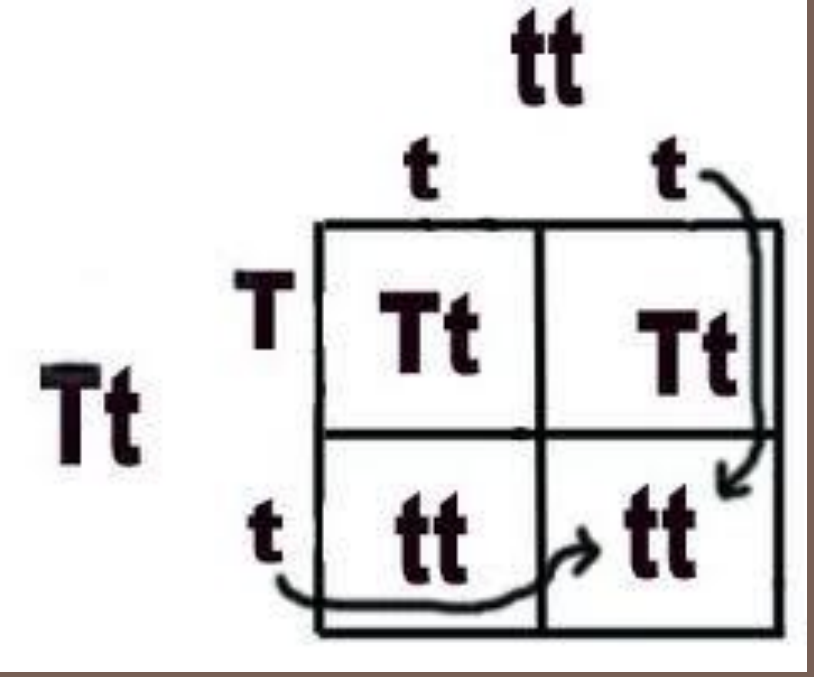
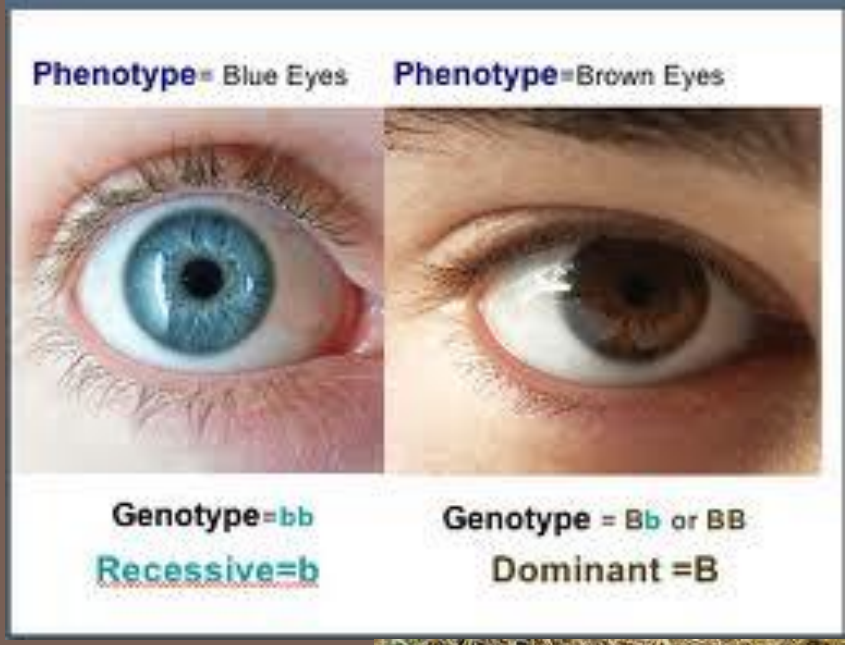




CHAPTER 11
GENETICS

Genetic discoveries 45 minutes

Impacts, Issues:

The Color of Skin

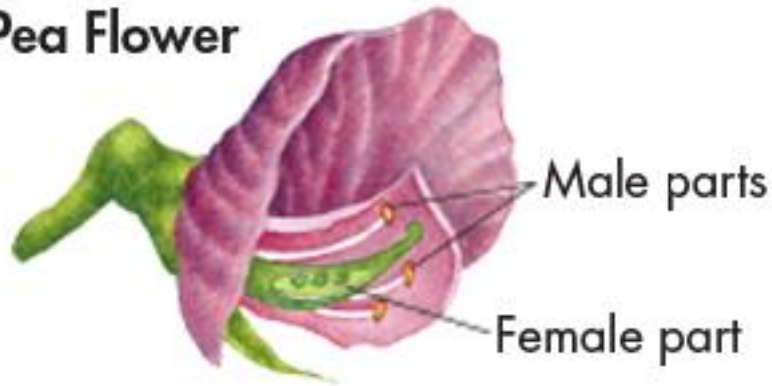
- Like most human traits, skin color has a genetic basis; more than 100 gene products affect the synthesis and deposition of melanins
  - In the picture of fraternal twins. , both grandmas were European descent and both grandfathers are African

11.1 Mendel, Pea Plants, and Inheritance Patterns

- Recurring inheritance patterns are observable outcomes of sexual reproduction
- Before the discovery of genes, it was thought that inherited traits resulted from a blend of parental characters
- Mendel was a monk with training in plant breeding and mathematics

