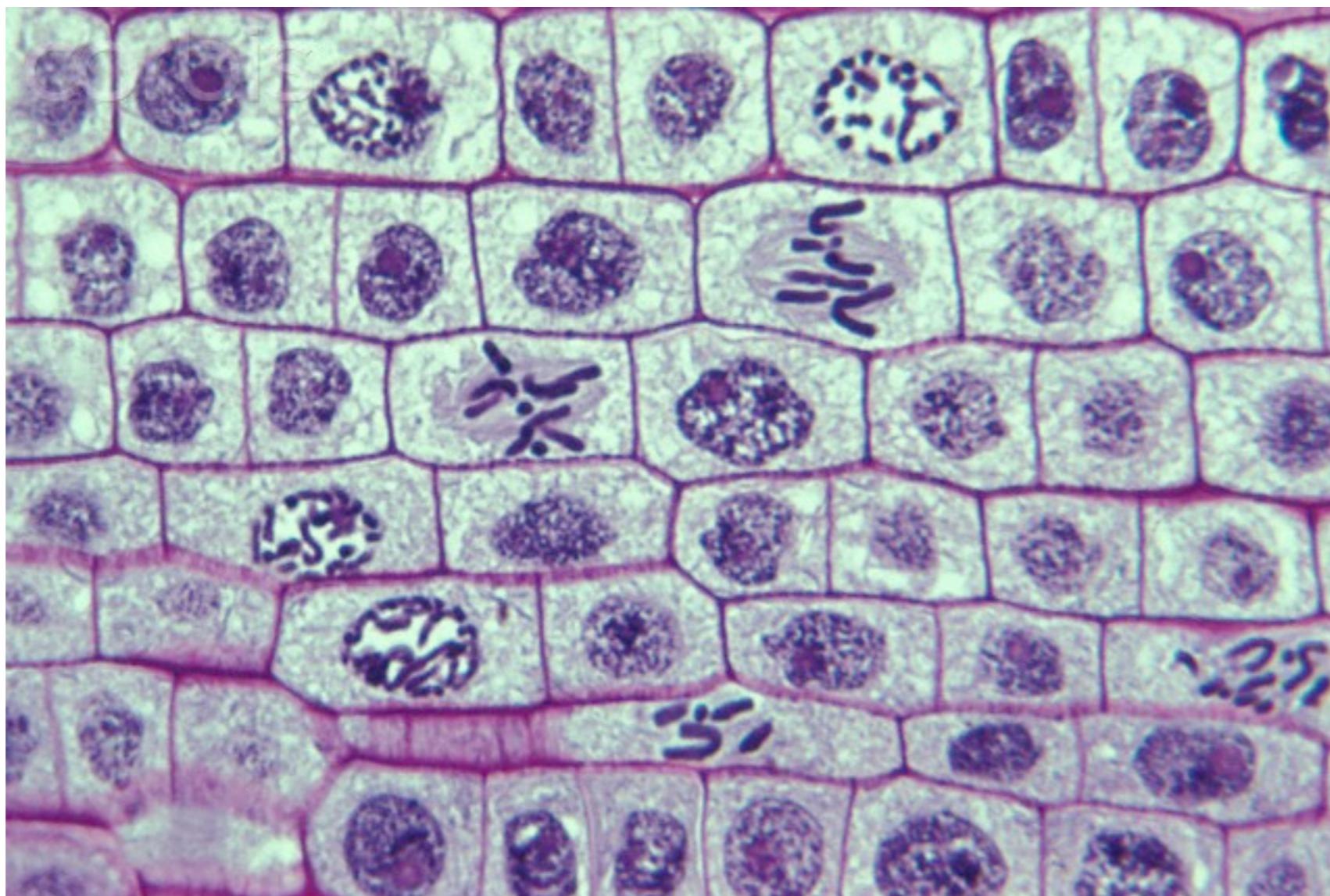
- | Chromosome
- || Pair of homologs (2N)
- X Sister chromatids

Ploidy (N)
Diploid (2N)
Haploid (1N)
Polyploid (>2N)
Gamete

Mitosis



What stage of mitosis?



Gametes have half the chromosomes of the soma



Theodor Boveri



Parascaris equorum

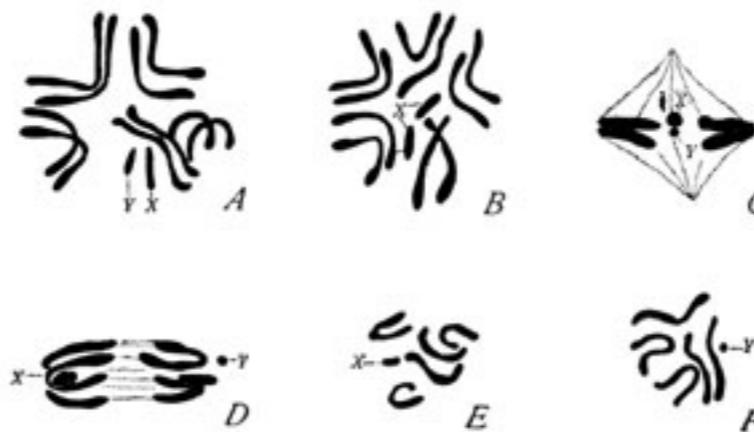


Discovery of sex chromosomes



Courtesy of the Marine Biological Laboratory.
Noncommercial, educational use only.

Nettie Stevens



Tenebrio melitor

then 50 beetle species and nine species of fly!

Lecture 2

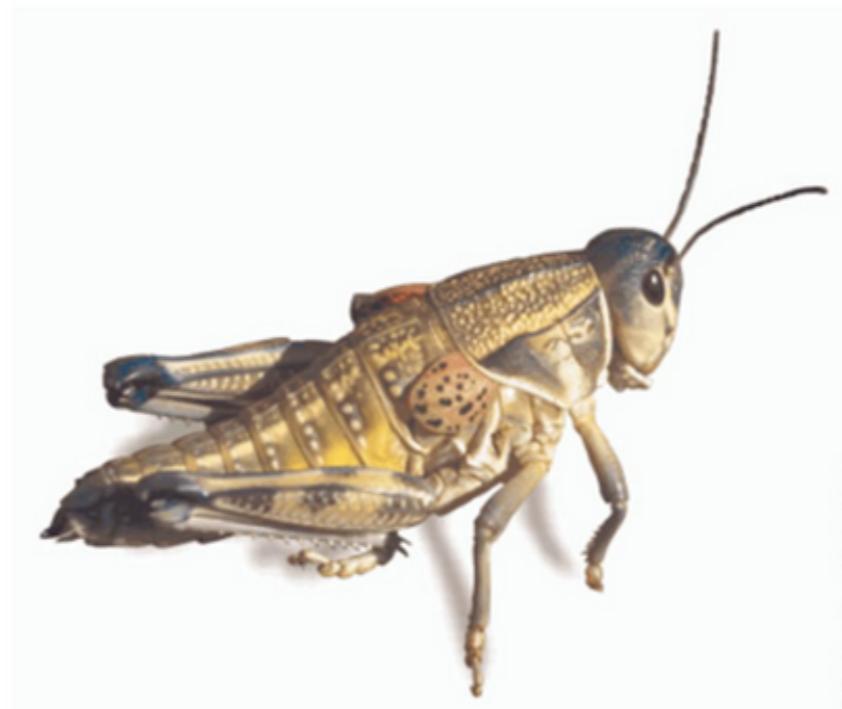
Discovery of a connection to Mendel's principles



Walter Sutton



Michael Abbey/Photo Researchers, Inc.



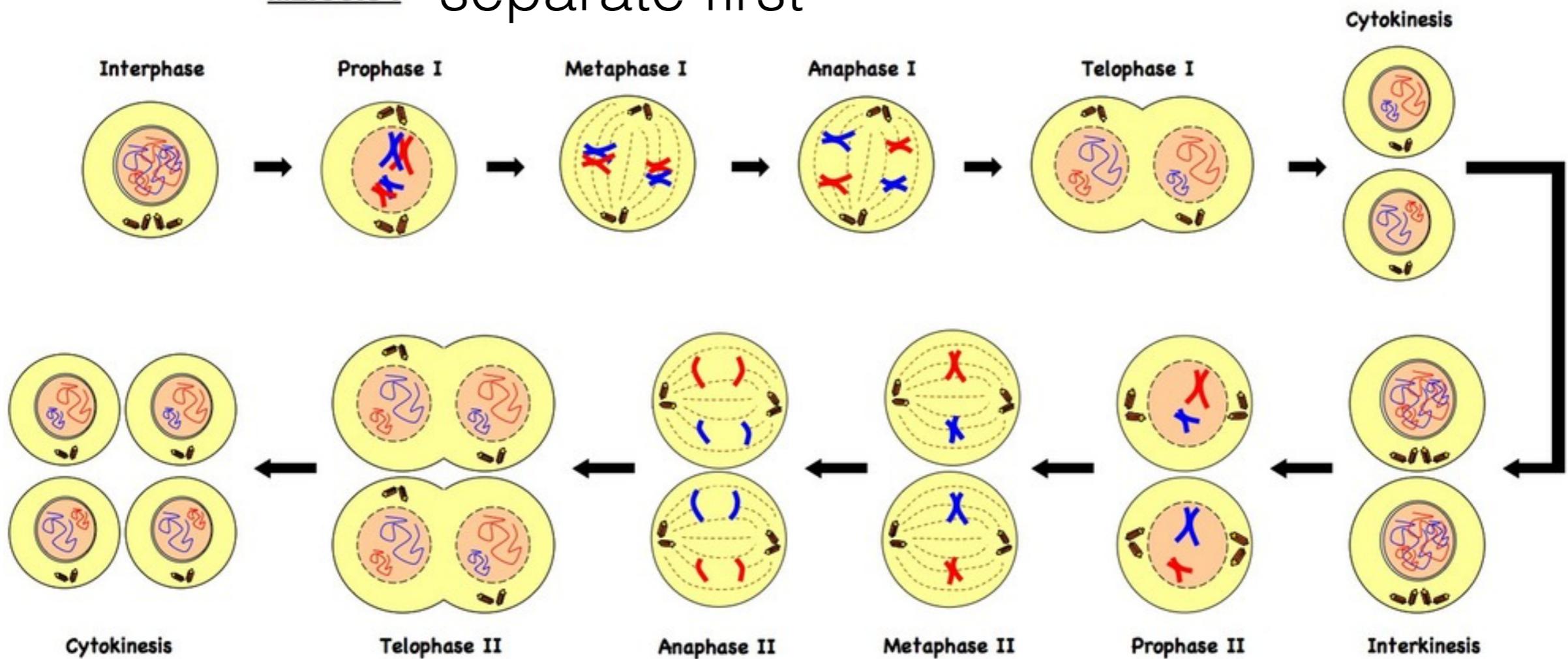
E.R. Deggingen/Color-Pic, Inc.

