

Inheritance of Linked Genes

Section 6.2

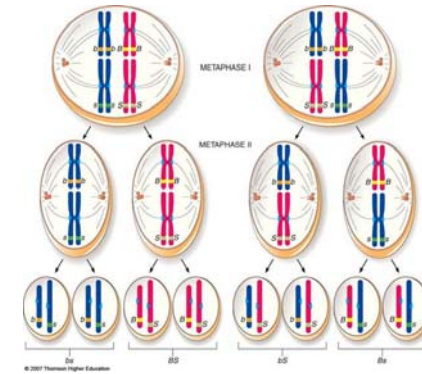
homework

Pg. 253 #7-10

Pg. 259 #1, 3, 4

Mendel's Law of Independent Assortment

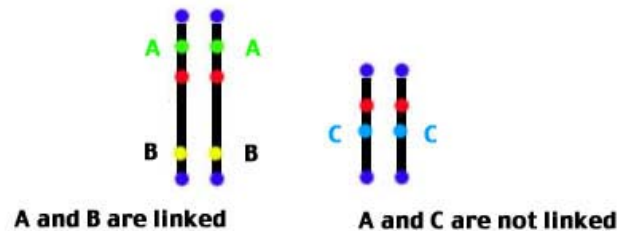
homologous pairs (and the alleles they carry) segregate independently of other pairs (and their alleles)



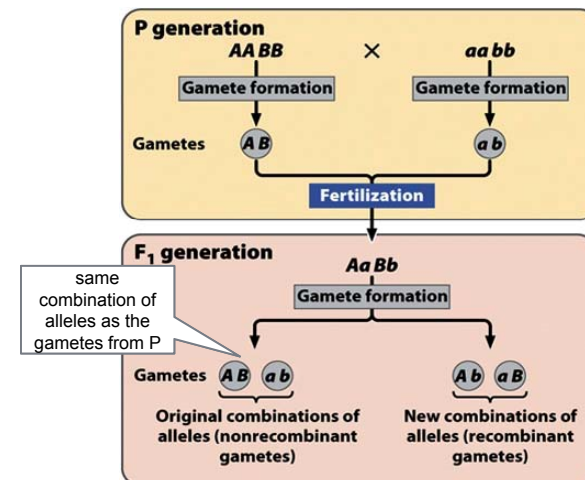
Outcome: All allele combinations have equal probability of occurring.

When two genes are “linked”, they tend to be inherited *together*.

Linked genes do not assort independently, because they are located on the **same chromosome**.



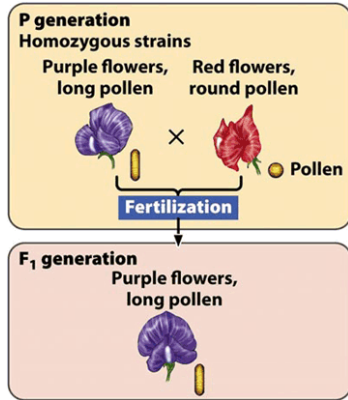
Independent Assortment produces predictable (Mendelian) ratios of allele combinations.



However... Linked genes are found in **parental** (non-recombinant) **combinations** much more frequently than expected.

Work done on a different species of pea plant...

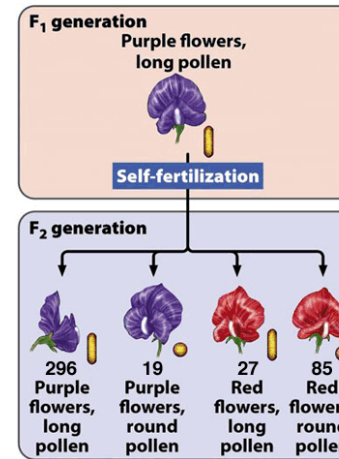
Character	Dominant trait	Recessive trait
flower colour	purple (P)	red (p)
pollen shape	long (L)	round (l)



$PPLL \times ppll$

all $PpLl$

According to Mendel, what phenotypic ratio is expected in the F2 generation?