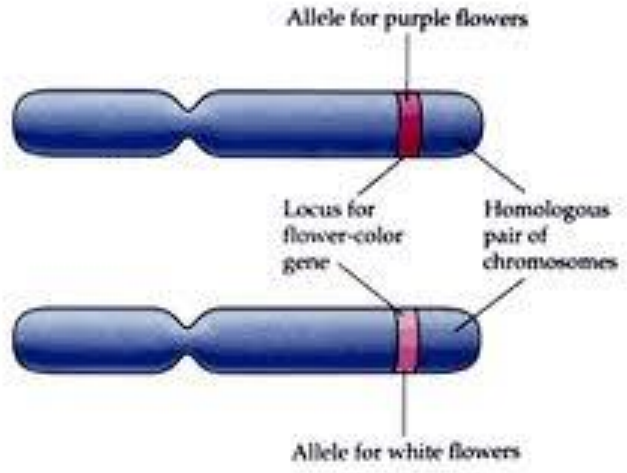
11.1 The work of Gregor Mendel

- **Genetics** = the study of heredity (passing down of characteristics from parent to offspring)
- Gregor Mendel = "the father of genetics"
  - Born in 1822 – Austrian monk
  - Worked with pea plants that were self-pollinating and true-breeding (the offspring always looked like the parent)



Important Genetic Terms

- **Trait** = a specific characteristic (pea color, hair color)
- **Gene** = the factors that are passed from parent to offspring (found at a locus on a chromosome)
- **Allele** = the different forms of a gene

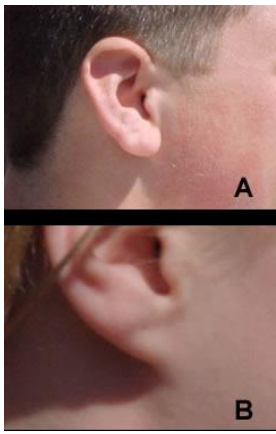


Terms Used in Modern Genetics

- A **mutation** is a permanent change in a gene
  - May cause a trait to change
- A **hybrid** has nonidentical alleles for a trait
  - Offspring of a cross between two individuals that breed true for different forms of a trait are hybrids

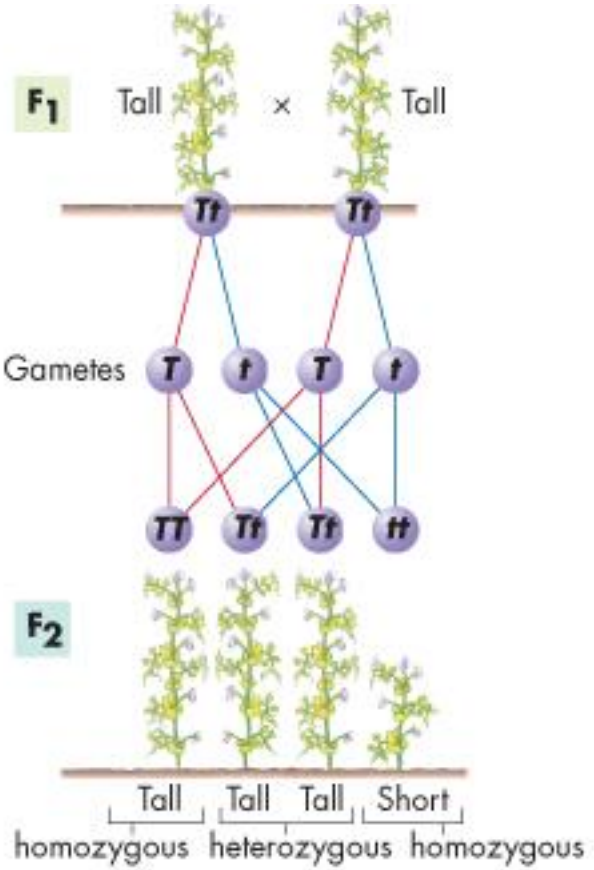
Mendel's Conclusions

- An individual's characteristics are determined by factors (**genes**) that are passed from one parental generation to the next
- **Principle of dominance** = some alleles are dominant and some are recessive
  - **Dominant** = need one allele (form of the gene) for the trait to be expressed
  - **Recessive** = need two alleles for the trait to be expressed



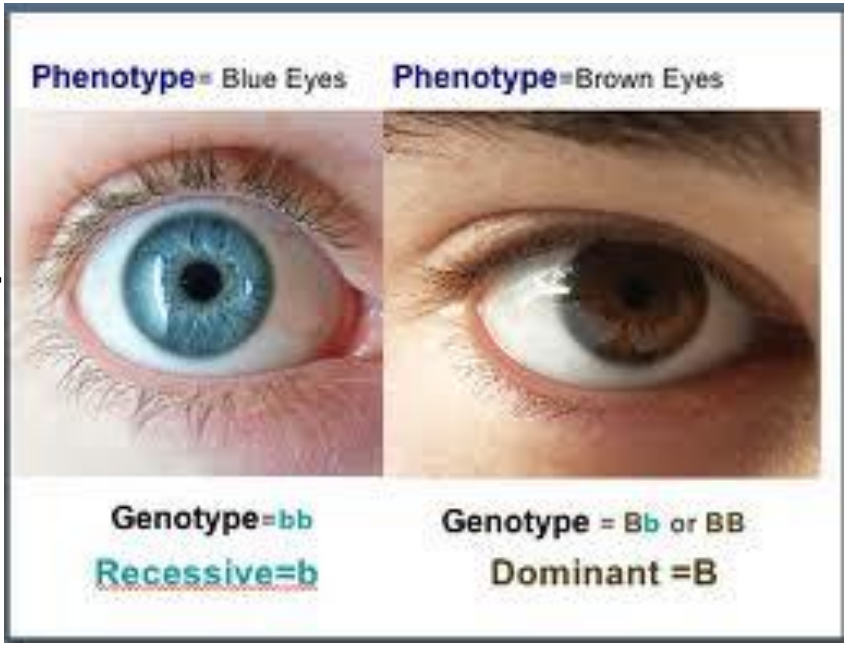
Genetics and probability

- **Dominant** alleles are written in **upper case** T = tall
- **Recessive** alleles are written in **lower case** t = short
- In this example:
  - There is a 50% chance that the plant the offspring will get a "T" allele
  - There is a 50% chance the plant will get a "t" allele