- Gametes have half chromosome complement of somatic cells
- Homolog separation to gamete was random

Meiosis: A reductional division in two acts

Homologs

MEIOSIS I separate first

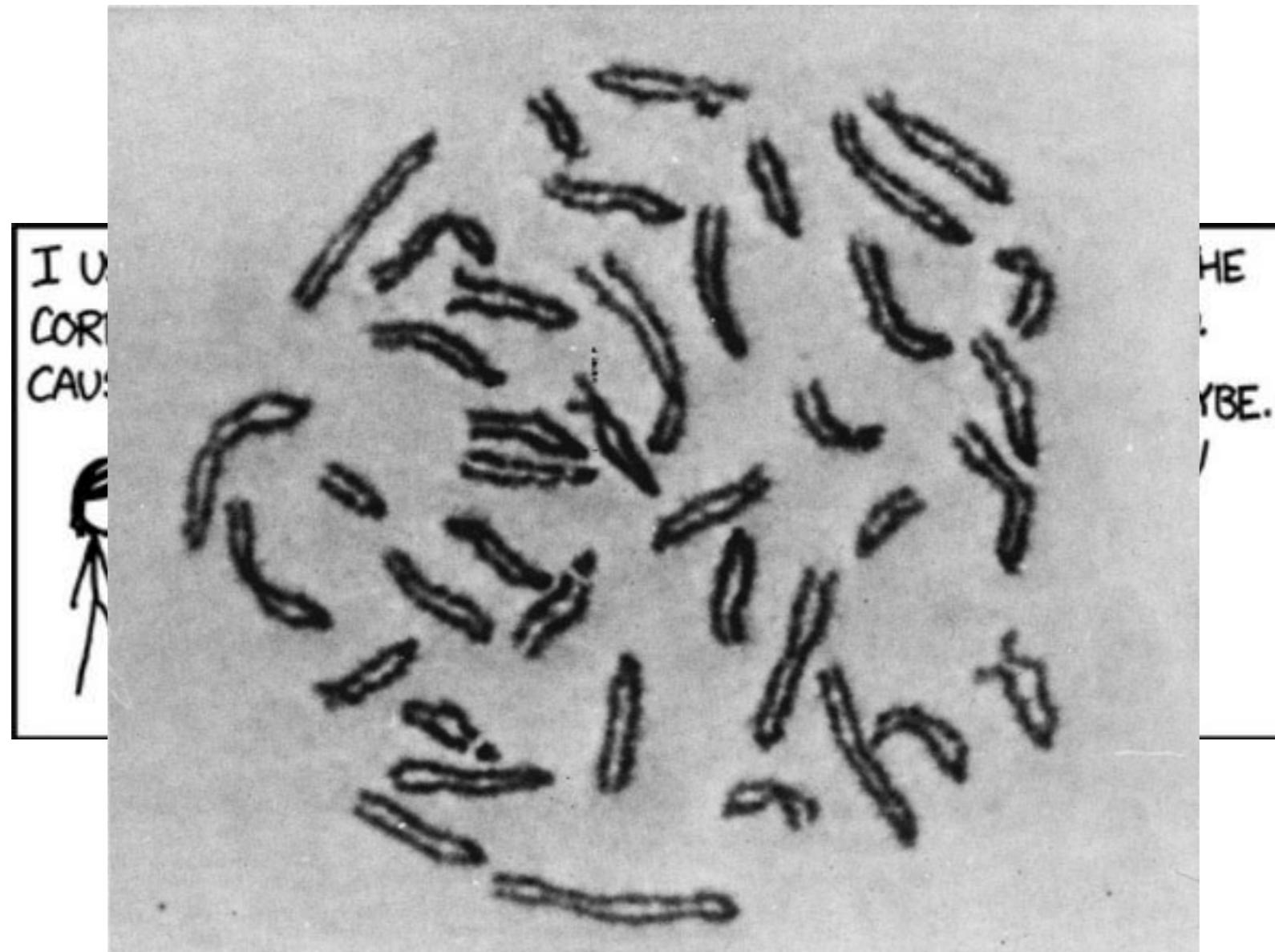


Sisters
separate last

Keep track of
centromere

Lecture 2

Correlation does not mean causation





Thomas Hunt Morgan

Drosophila melanogaster: genetics superstar



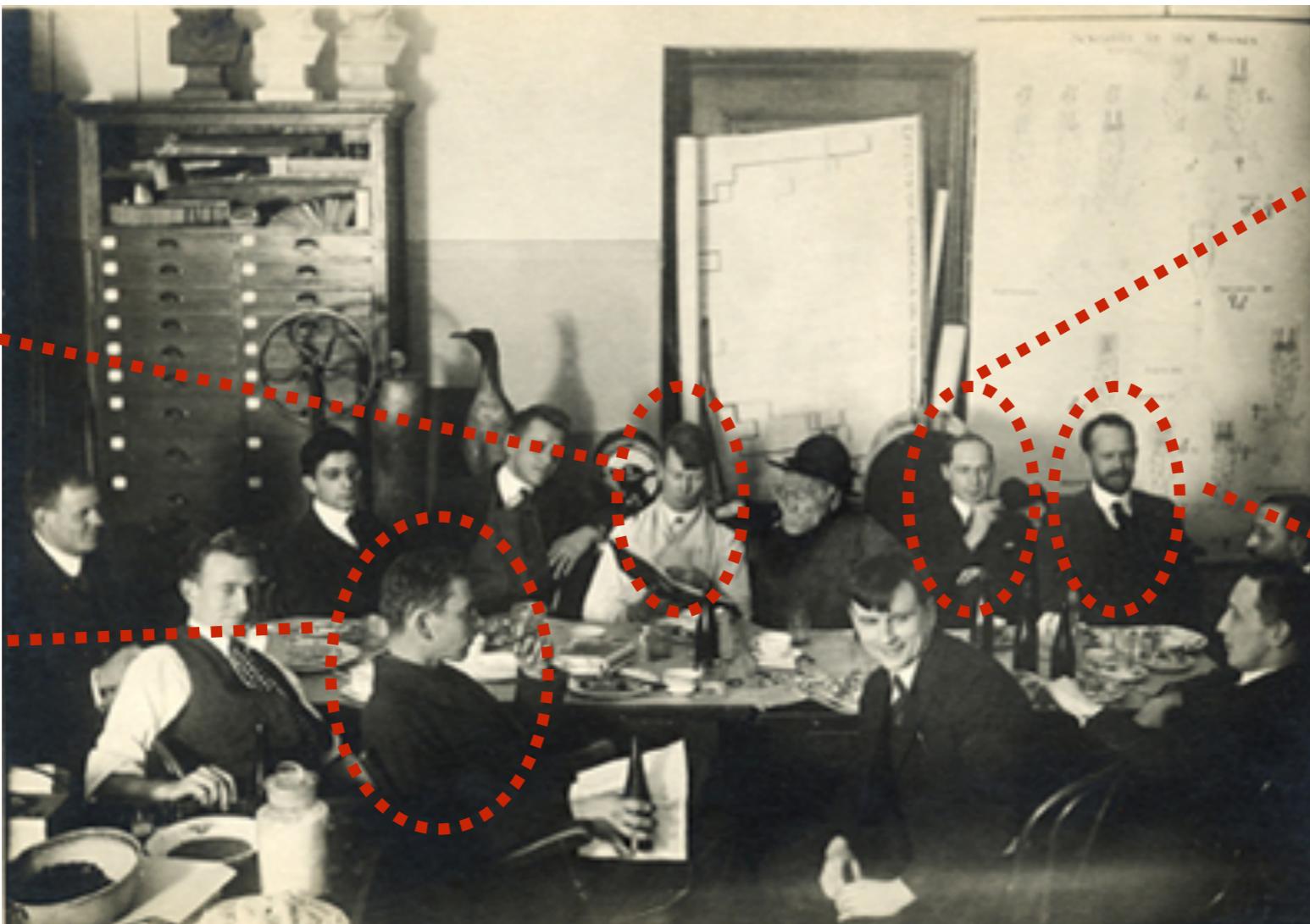
Courtesy of the Marine Biological Laboratory.
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Nettie Stevens



Thomas Hunt Morgan

The fly room at Columbia



Calvin Bridges



Alfred Sturtevant



Hermann Muller



Thomas H. Morgan

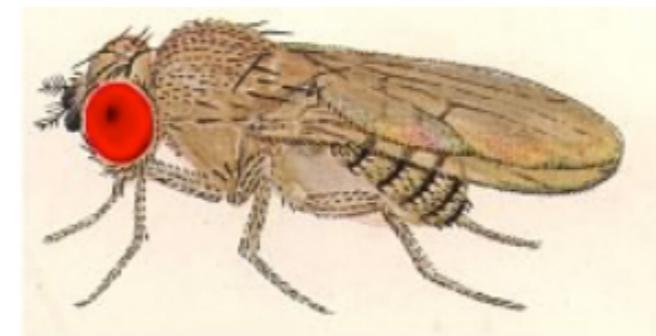
***W*⁺**

W





X



♂



♀



♂



♀

What is dominance relationship of *white* mutant allele?

