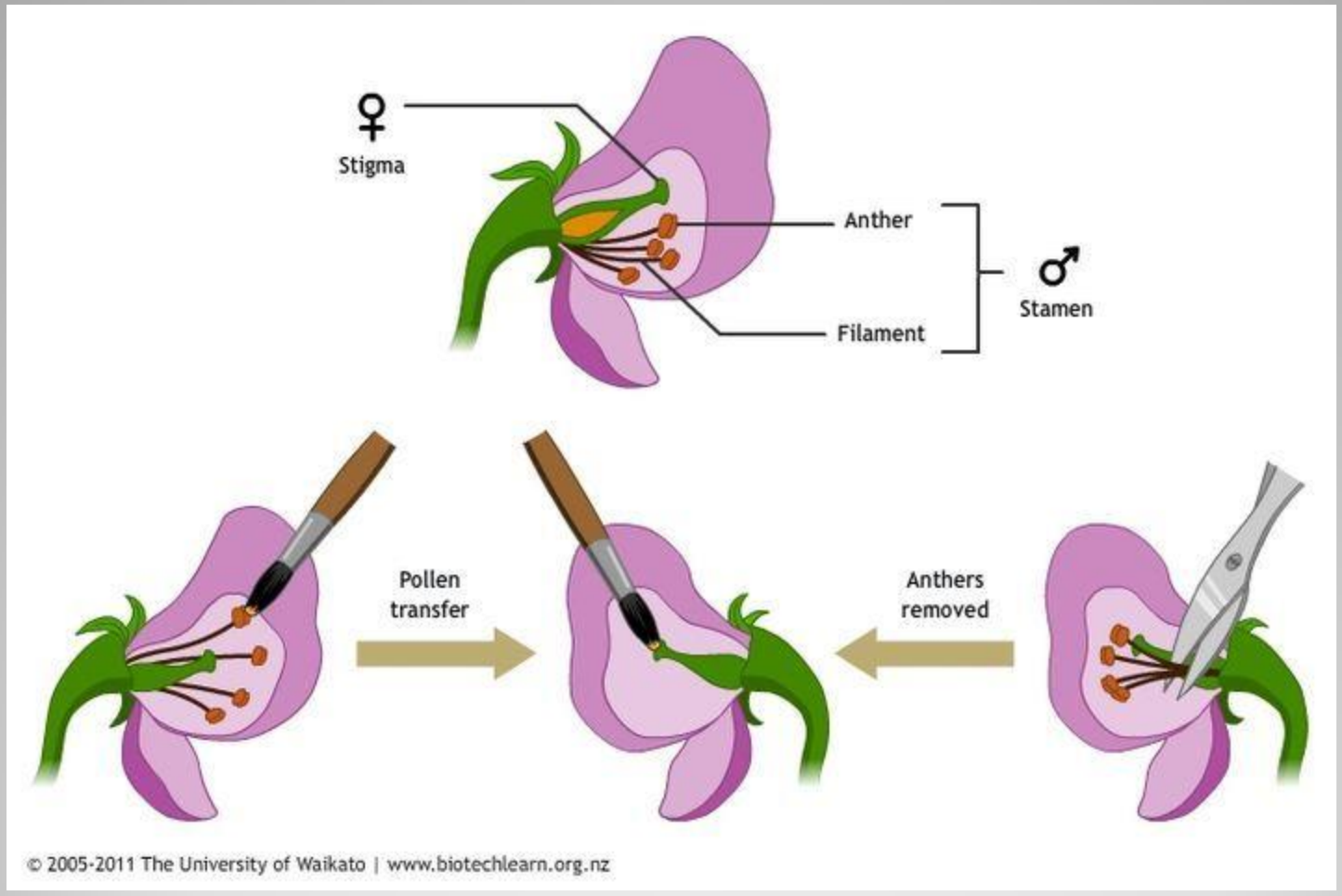
Introduction to Genetics

Chapter 11

11.1 Gregor Mendel

- Genetics-scientific study of heredity
- Mendel-1822
- Studied true breeding pea plants-if they self pollinated offspring would be identical to parent plant
- Wanted to cross pollinate so cut off male flowers and hand-applied pollen from other plants



11.1 Gregor Mendel

- Studied 7 traits
- **P1**-original plants
- **F1** first generation offspring
- Made hybrids by crossing plants with different characteristics due to different forms of each gene (**alleles**)

	Seed Shape	Seed Color	Seed Coat Color	Pod Shape	Pod Color	Flower Position	Plant Height
P	Round X Wrinkled	Yellow X Green	Gray X White	Smooth X Constricted	Green X Yellow	Axial X Terminal	Tall X Short
F_1	Round	Yellow	Gray	Smooth	Green	Axial	Tall

11.1 Gregor Mendel

- Two conclusions-
- Biological characteristics are determined by factors that are inherited (genes)
- Some alleles are **dominant** and some **recessive**

11.1 Gregor Mendel

- Mendel wanted to know if the recessive alleles had disappeared or were still present in the F1 generation
- Crossed F1 plants to make F2 plants using self pollination
- Traits controlled by the recessive alleles reappeared
- Somehow the alleles had been separated-**segregation**-occurred in gametes (sex cells)
- Each F1 plant has 2 alleles for each trait and produces two types of gametes
- Results in new combinations of alleles

11.1 Gregor Mendel

- Mendel realized form his crosses that when he crossed the plants he always got the same ratios of characteristics in the offspring
- Laws of probability explain his results