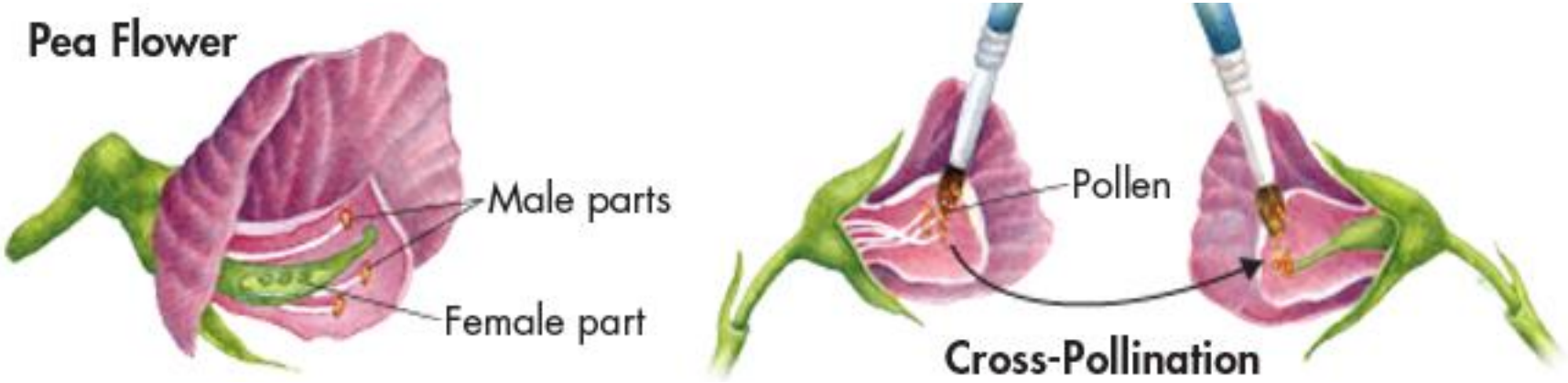
Even more genetic terminology

- **Genotype** = the genetic makeup of an organism
  - **Homozygous** = organisms that have two identical alleles for a gene (BB or bb)
  - **Heterozygous** = organisms that have two different alleles for a gene (Bb)
- **Phenotype** = the physical appearance of an organism



Mendel's Pea Plants

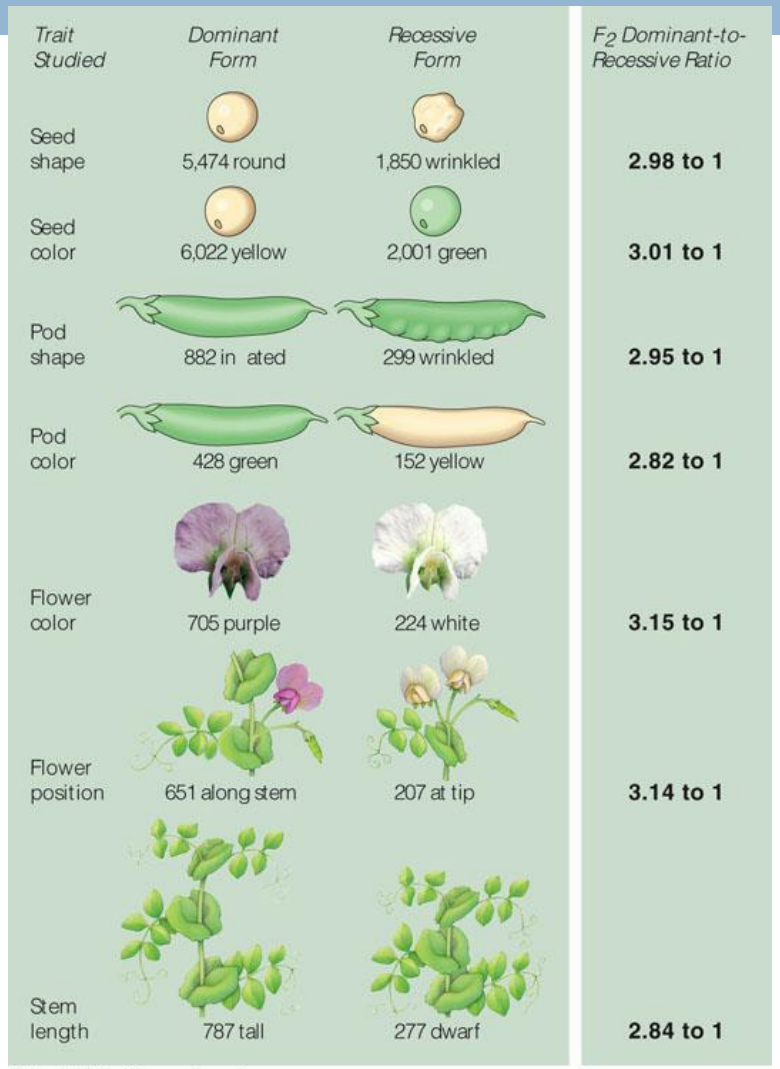
- Mendel cross pollinated his true-breeding plants