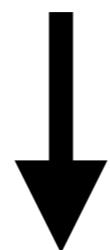


X

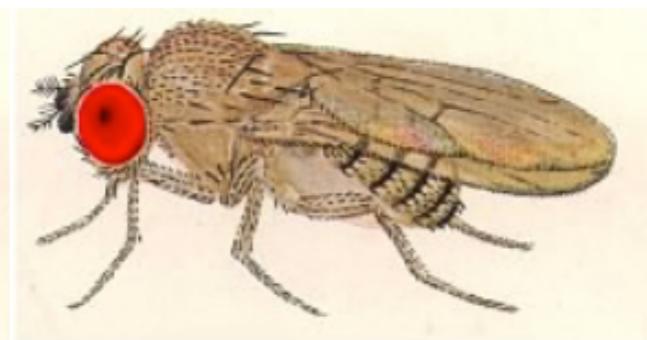
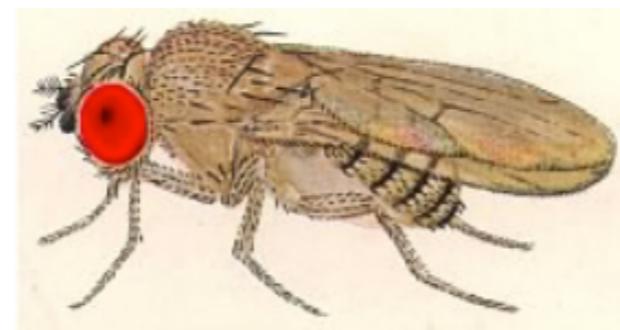


F1

♂



♀



♂

♂

♀

♀

Equal ratios of each sex and eye color

Lecture 2

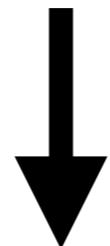
The reciprocal cross



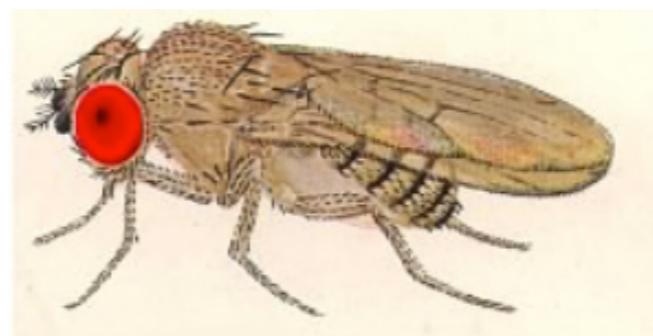
X



♂

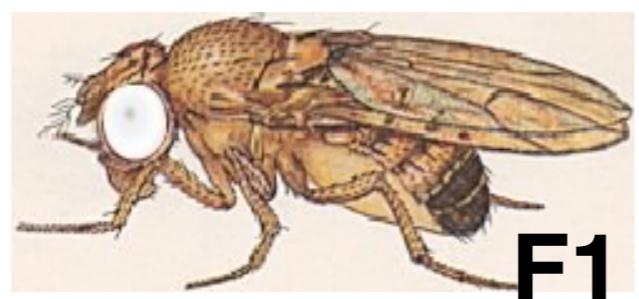


♀



♂

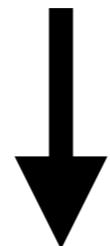
♀



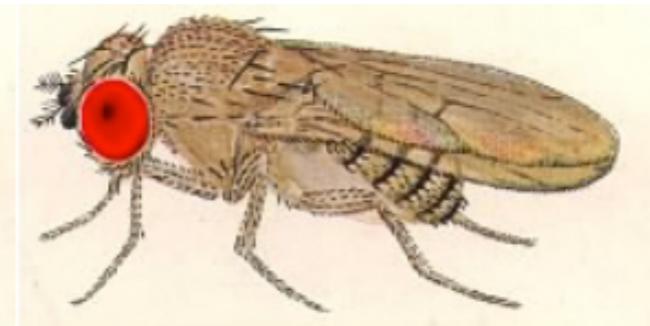
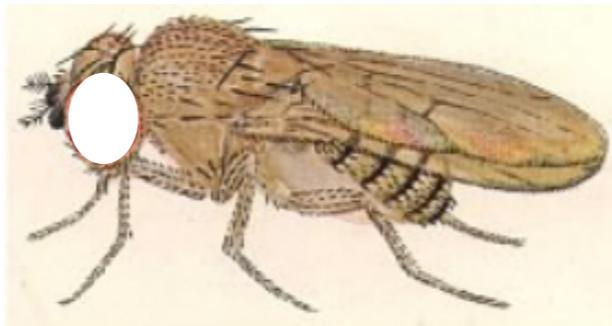
X



♂



♀



♂

♂

♀

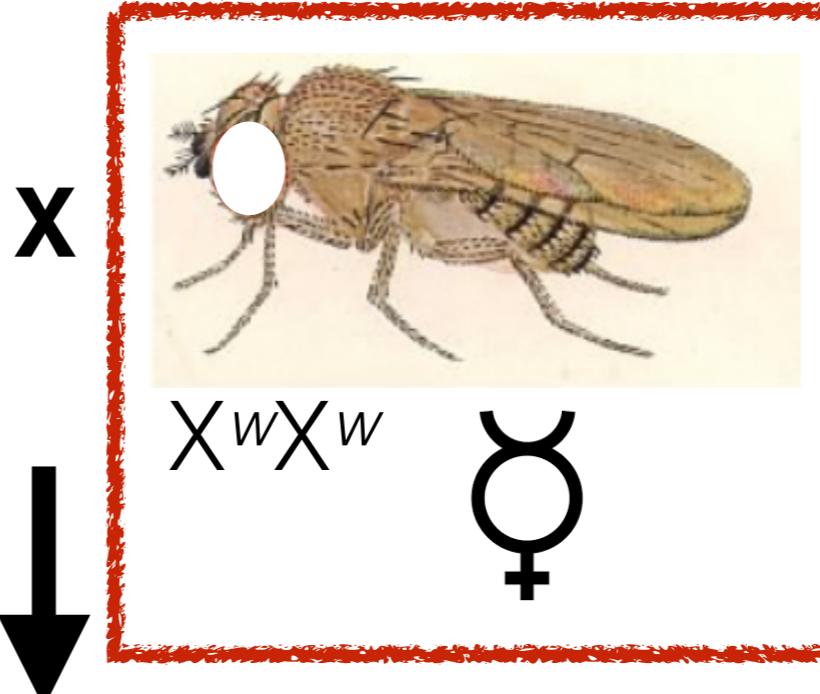
♀

Equal ratios of each sex and eye color

Lecture 2



$X^{w+}Y$ ♂



1999/2000
offspring



X^wY ♂

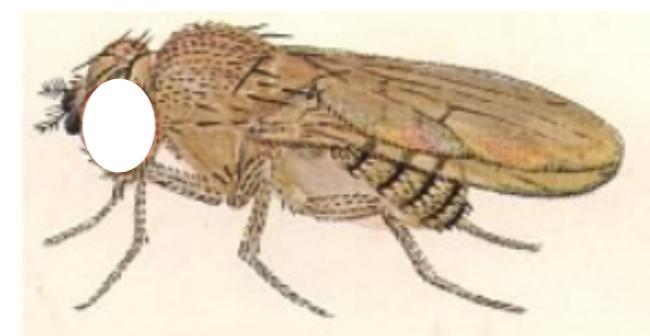


X^wX^{w+} ♀

1/2000
offspring

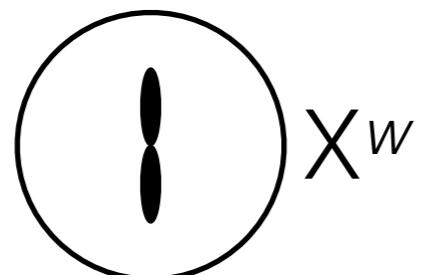
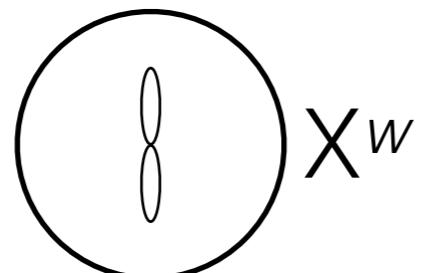
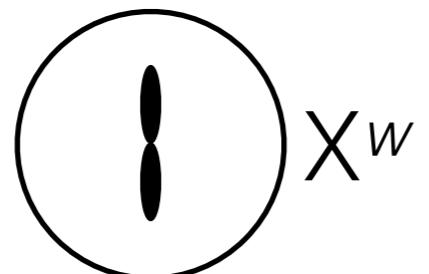
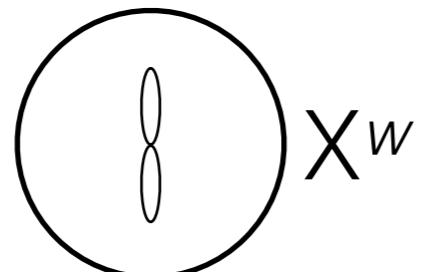