Phenotype	Expected	Observed
purple, long	$9/16 \times 427 = 240$	296
purple, round	$3/16 \times 427 = 80$	19
red, long	$3/16 \times 427 = 80$	27
red, round	$1/16 \times 427 = 27$	85
total	427	427

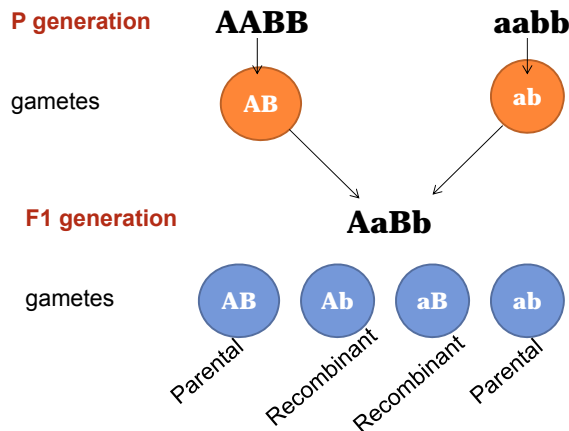
Observation

- F₂ doesn't follow 9:3:3:1.
- Parental combinations of traits are observed more frequently than predicted.

Inference

The genes for flower colour and seed shape are **linked**.

Consider the cross $AABB \times aabb$...

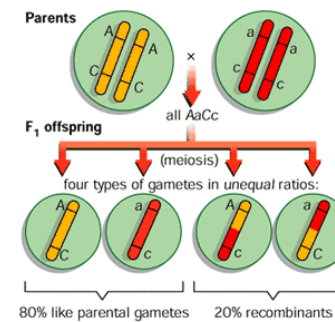


Which of these gametes are:

- Parental?
- Non-parental? ("recombinant")

Recombination for Linked Genes

Linked genes are located on the same chromosome.

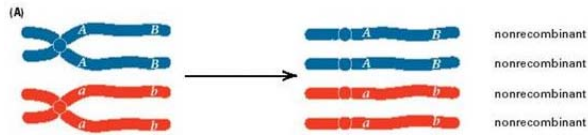


Alleles on the same chromosome **segregate together** during meiosis.

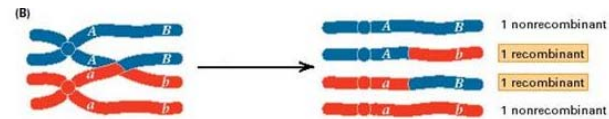
...so how are **non-parental** combinations of alleles produced?

The only way to produce non-parental allele combinations is through **crossing over** in Meiosis I.

Without recombination...



With recombination...



This is the only way for **genetic recombination** to occur between linked genes.

Practice #1

Two plants (BBHH and bbhh) are crossed.

a) What is the F₁'s genotype?

BbHh

b) List all combinations of alleles that are possible in the gametes of the F₁. Indicate which combinations are *parental* (P) and which are *recombinant* (R).

(P) **BH** **bH** (R)

(R) **Bh** **bh** (P)

c) What proportions would be expected for each gamete, if the B and H loci are **unlinked**?

25% each (equal probability)

d) The F₁ offspring are self-fertilized. What will be the F₂ phenotypic ratio, if the genes are unlinked (they assort independently)?

9:3:3:1

e) How would the phenotypic proportions differ if the genes were linked?

Parental combinations would occur more frequently than expected.

Practice #2

Two true-breeding fruit flies (AAbb and aaBB) are crossed. The F₁ generation are all heterozygous for both genes (AaBb). The F₁ are then test-crossed, and the offspring of the test crosses are counted up.

a) Draw the Punnett square for the **parental** cross of AAbb x aaBB.

b) Complete the chart by classifying the composition of the F1 gamete as either *parental* or *recombinant*.

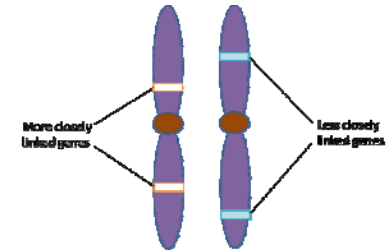
Phenotype of test cross offspring	Number of individuals	F1 gamete: Parental or recombinant?
aB	522	
Ab	515	
ab	234	
AB	229	
Total	1500	

c) Based on the information in the table, are the loci for genes A and B located on *separate* chromosomes, or the *same* one?

Linkage Mapping

The recombination frequency for two loci can be used to infer the physical distance between them.

Higher recombination frequency = Greater distance



Summary

- Linked genes are located on the same chromosome.
 - they do not assort independently
- dihybrid crosses don't yield 9:3:3:1 ratios
 - parental combinations of traits are passed on more frequently than expected

- since the genes are located on the same chromosome, the only way to produce new combinations is through crossing over during Prophase I.
- the frequency of recombination (crossing over) can be used to infer physical distance between genes:
 - more recombination indicates greater distance