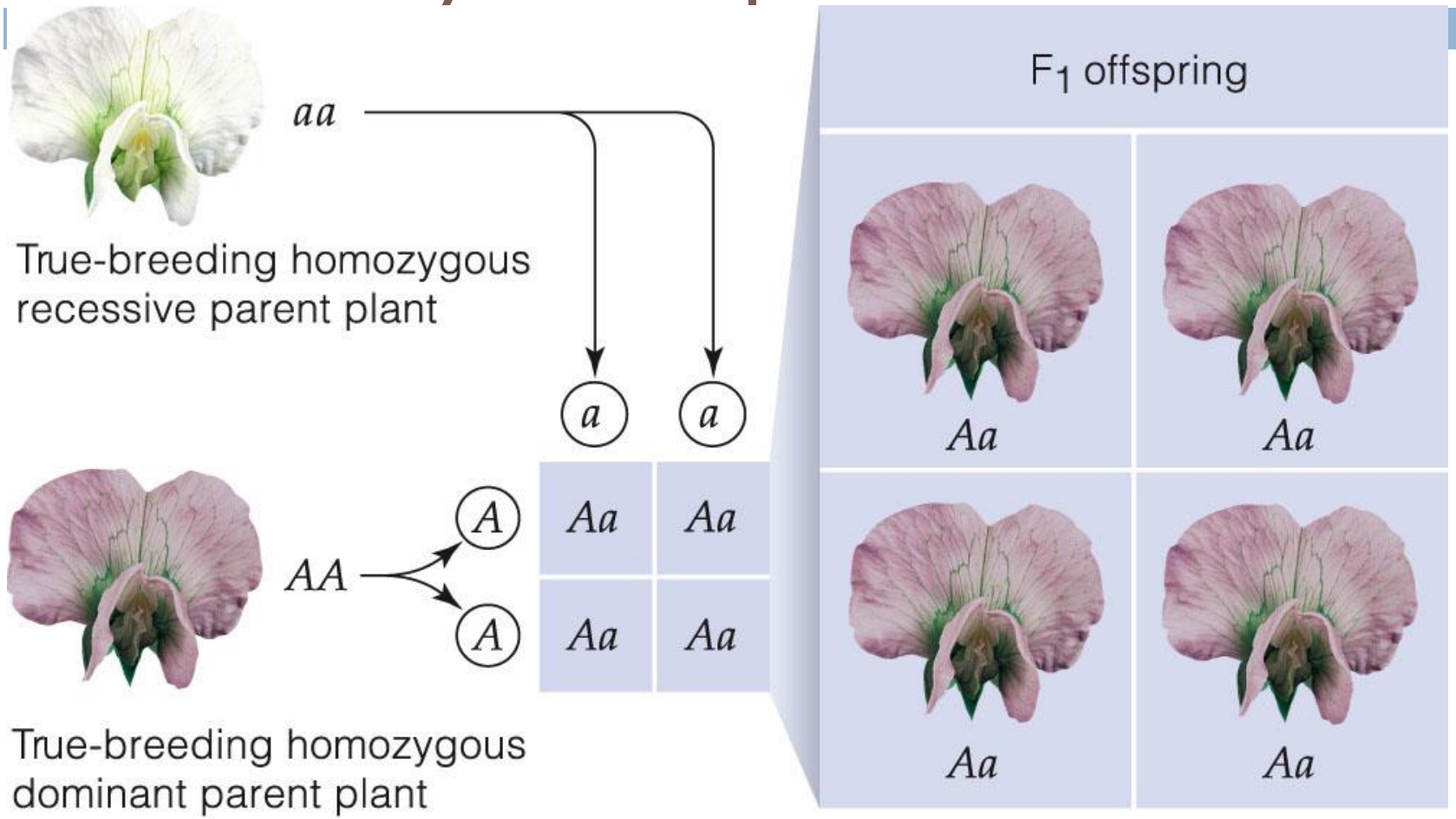
Mendel's Seven F_1 Crosses on Pea Plants

	Seed Shape	Seed Color	Seed Coat	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