♂

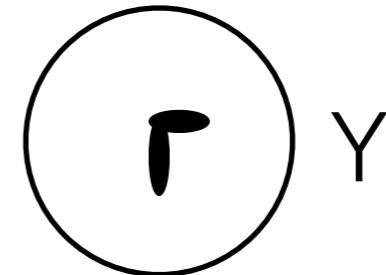
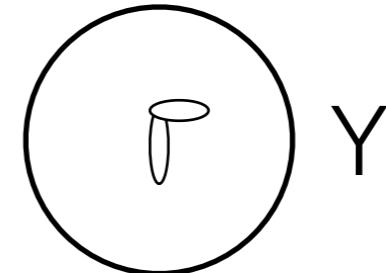
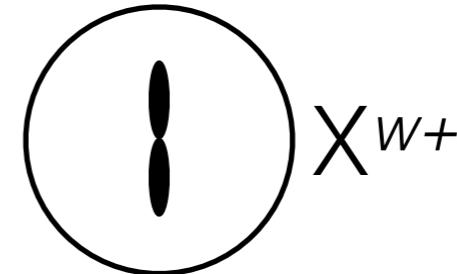
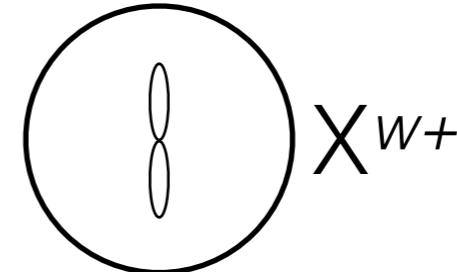


♀

Female
gametes

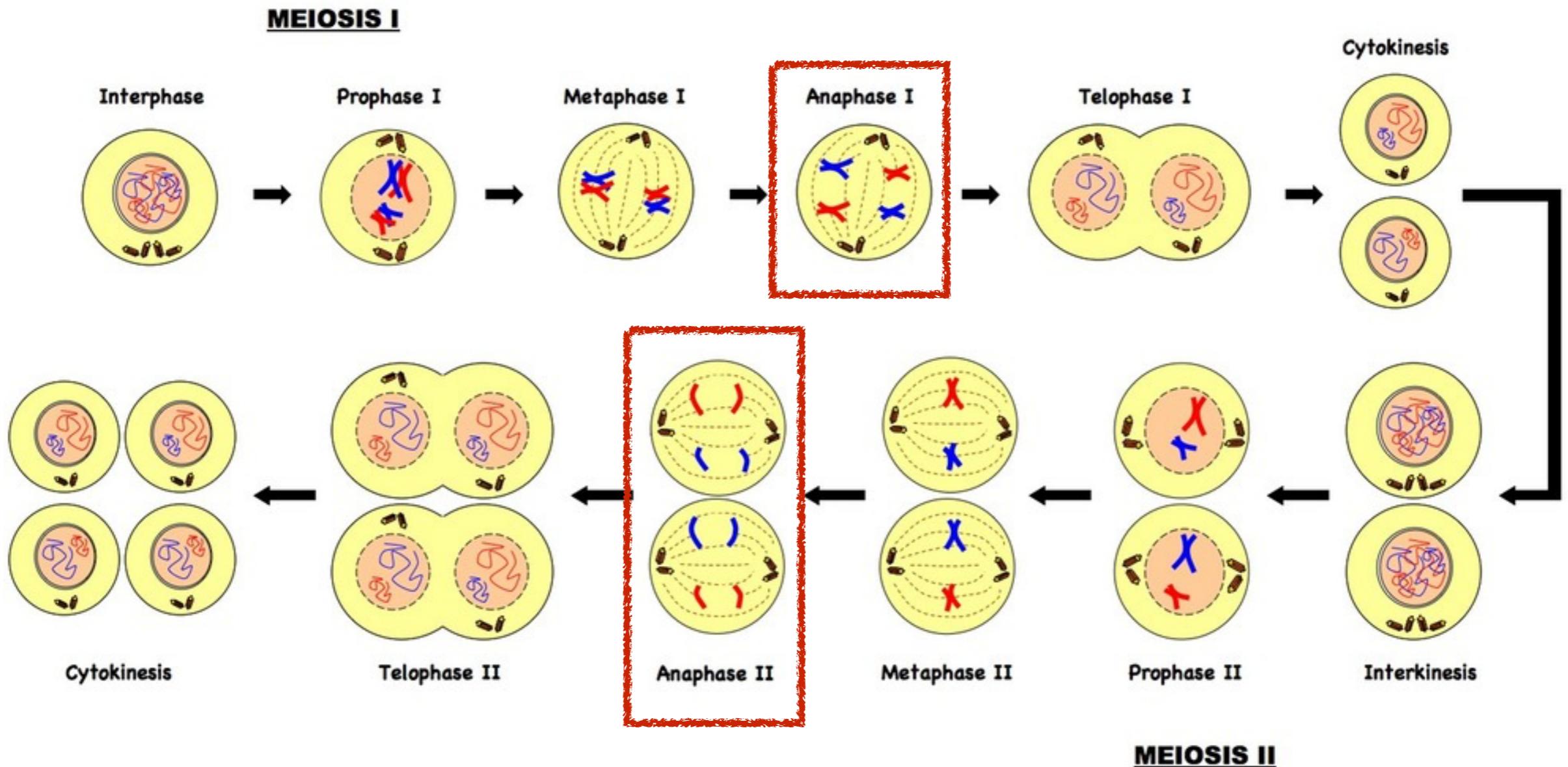


Male
gametes

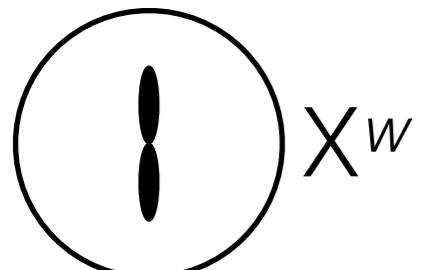
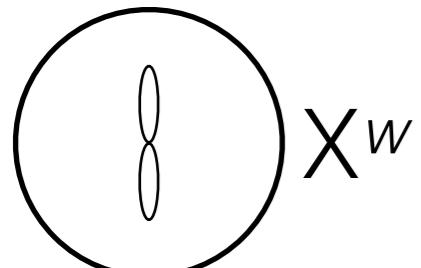
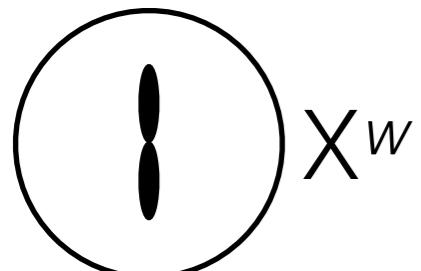
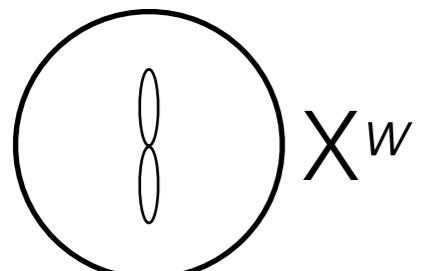


1999/2000 $X^{w+}X^w$
offspring X^wY

Meiotic non-disjunction



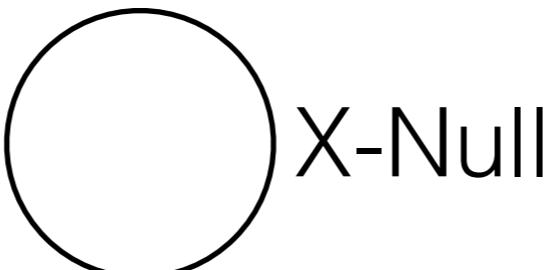
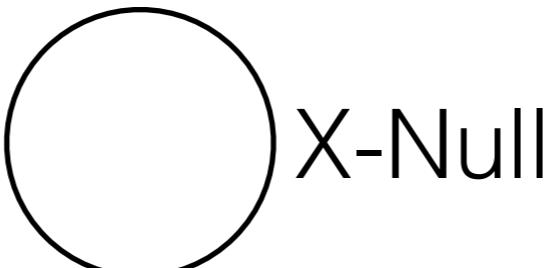
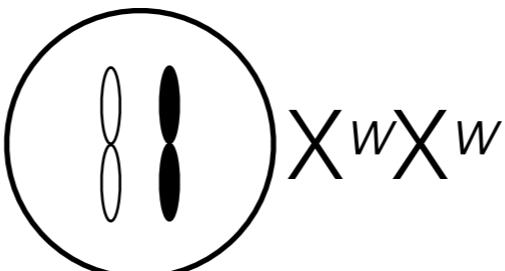
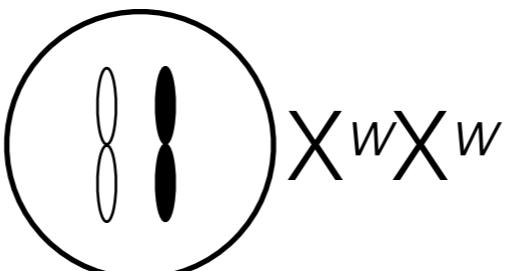
Female
gametes