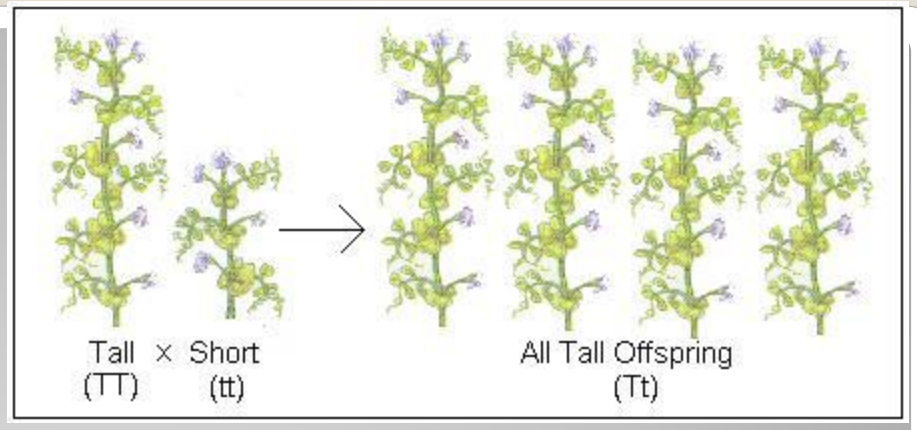
11-2 Probability and Punnett Squares

- Coin toss example
- 50% heads or tails
- Probability =1/2
- Each coin toss is independent of the one before
- Probability of getting heads or tails a second and third time=1/2x1/2x1/2=1/8
- Can use probabilities to predict outcomes of crosses

11-2 Probability and Punnett Squares

- Punnett squares

	T	t
T	TT	Tt
t	Tt	tt



TT, tt=homozygous
Tt=heterozygous

25% chance of getting each **genotype**
Ratio of **phenotypes** is 75% tall, 25% short

11-2 Probability and Punnett Squares

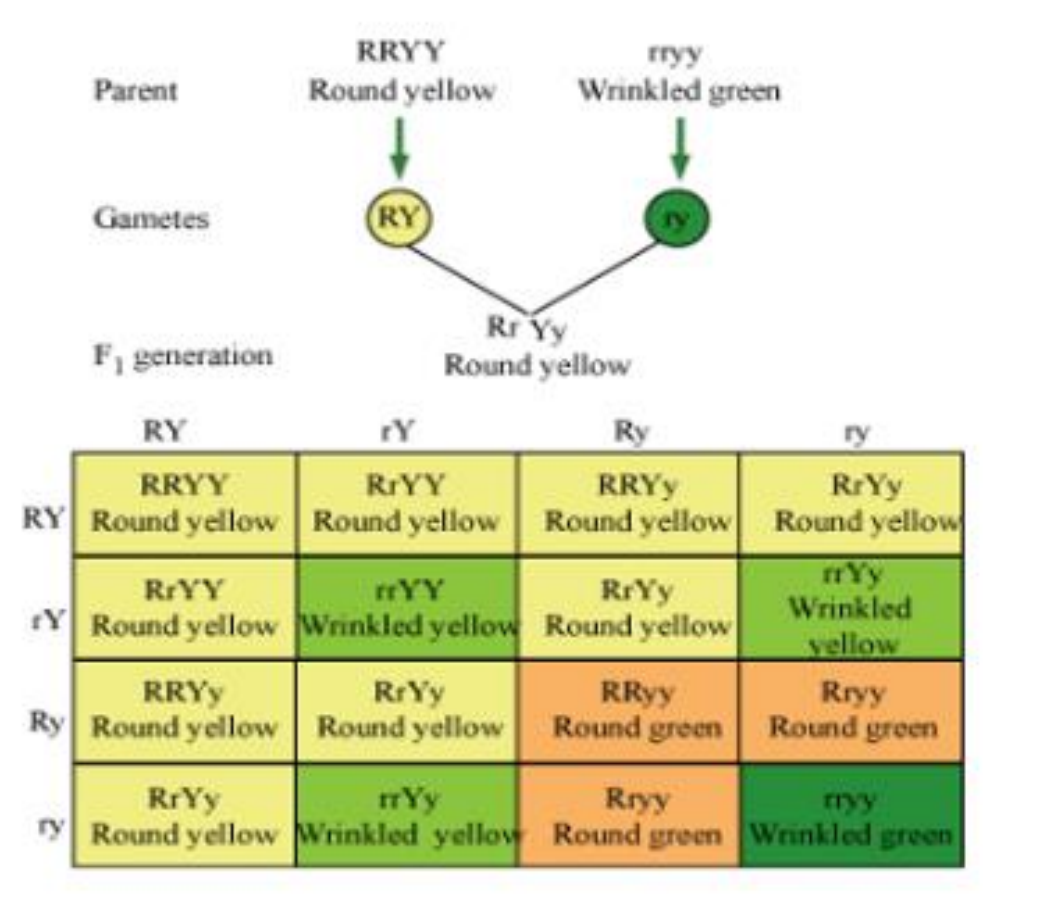
- Probabilities explained Mendel's results
- Probabilities describes average of a large number of events(for many crosses for example) but cannot predict the outcome of a single event
- Think about the coin toss example

11-2 Probability and Punnett Squares

- Mendel wondered if the alleles for the different traits segregated independently from the segregation of alleles for other traits
- Did 2-factor crosses