Mendel's Monohybrid Experiments

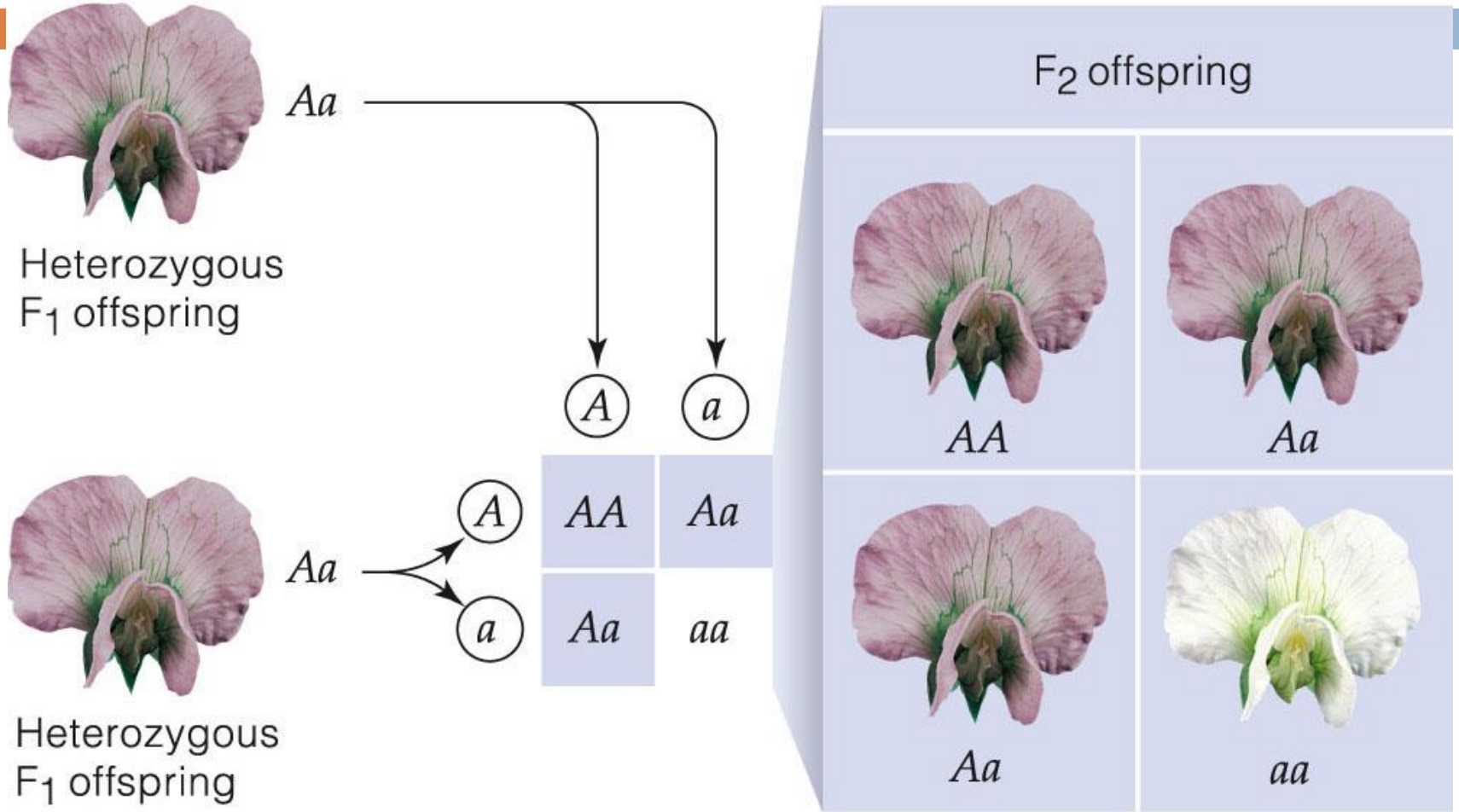


Phenotype Ratios in a Monohybrid Experiment



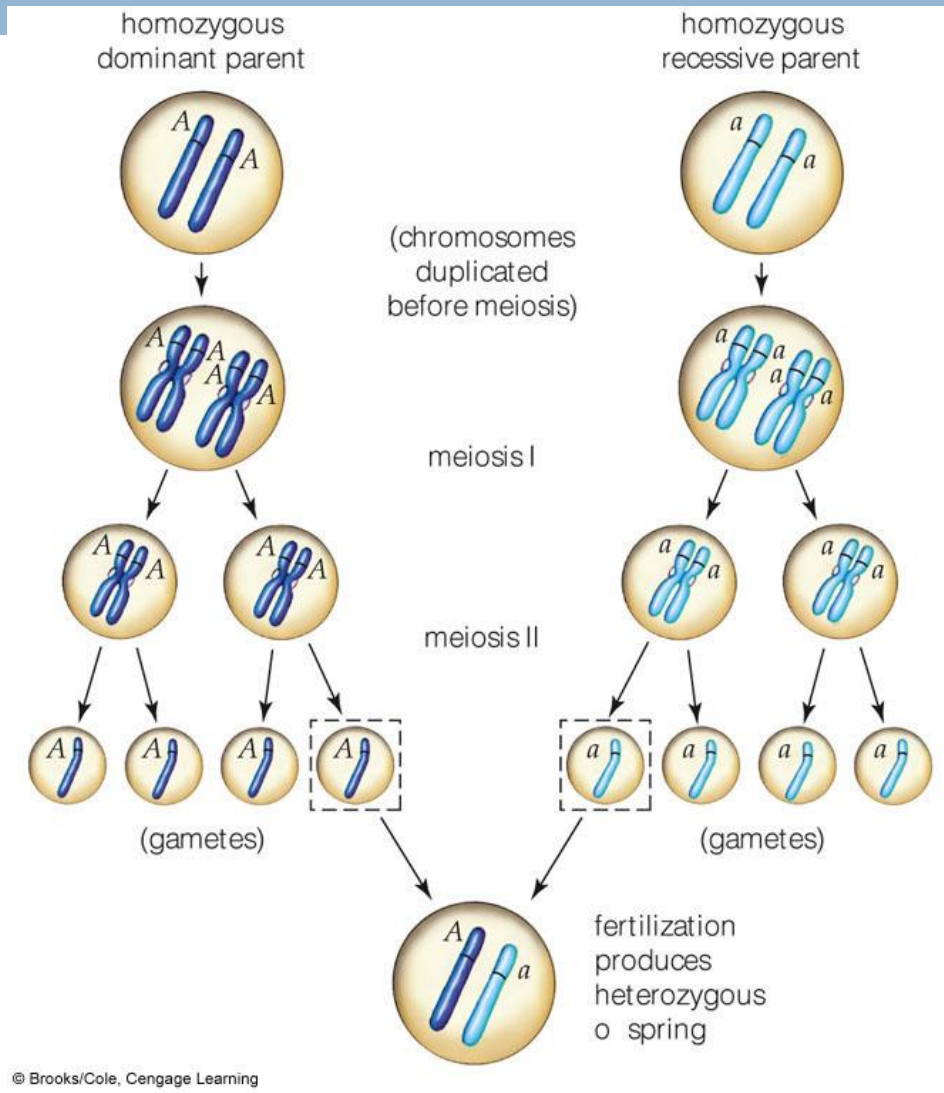
B A cross between two plants that breed true for different forms of a trait produces F_1 offspring that are identically heterozygous.

Phenotype Ratios in a Monohybrid Experiment



C A cross between the F_1 offspring is the monohybrid experiment. The phenotype ratio of F_2 offspring in this example is 3:1 (3 purple to 1 white).

Segregation of Alleles at a Gene Locus



Mendel's Law of Segregation

- Mendel observed a phenotype ratio of 3:1 in the F_2 offspring of his monohybrid crosses
  - Consistent with the probability of the *aa* genotype in the offspring of a heterozygous cross (*Aa* x *Aa*)

- This is the basis of Mendel's law of **segregation**
  - Diploid cells have pairs of genes on pairs of homologous chromosomes
  - The two genes of each pair separate during meiosis, and end up in different gametes

Testcrosses

- **Testcross**
  - A method of determining if an individual is heterozygous or homozygous dominant
  - An individual with unknown genotype is crossed with one that is homozygous recessive (*AA* x *aa*) or (*Aa* x *aa*)

Applying Mendel's Principles

- Mendelian genetics is based on **probability** = the likelihood that an event would occur