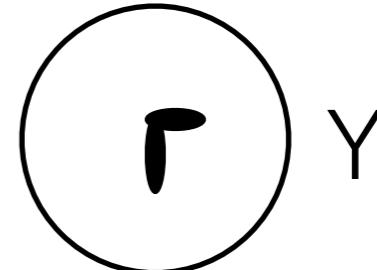
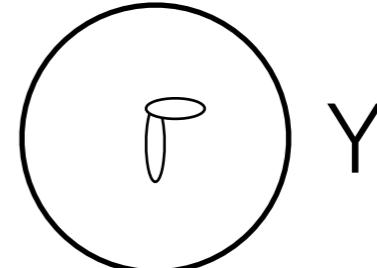
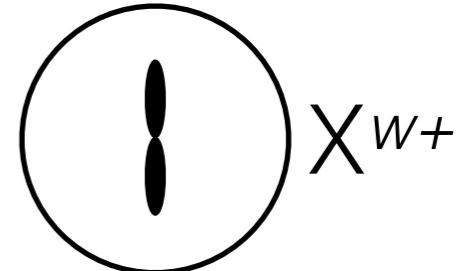
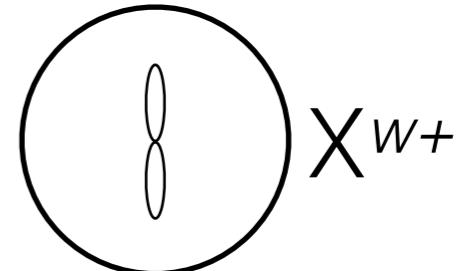
1999/2000
offspring

$X^{w+}X^w$
 X^wY

Meiosis I NDJ
Female gametes



Male
gametes



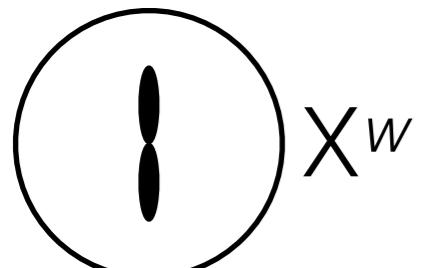
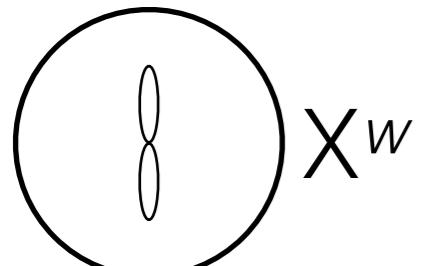
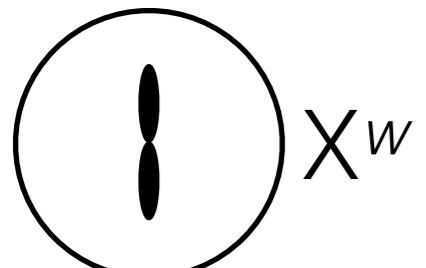
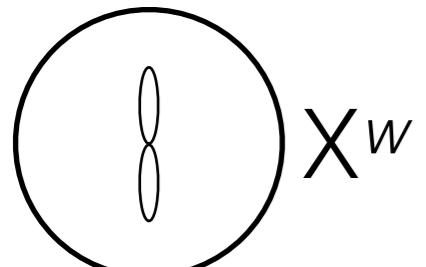
1/2000
offspring

$X^{w+}0$
 X^wX^wY

red male

white female

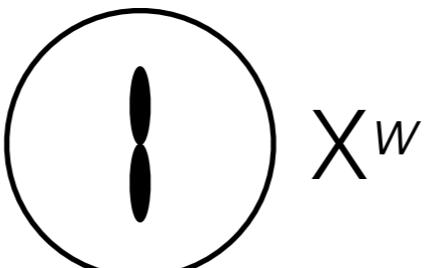
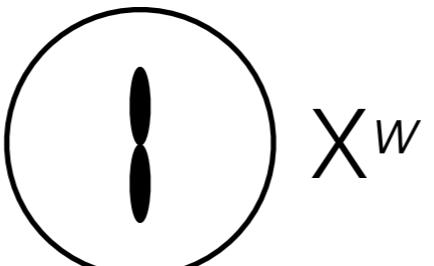
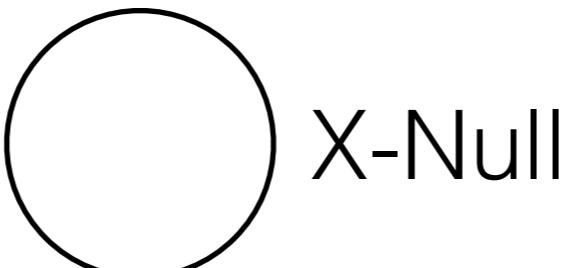
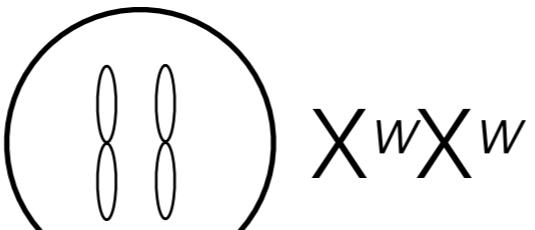
Female
gametes



1999/2000
offspring

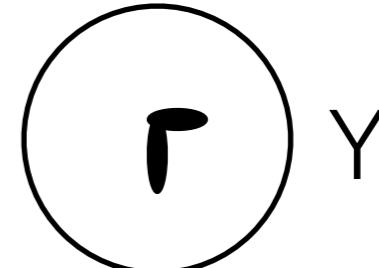
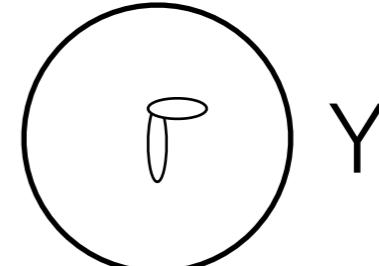
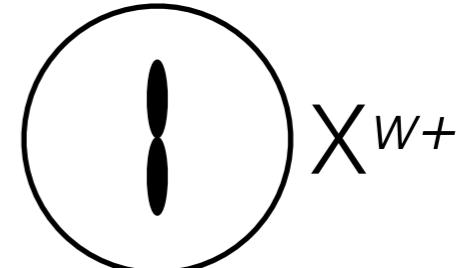
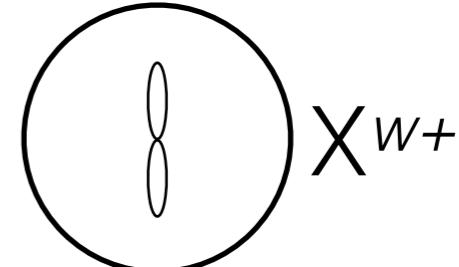
$X^{w+}X^w$
 X^wY

Meiosis II NDJ
Female gametes



1/2000
offspring

Male
gametes



$X^{w+}0$
 X^wX^wY

red male
white female

The connections between chromosome NDJ and a trait was made by Stevens and Bridges



Courtesy of the Marine Biological Laboratory.
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Nettie Stevens



Calvin Blackman Bridges, 1927.
Photo courtesy of Cold Spring Harbor
Laboratory Archives.

Calvin Bridges



**Polytene
chromosomes**

Why did the first cross not indicate to them that something weird was going on?