11-3 Mendelian Genetics

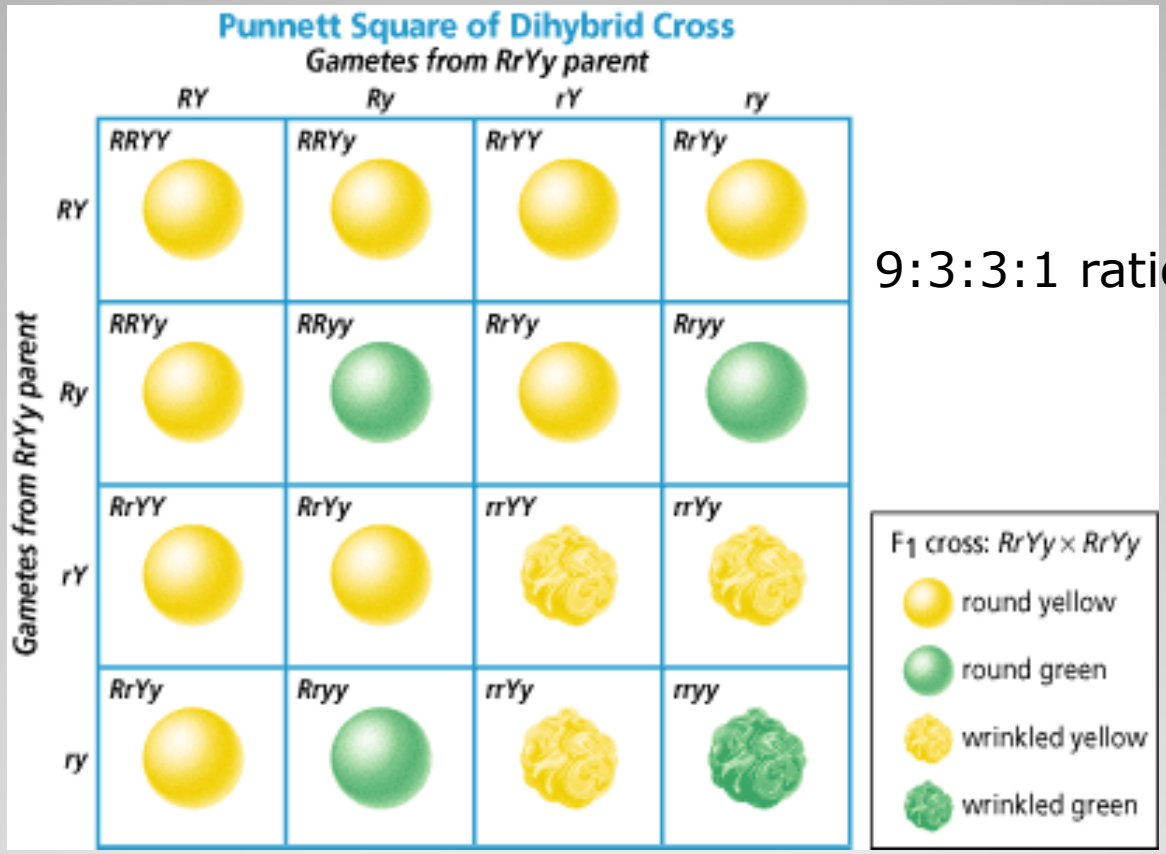
- Two factor crosses-F1



	RY	rY	Ry	ry
RY	RRYY Round yellow	RrYY Round yellow	RRYy Round yellow	RrYy Round yellow
rY	RrYY Round yellow	rrYY Wrinkled yellow	RrYy Round yellow	rrYy Wrinkled yellow
Ry	RRYy Round yellow	RrYy Round yellow	RRyy Round green	Rryy Round green
ry	RrYy Round yellow	rrYy Wrinkled yellow	Rryy Round green	rryy Wrinkled green

11-3 Mendelian Genetics

- Two factor crosses-F2



9:3:3:1 ratio

11-3 Mendelian Genetics

- New plants had new combinations of alleles not seen in parent plants in a 9:3:3:1 ratio
- **Law of independent assortment**

11-3 Mendelian Genetics

- Some alleles are neither dominant nor recessive
- Some traits are controlled by multiple alleles or genes
- **Incomplete dominance**-when one allele is not completely dominant over another one
- The heterozygous phenotype is in between the two homozygous phenotypes Ex: pink flowers from a red-white flower cross

11-3 Mendelian Genetics

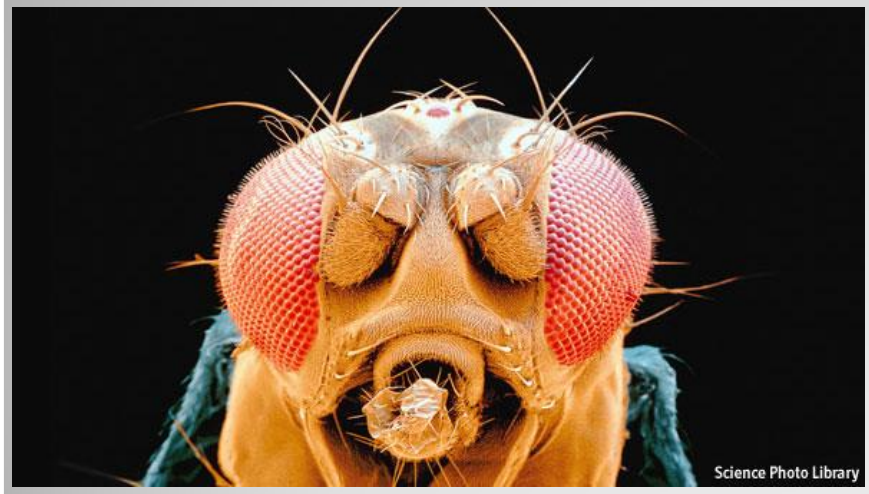
- **Co-dominance**-both alleles contribute to the phenotype
- Ex: Roan cattle have both red and white hair and appear pinkish-brown or speckled chickens with black and white feathers

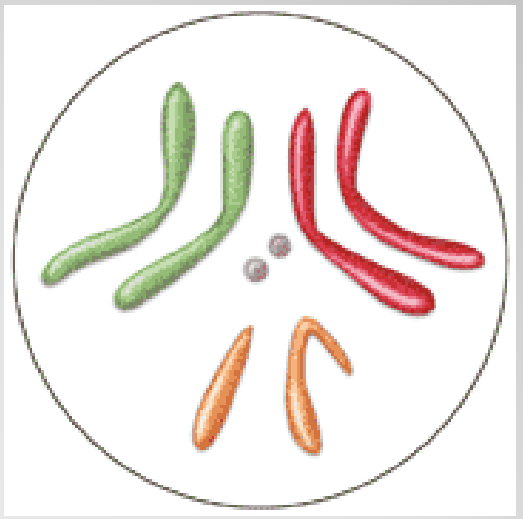
11-3 Mendelian Genetics

- **Multiple alleles**-more than two alleles for a single gene
- Ex: 4 coat colors for rabbits
- **Polygenic traits**-traits controlled by more than one gene
- Ex: skin color in humans is controlled by 4 different genes

11-3 Mendelian Genetics

- Thomas Morgan (early 1900's)studied inheritance in flies (*Drosophila melanogaster*) and found Mendel's principles were the same in flies as in plants