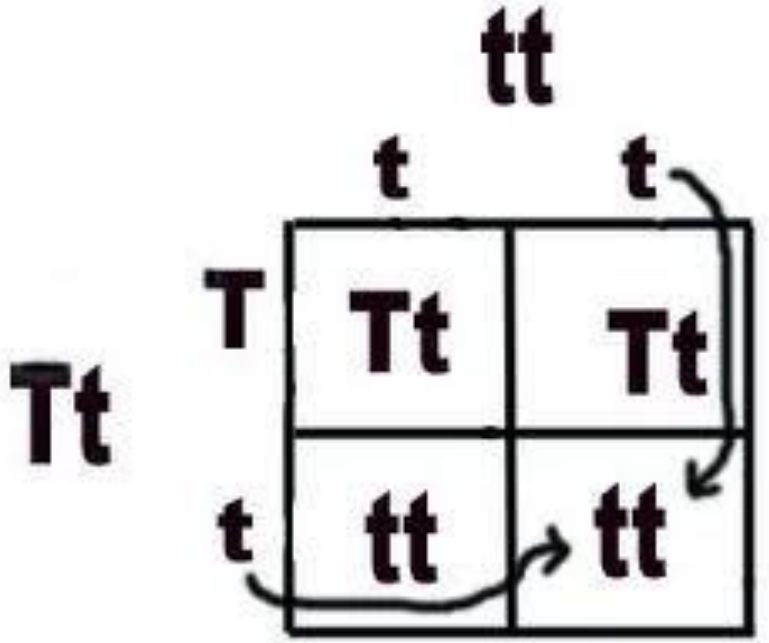
Punnett Squares

- **Punnett squares** = a diagram that uses probability to predict the possible genotype and phenotype combination in crosses

T = tall

t = small

(choose a letter from the dominant allele)



Oh no! You need to think!!!!

- For each example, write the genotype and phenotype.

1) The Rr flower

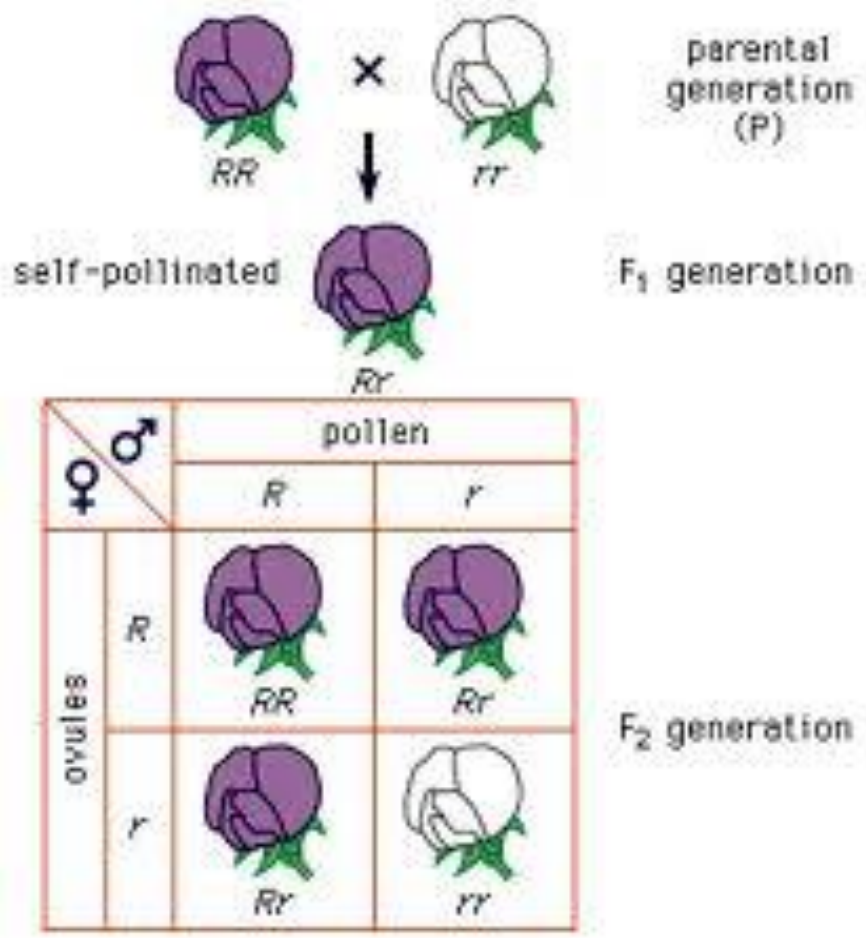
Genotype Rr

Phenotype Purple

2) The rr flower

Genotype rr

Phenotype white



Monohybrid cross

In peas, yellow seeds are dominant to green.