X^wY

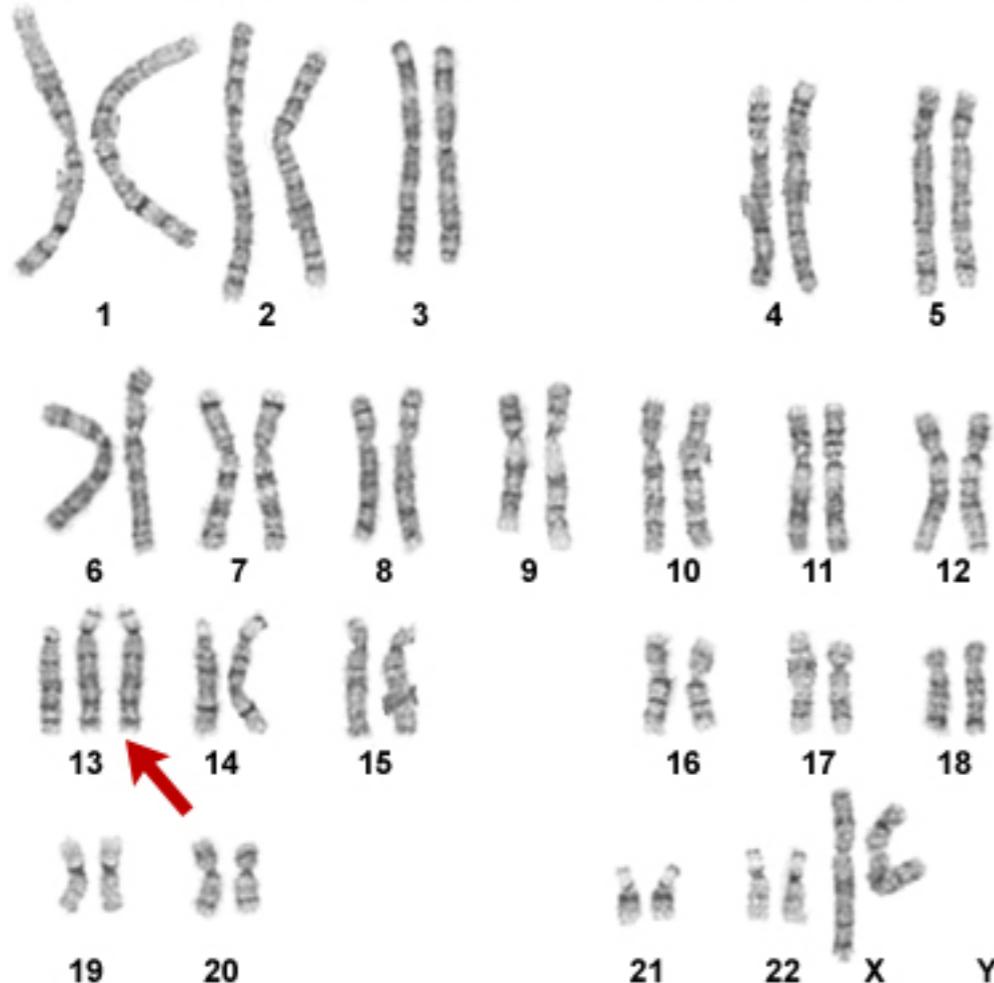
X

$X^{w+}X^{w+}$

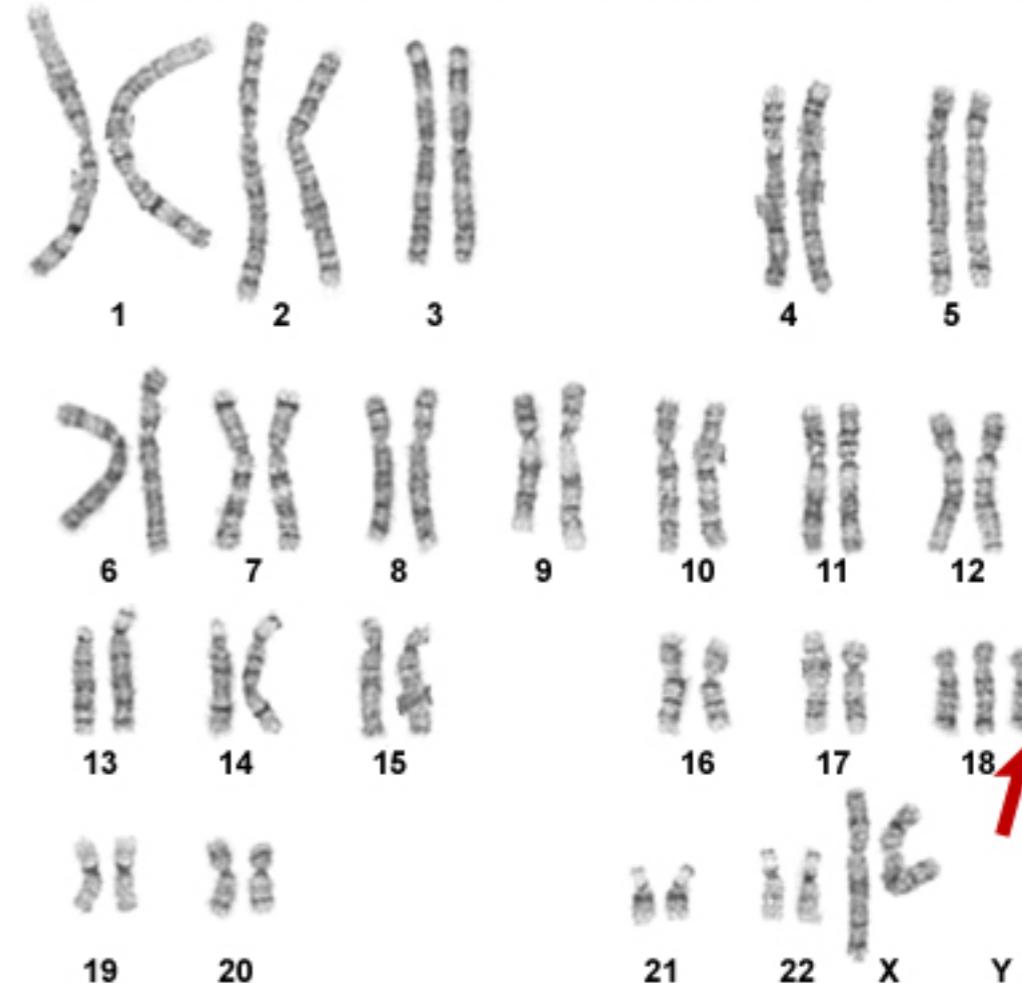
How can you tell the difference
between Meiosis I NDJ and Meiosis II NDJ?

Non-disjunction is a relatively common error - not just the X chromosome aneuploidy

Karyotype From a Female With Patau syndrome (47,XX,+13)



Karyotype From a Female With Edwards Syndrome (47,XX,+18)



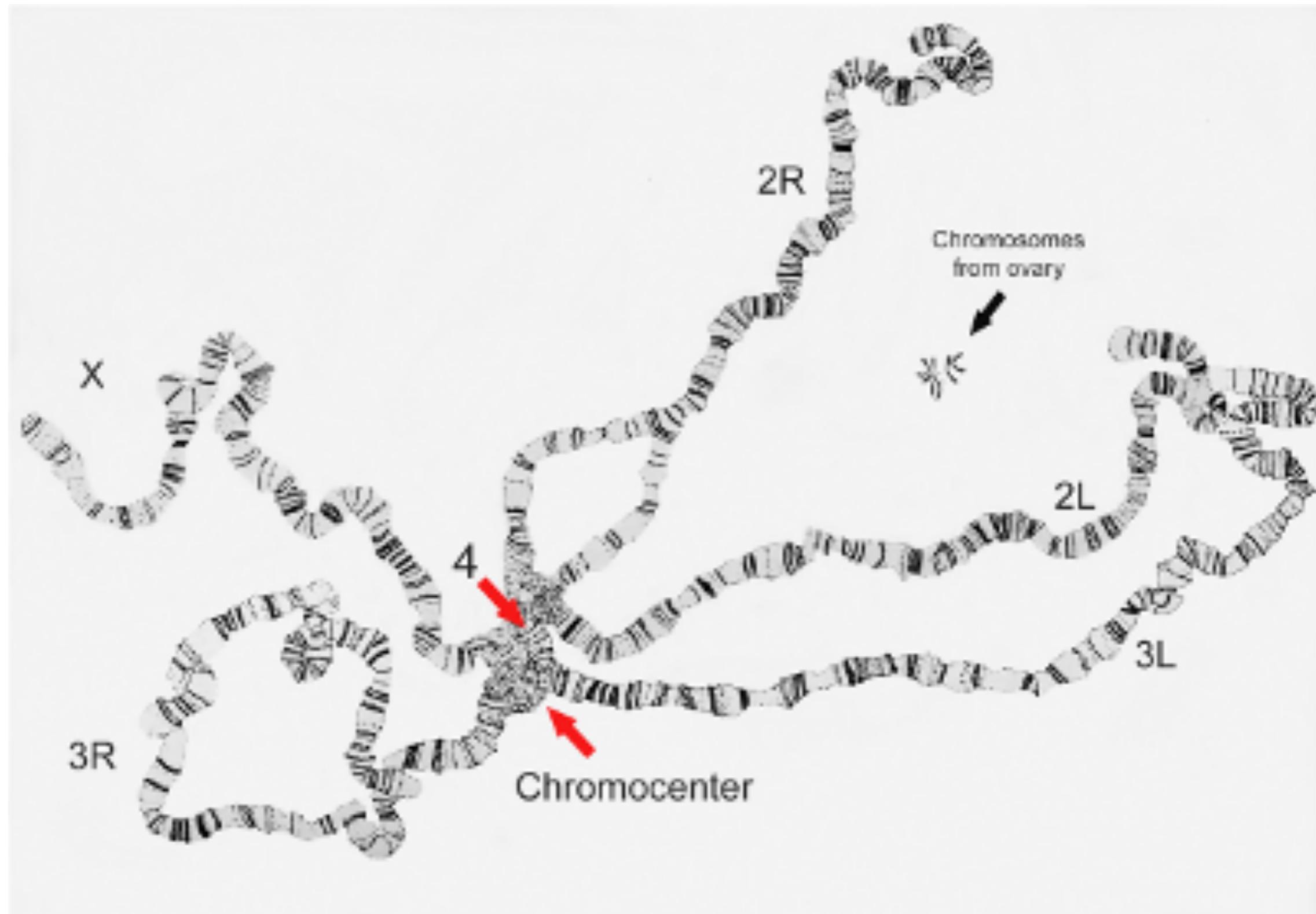
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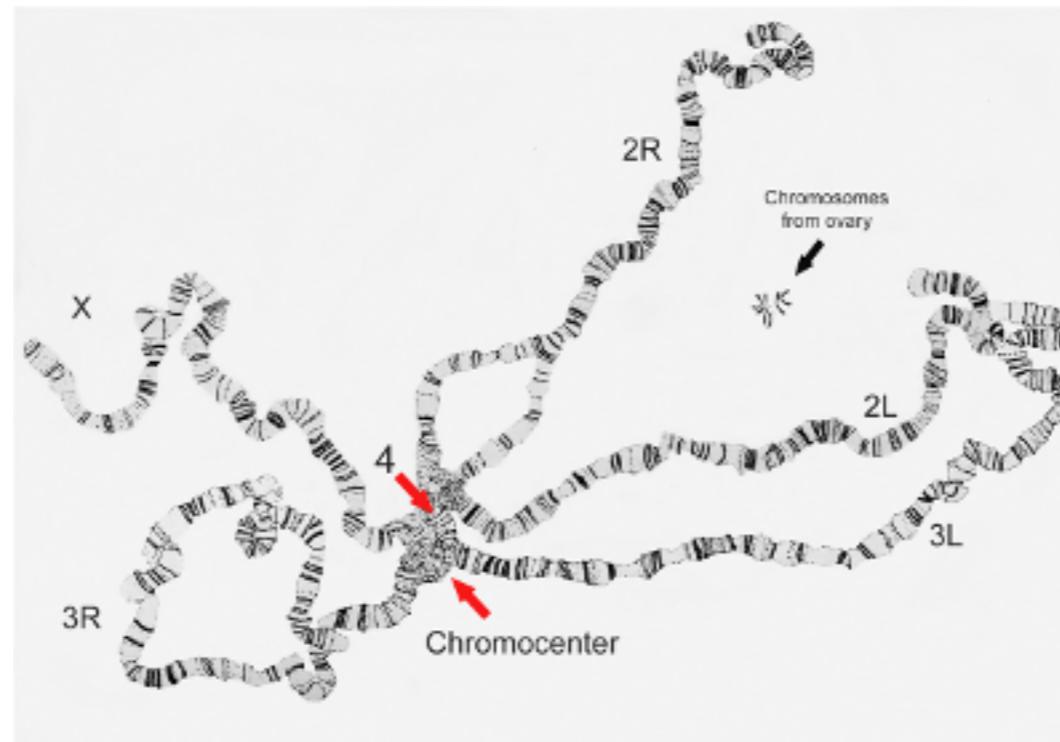
Non-disjunction is a relatively common error - not just the X chromosome aneuploidy