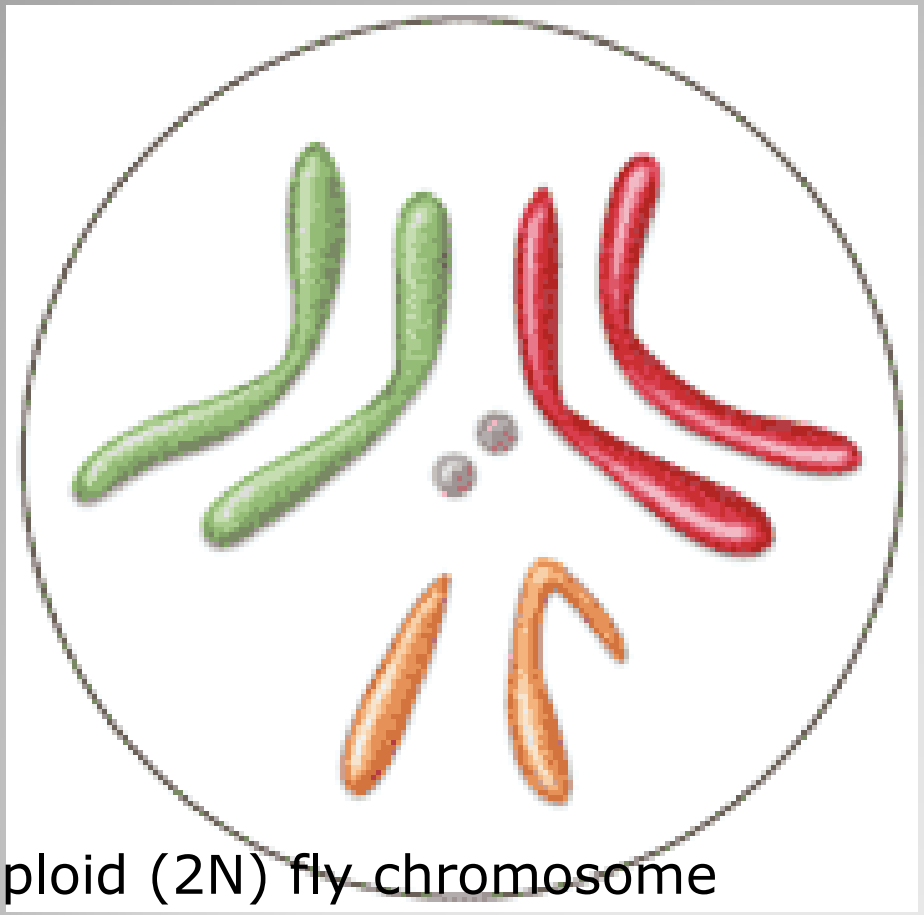




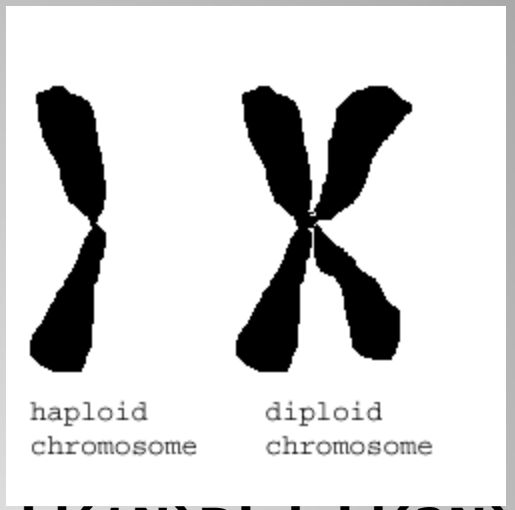
11-3 Mendelian Genetics

- Mendel reasoned that if all cells had alleles from both parents, and alleles were independently assorted or segregated, when the gametes formed there must be a process that separates the two sets of genes so that each gamete has only one set.
- **Meiosis**