Complete the following cross Yy x yy

1) Make a key – yellow = Y

green = y

2) Parental genotypes – if not given

yy x Yy

3) Set up the Punnett square

4) Figure out the phenotypic and genotypic ratio

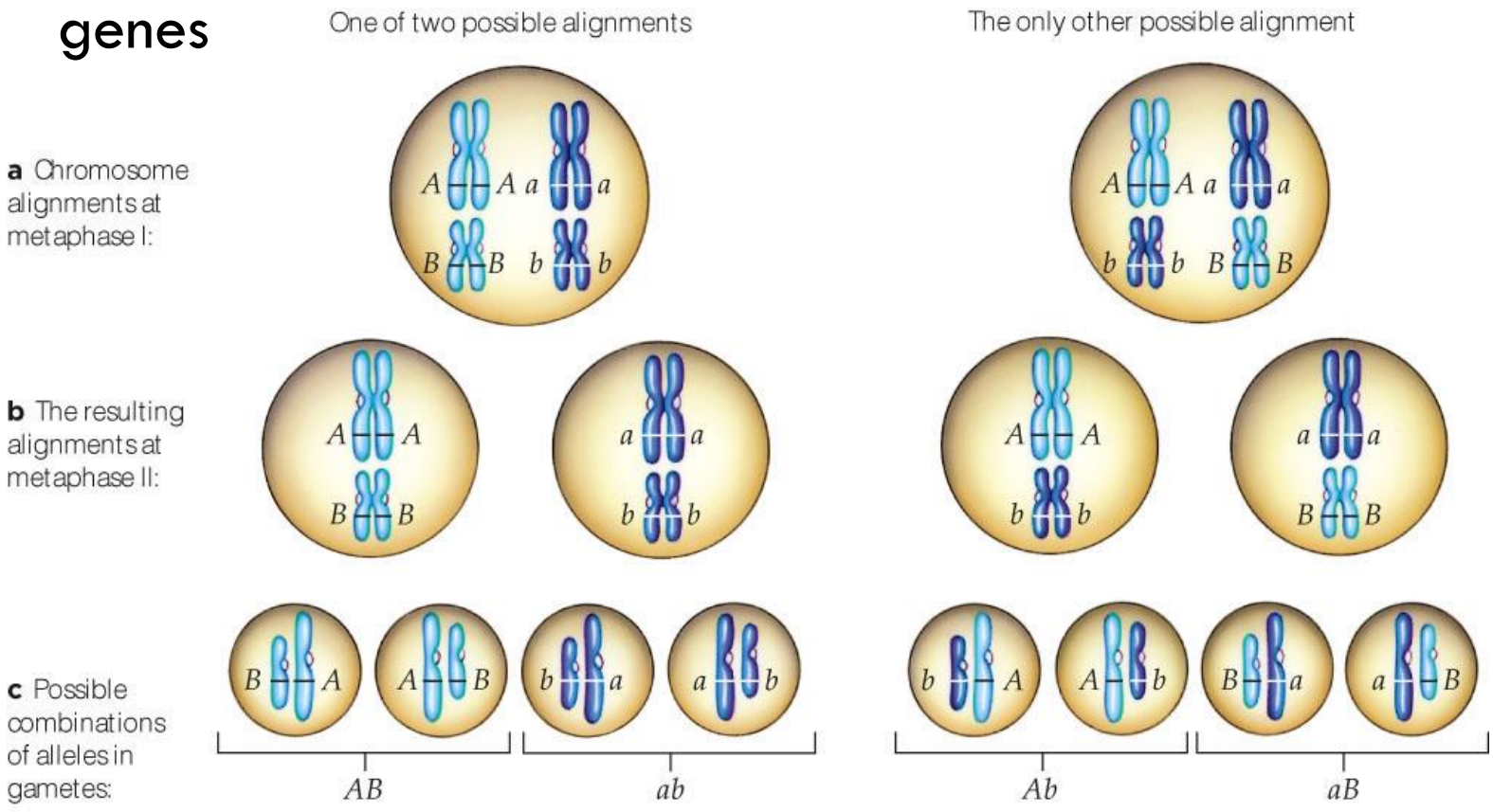
	Y	y
y	Yy	yy
y	Yy	yy

Phenotypic ratio - 1 yellow : 1 green

Genotypic ratio - 1 Yy : 1 yy

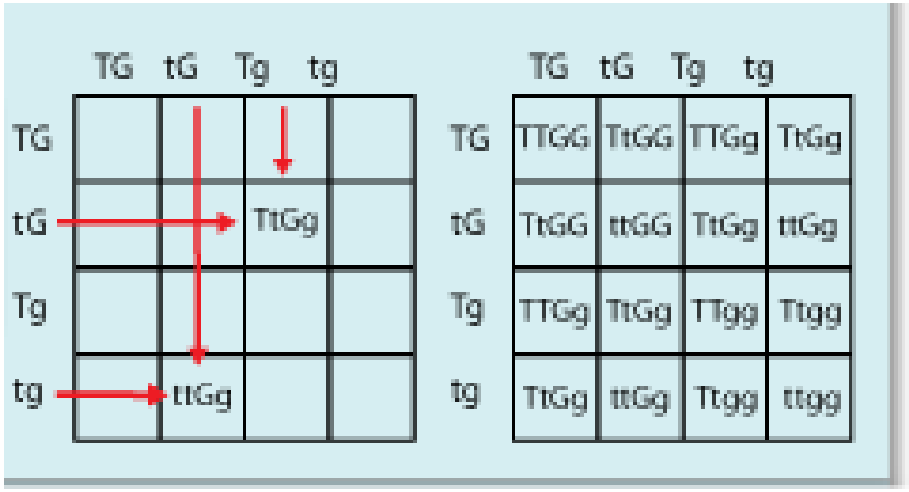
11.3 Mendel's Law of Independent Assortment

- Mendel's law of **independent assortment**
  - Many genes are sorted into gametes independently of other genes



Dihybrid cross

- When there are 2 traits it is a **dihybrid cross.**
- Genes for different traits can segregate independently during the formation of gametes



Dihybrid cross

- EXAMPLE PROBLEM

  Cross two plants that are heterozygous for height and pod color. Tall is dominant to short and green pods are dominant to yellow