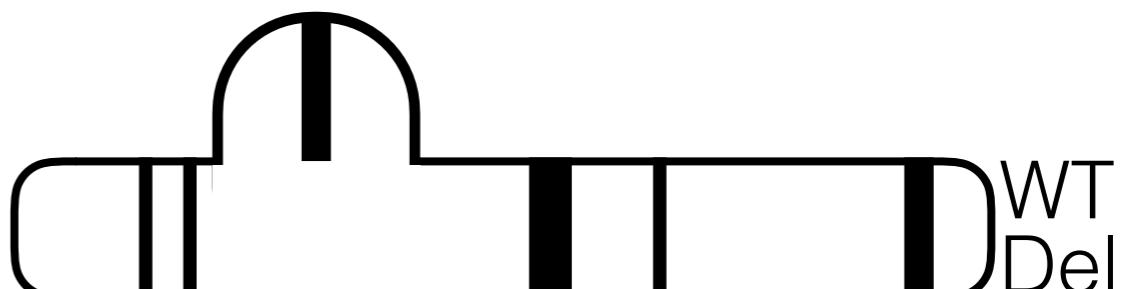
Drosophila polytene chromosomes allow us to directly visualize genetic principles



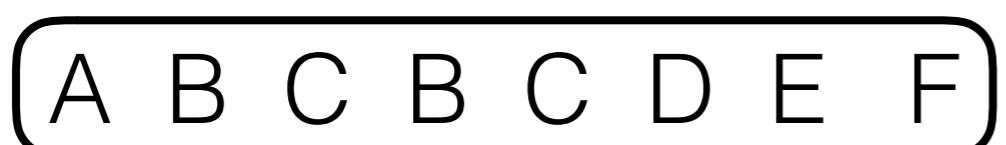
Chromosomal abnormalities



WT



Deletion BC



Duplication BC

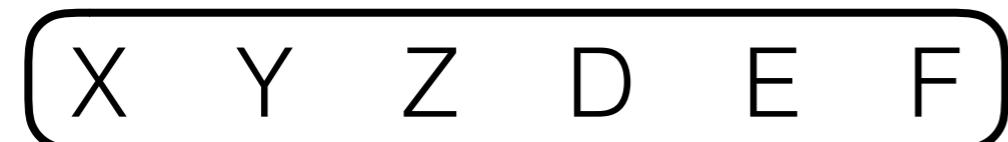
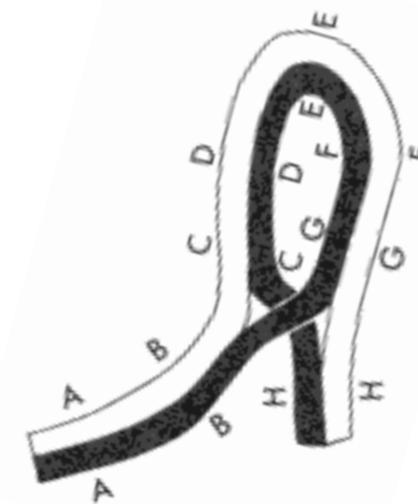
Chromosomal abnormalities