11-4 Meiosis

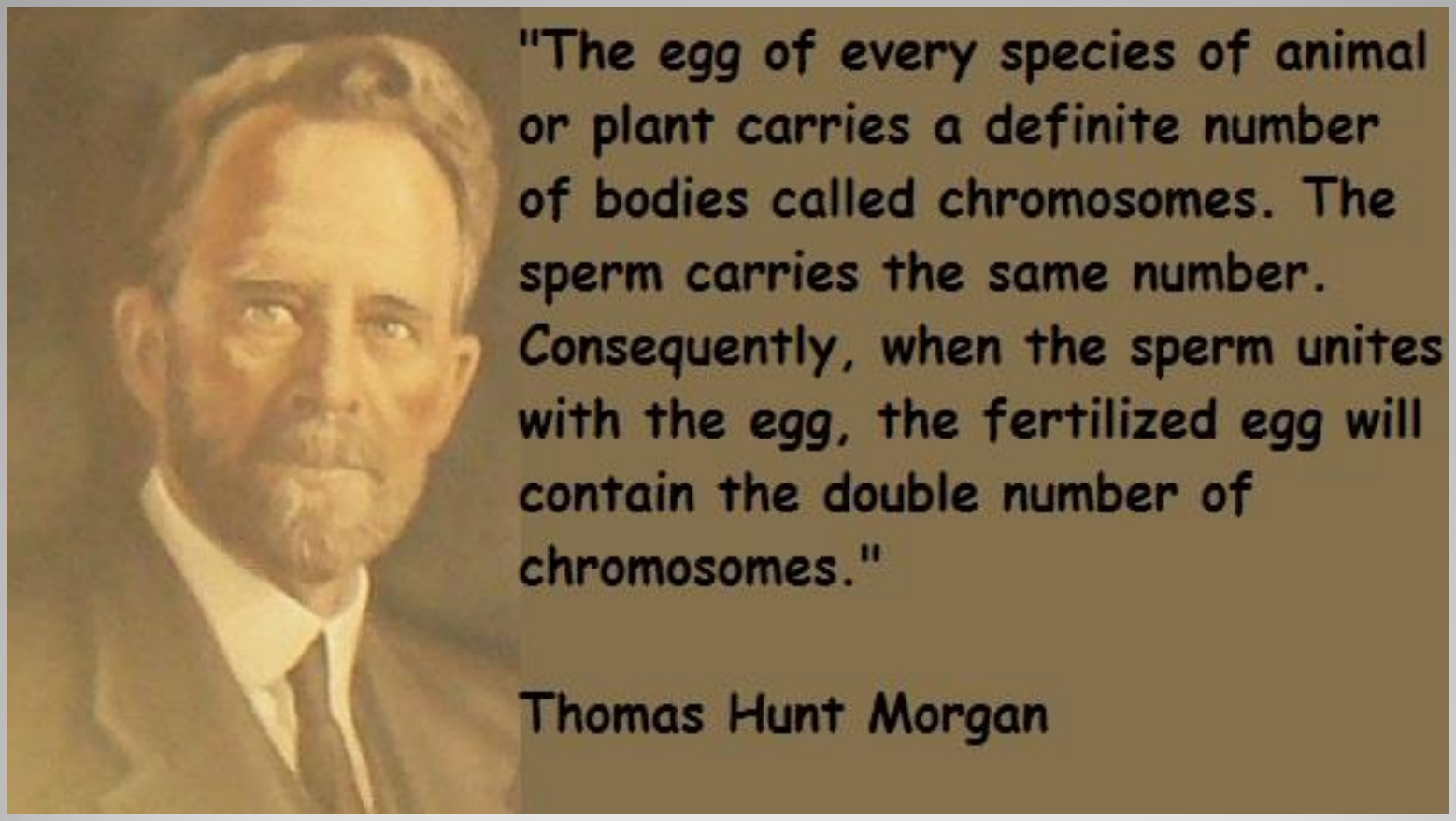


Diploid (2N) fly chromosome
8 chromosomes each with two halves or chromatids
2N=8



Haploid(1N)Diploid(2N)

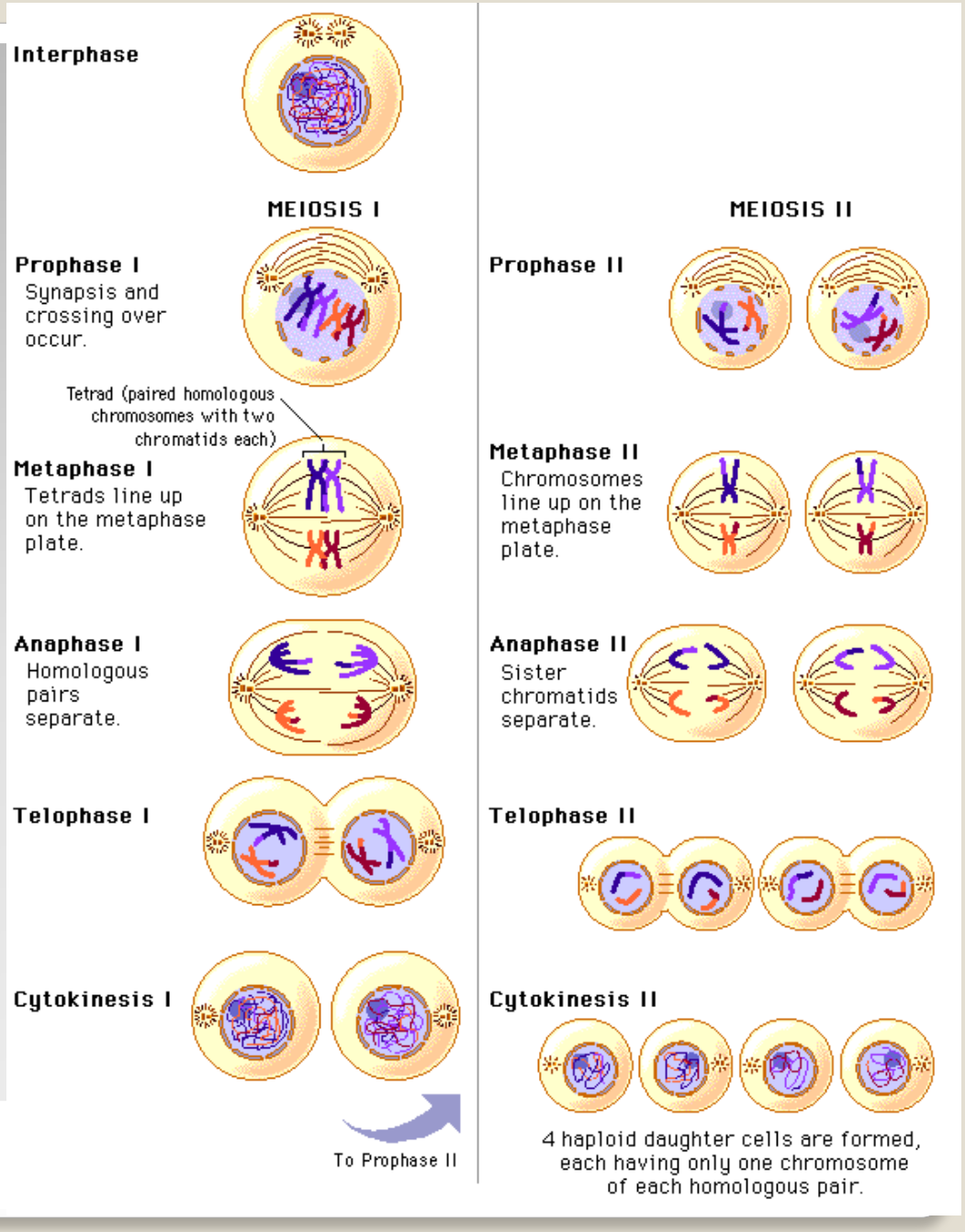
11-4 Meiosis


"The egg of every species of animal or plant carries a definite number of bodies called chromosomes. The sperm carries the same number. Consequently, when the sperm unites with the egg, the fertilized egg will contain the double number of chromosomes."
Thomas Hunt Morgan