Step 1 – Make a key and determine the parents

Tall = T Green = G

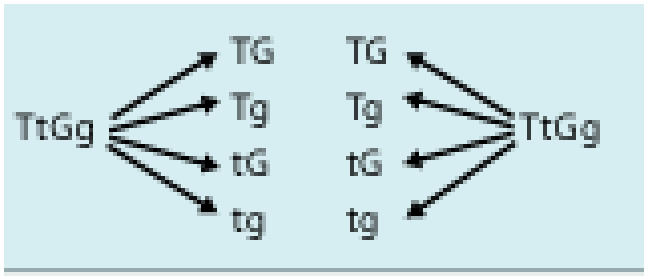
Short = t Yellow = g

Step 2 – Write the genotypes of the parents

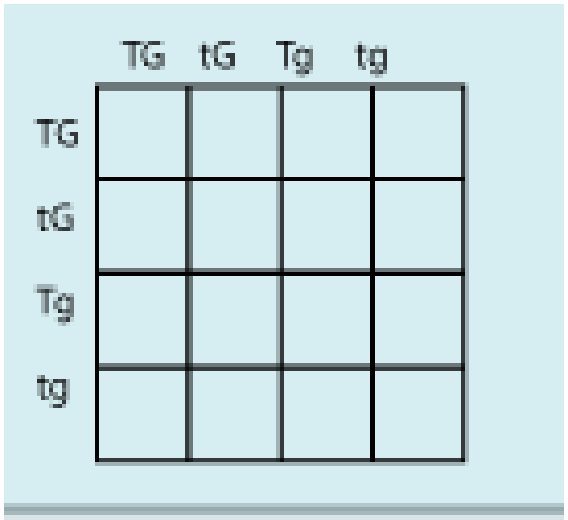
TtGg x TtGg

Dihybrid cross

Step 3 – Determine the possible allele combinations for the gametes

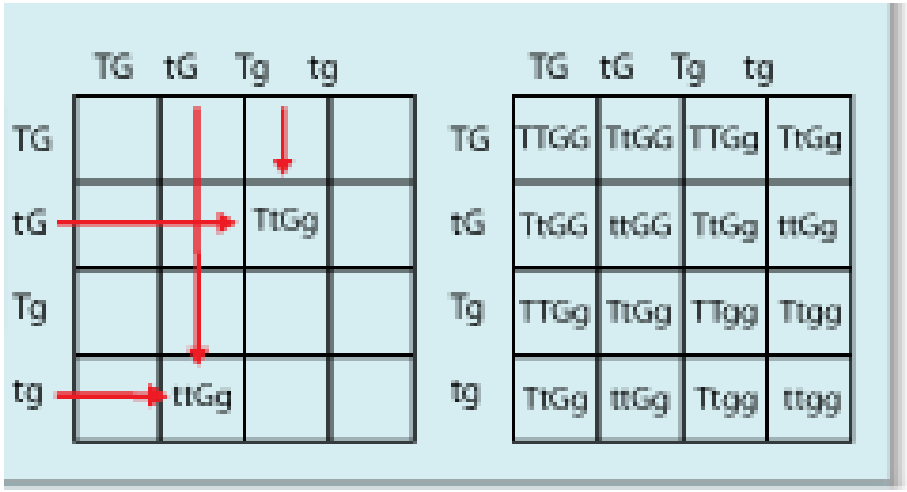


Step 4 – Set up the 16 square Punnett square



Dihybrid cross example

Step 5 – Complete the Punnett square



Step 6 – Determine the phenotypic ratio

9 tall green: 3 tall yellow: 3 short green: 1 short yellow

P generation

parent plant homozygous for purple flowers and long stems

AABB

parent plant homozygous for white flowers and short stems

aabb

A Meiosis in homozygous individuals results in one kind of gamete.

B A cross between plants homozygous for two different traits yields one possible combination of gametes:

AB × *ab*

Fig. 11-9a, p. 175

F_1 generation

All F_1 offspring are *AaBb*,
with purple flowers and tall stems.

C Meiosis in *AaBb* dihybrid plants results in four kinds of gametes:

(*AB*) (*Ab*) (*aB*) (*ab*)

F_2 generation

These gametes can meet up in one of 16 possible wayswhen the dihybrids are crossed (*AaBb* X *AaBb*):

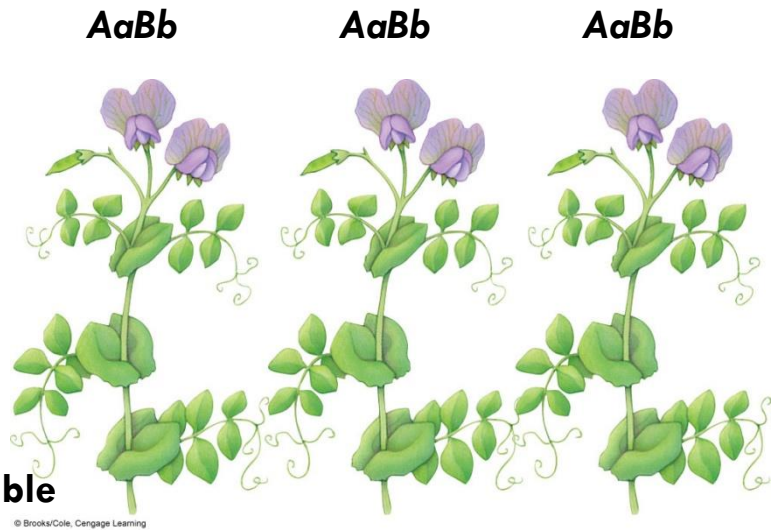


Fig. 11-9b, p. 175

D Out of 16 possible genetic outcomes of this dihybrid cross, 9 will result in plants that are purple-flowered and tall; 3, purple-flowered and short; 3, white-flowered and tall; and 1, white-flowered and short. The ratio of phenotypes of this dihybrid cross is 9:3:3:1.

Fig. 11-9c, p. 175

Mendel's Law of Independent Assortment

- Mendel's dihybrid experiments showed that "units" specifying one trait segregated into gametes separately from "units" for other traits

- *Exception:* Genes that have loci very close to one another on a chromosome tend to stay together during meiosis

- In moose, brown coat color (B) is dominant to albino (no pigment) (b) and rough coat (R) is dominant to smooth coat (r). A homozygous brown, homozygous rough male mates with a albino, smooth female.
- Draw Punnett squares and determine the expected phenotypic ratios for the:
  - **a)** F1 generation
  - **b)** F2 generation
  - **c)** cross between an F1 moose and a moose with the genotype BBRr

- **a)** F1 generation = 100% BbRr = **100% Brown, rough**
- **b)** F2 generation =

9 brown rough: 3 brown smooth: 3 albino rough: 1 albino smooth

- **c)** cross between an F1 moose and a moose with the genotype BBRr

  = BBRr x BbRr = 3 Brown rough:1brown smooth