WT



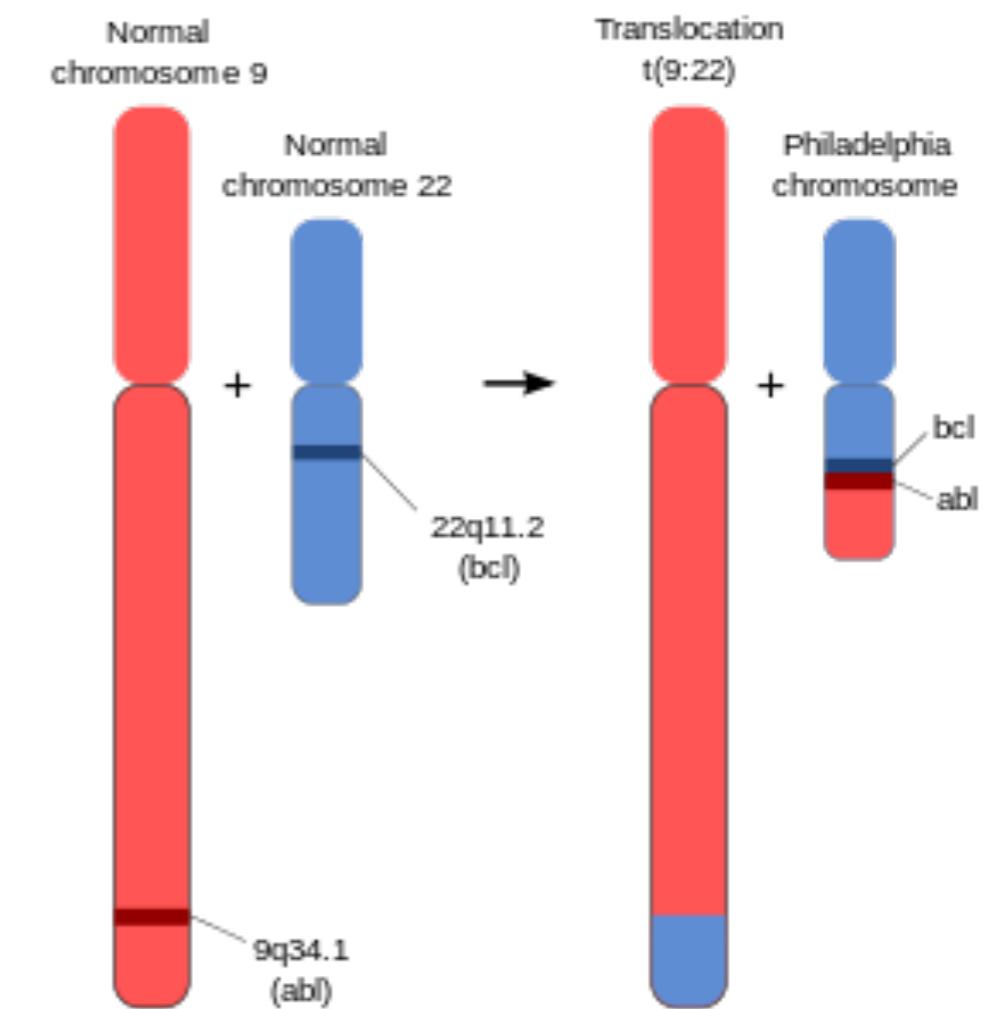
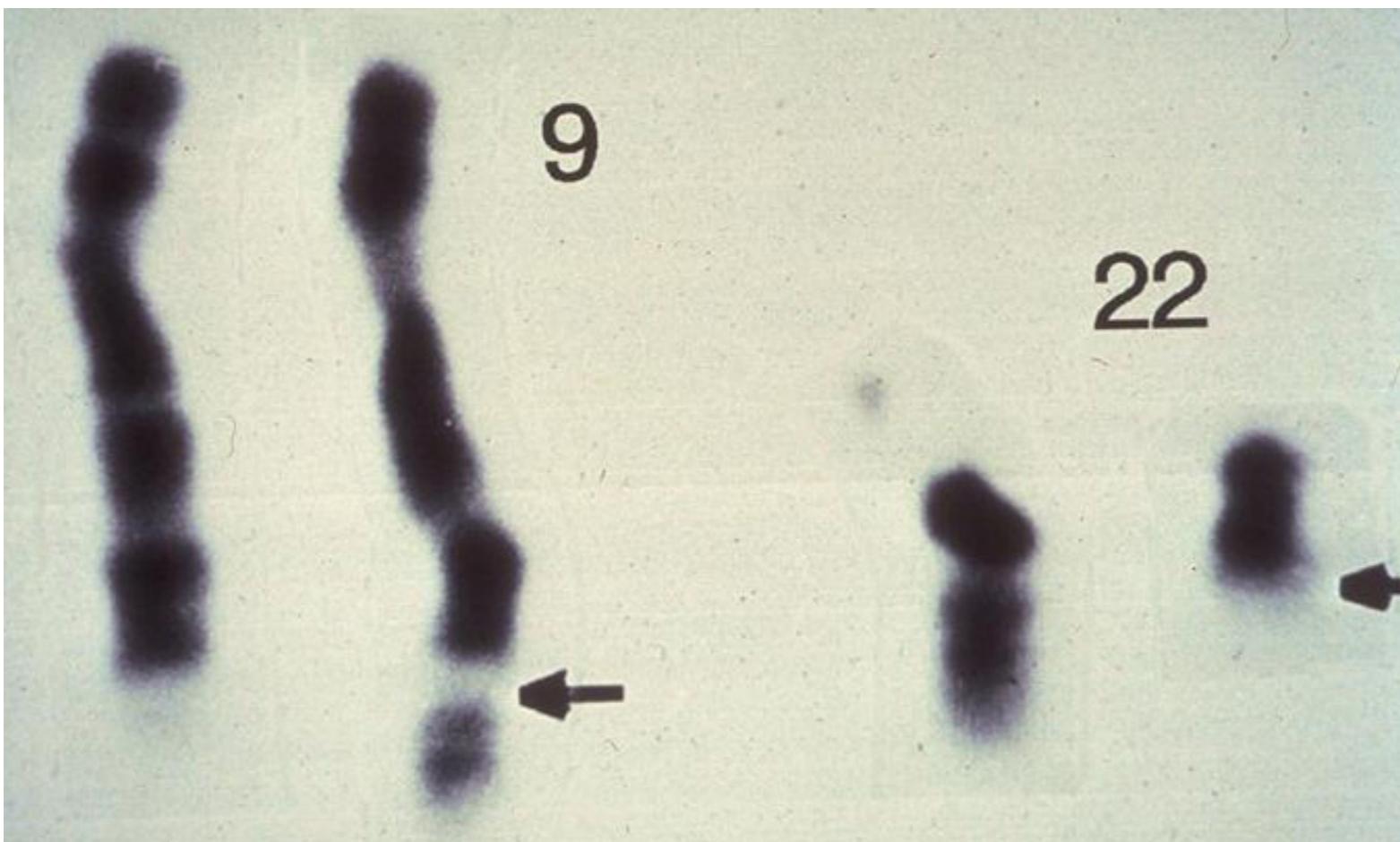
Inversion BCD



Translocation ABC-XYZ

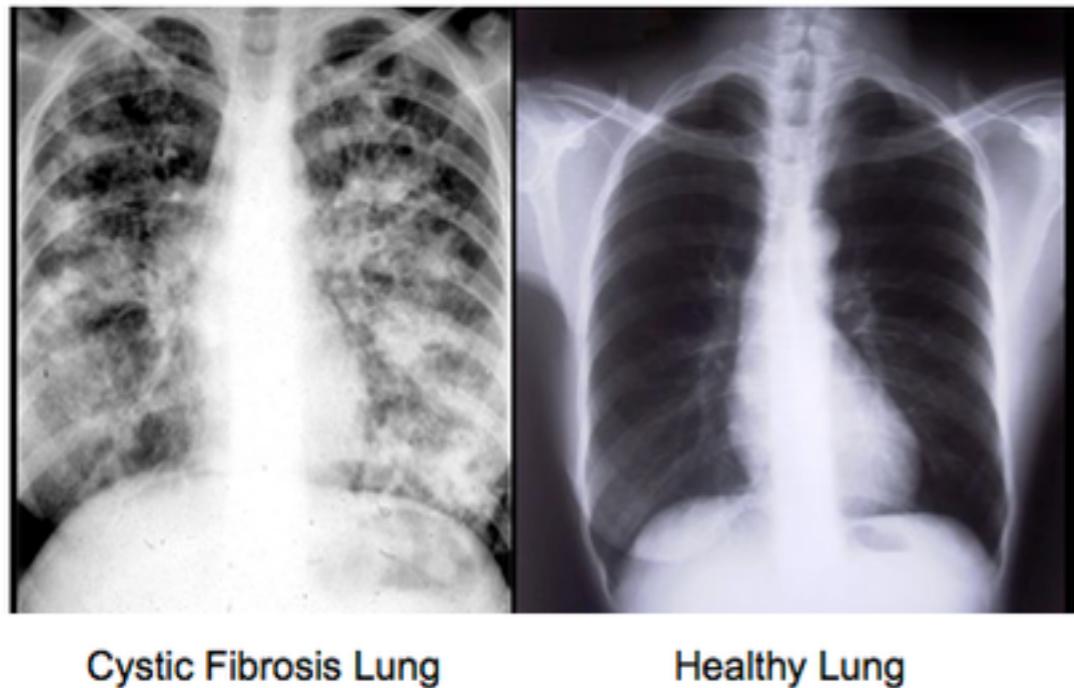
Fusion of two chromosomes

The Philadelphia chromosome: translocation

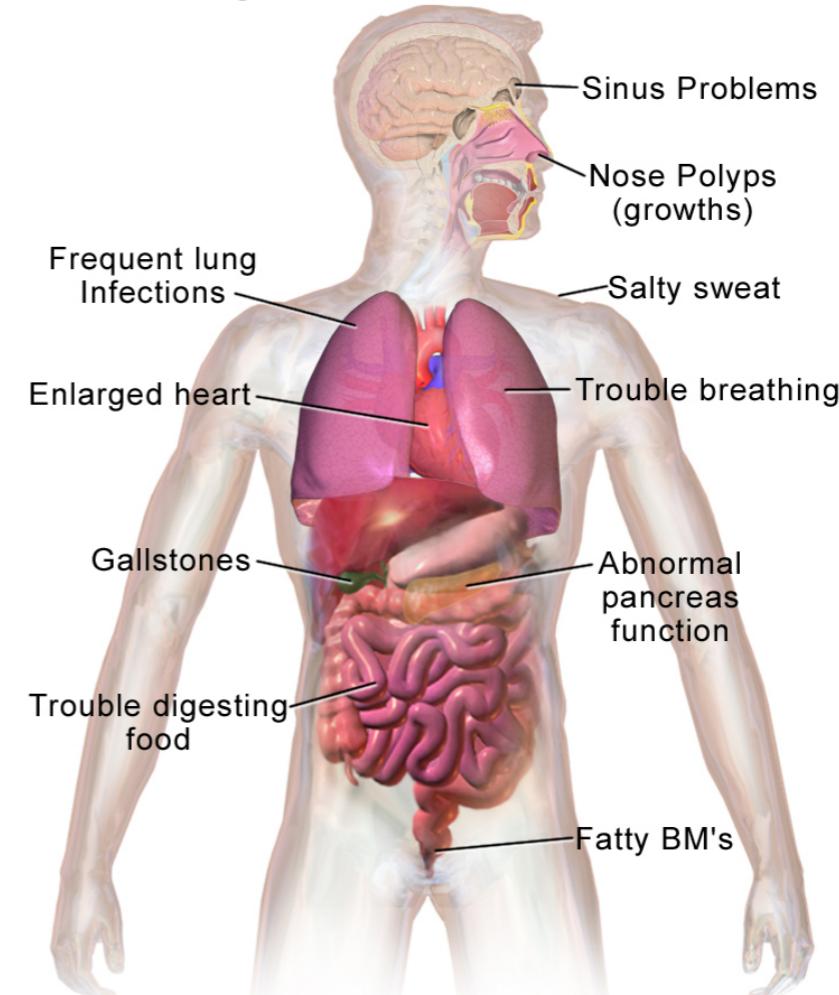


Janet Rowley

What about cystic fibrosis and today's topic?



Health Problems with Cystic Fibrosis



- Rare disease affects 1/10,000 live births
- Breathing difficulties caused by thick mucus
- Pancreas, liver, kidneys, and intestine are also deficient