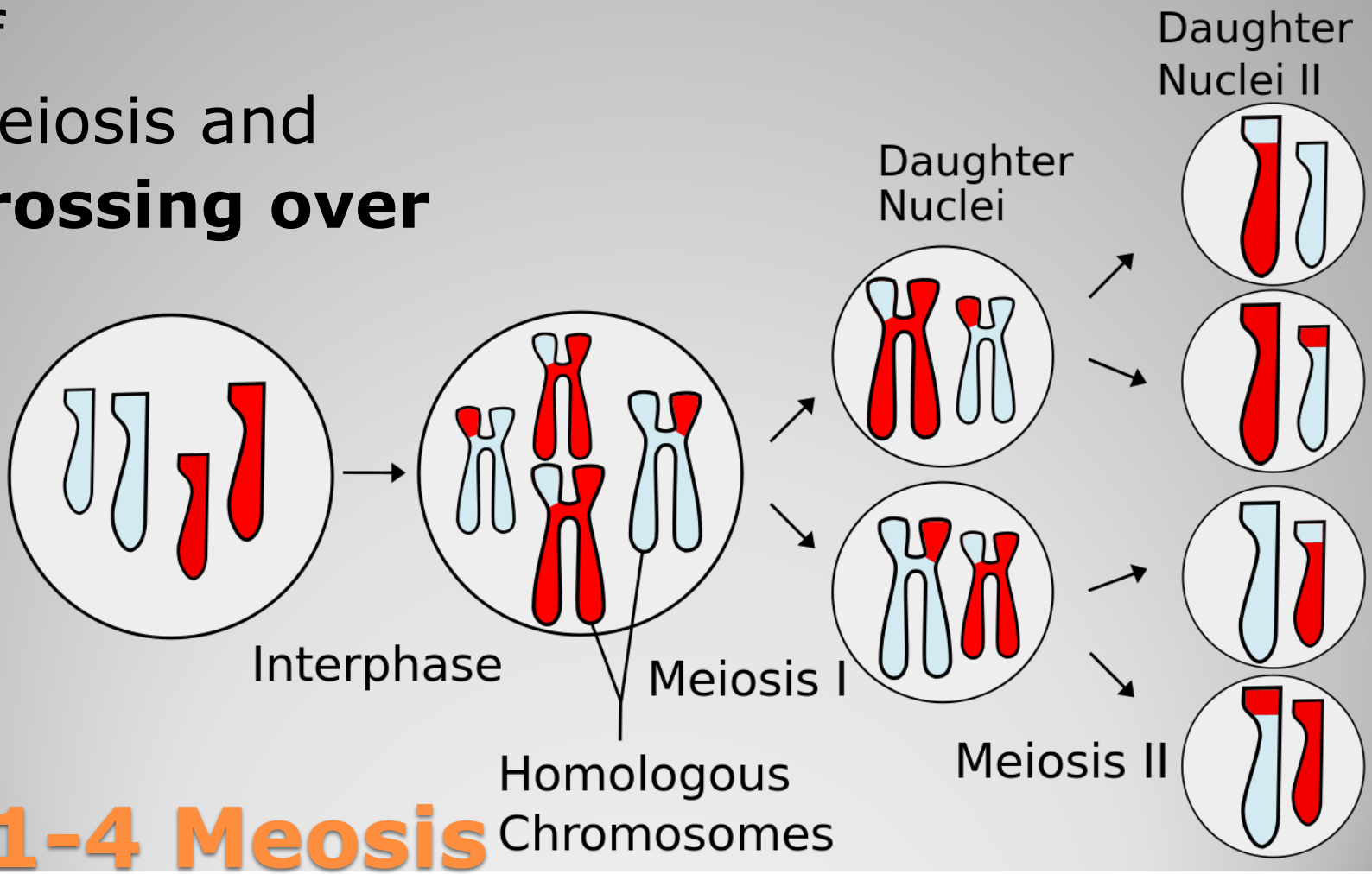
11-4 Meosis

- **Phases of Meiosis and crossing over**

11-4 Meosis



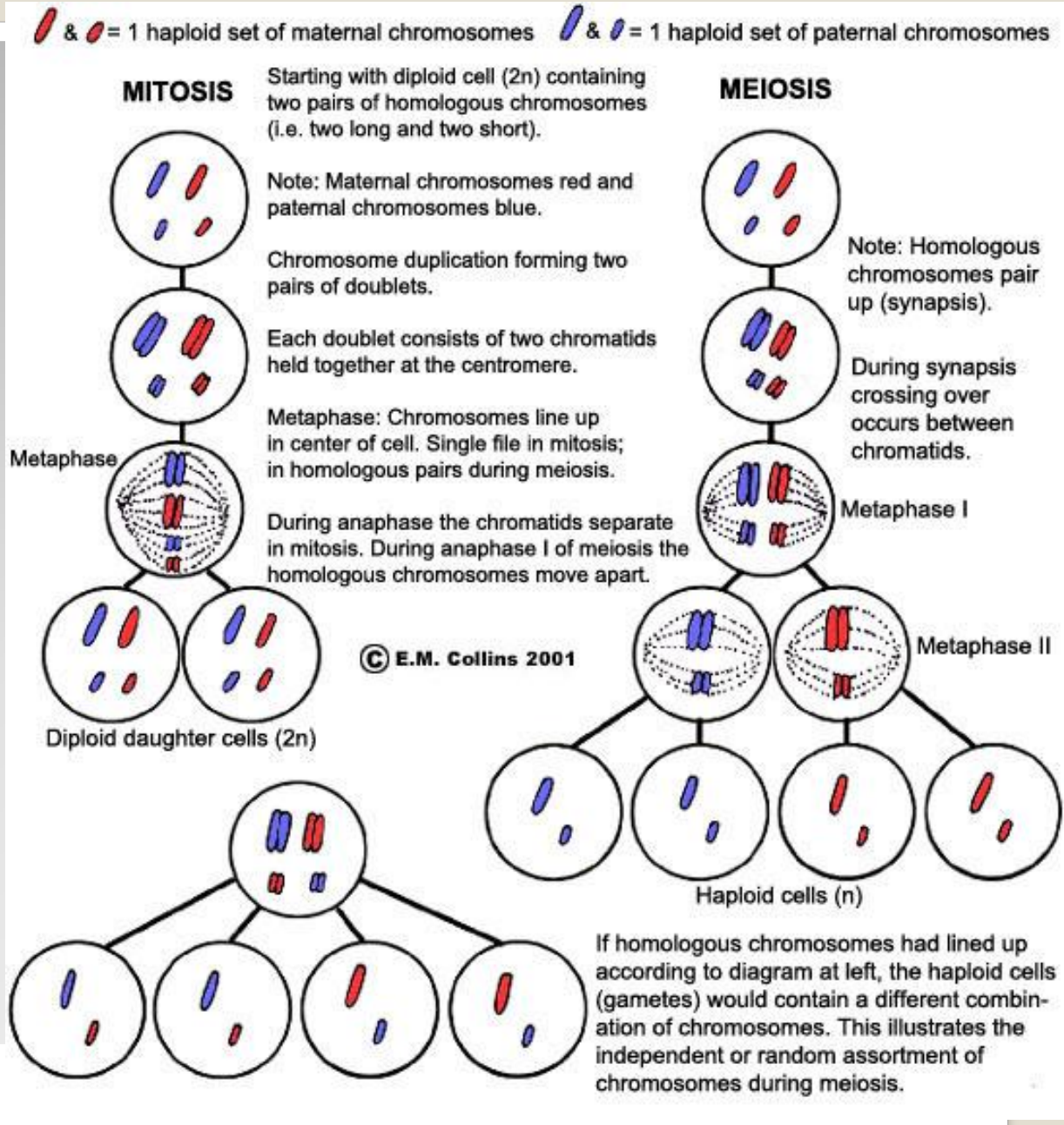
- Phases of Meiosis and **crossing over**



11-4 Meosis

- Comparing
- Mitosis and
- Meiosis

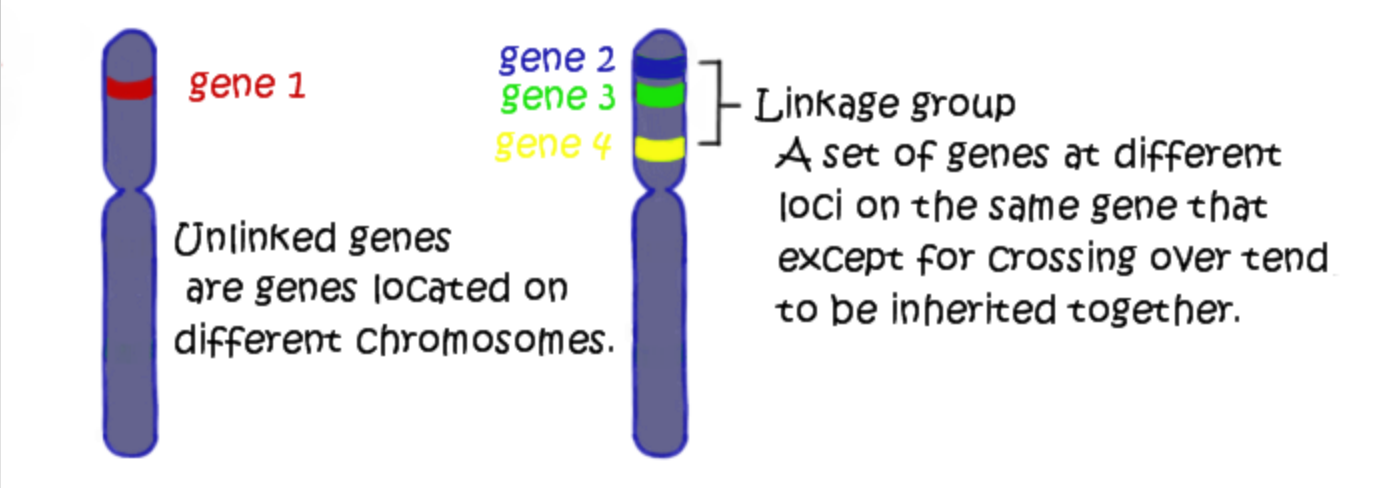
11-4 Meosis



- https://www.youtube.com/watch?v=qCLmR9-YY7o

11-4 Meosis

- Genes that are on the same chromosome are **linked** and are inherited together
- Chromosomes are groups of linked genes
- Chromosomes assort independently, not genes

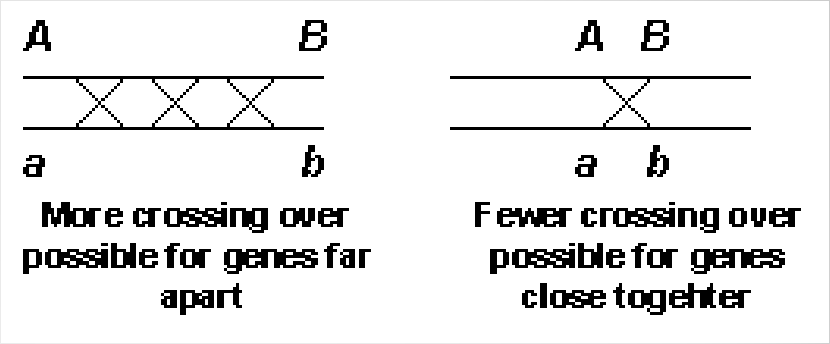


11-5 Linkage and Gene Maps

- Mendel was just lucky 6 of the 7 traits he studied were on separate chromosomes.

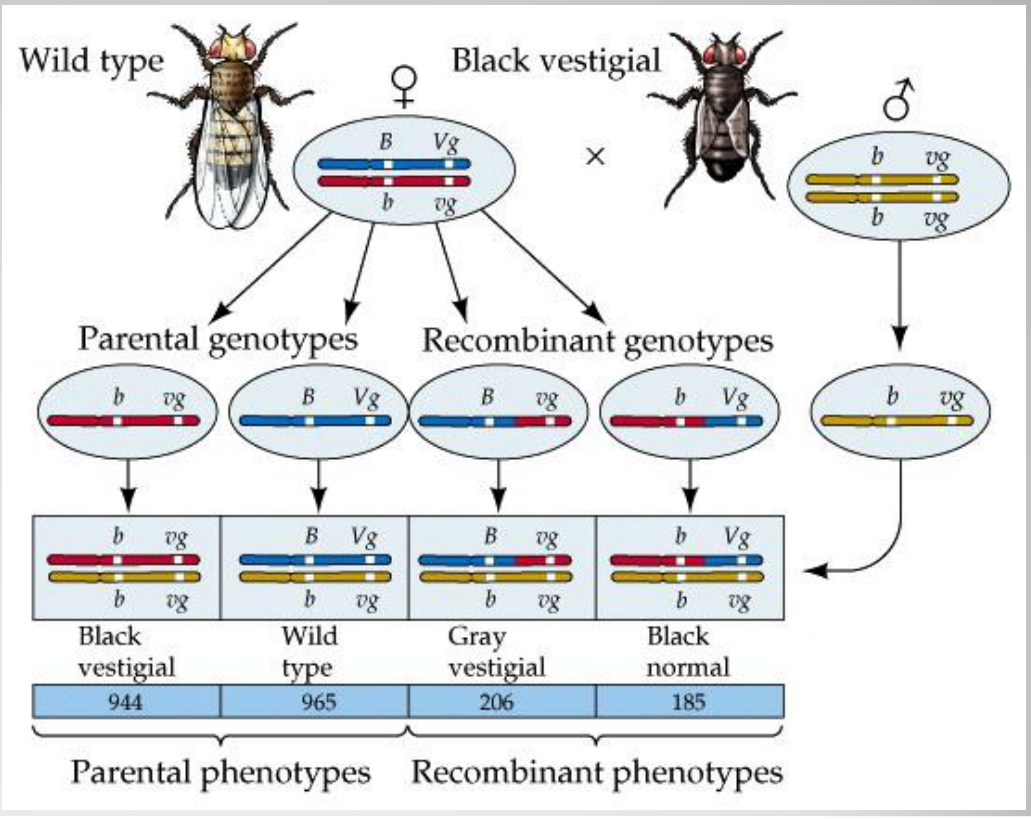
11-5 Linkage and Gene Maps

- Genes can become unlinked by crossing over
- Crossing over of linked genes on homologous chromosomes produces new genetic variation and diversity
- The further apart two genes on a chromosome are the more likely crossing over will occur

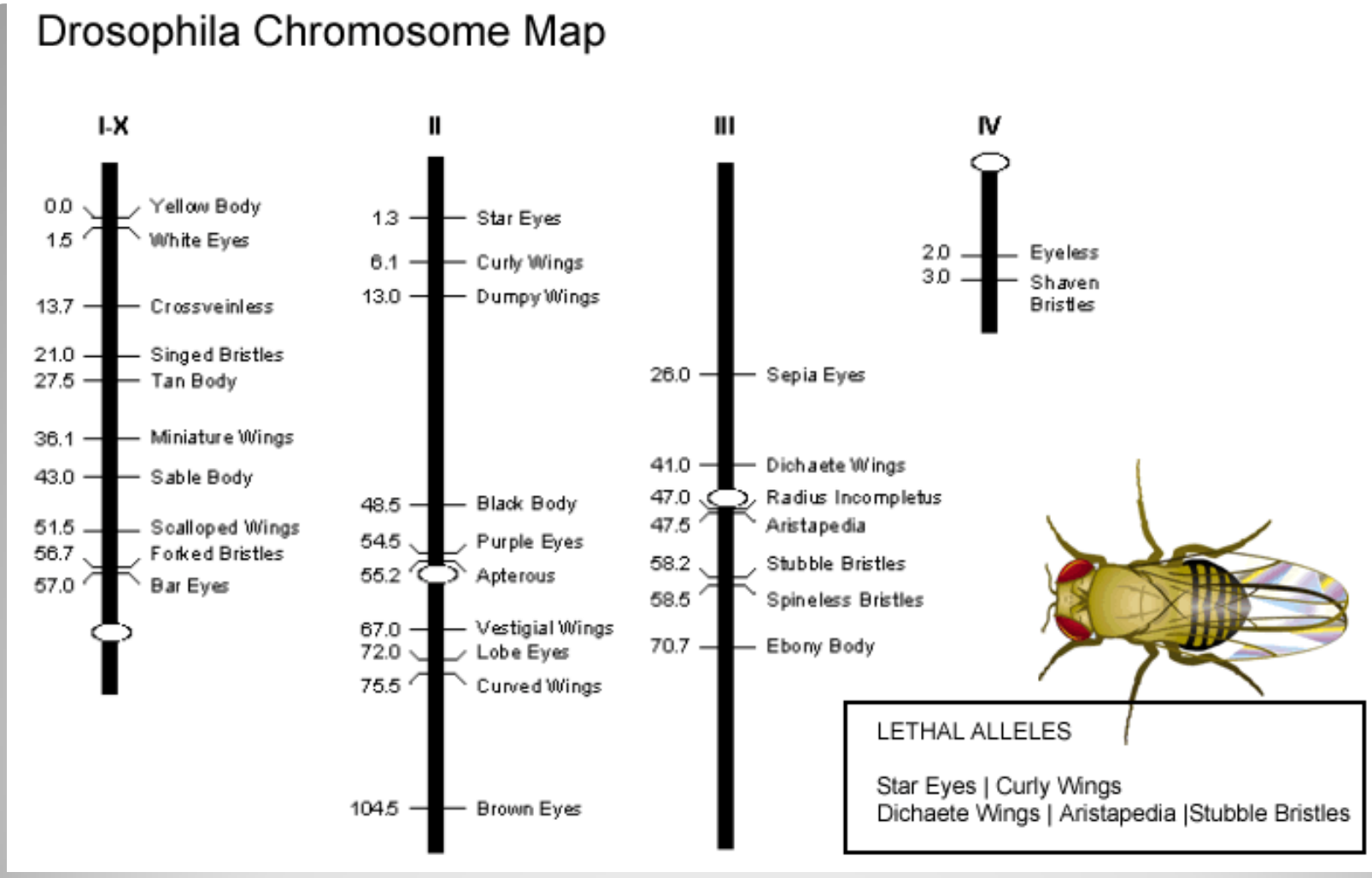


11-5 Linkage and Gene Maps

- Can use crossing over or **recombination rates** to build maps of where the relative positions of all the genes are on a chromosome



11-5 Linkage and Gene Maps



11-5 Linkage and Gene Maps