Flower color	Purple	×	White
Seed color	Yellow	×	Green
Seed shape	Round	×	Wrinkled
Pod shape	Inflated	×	Constricted
Pod color	Green	×	Yellow
Flower position	Axial	×	Terminal
Stem length	Tall	×	Dwarf

Basic Medellian Experiment

P Generation
(true-breeding Parents
= have had same phenotype
over many generations)

Purple flowers × White flowers

F$_1$ Generation
(hybrids)

All plants had purple flowers

Self- or cross-pollination

F$_2$ Generation

705 purple-flowered plants   224 white-flowered plants

Technique

1

2

Stamens

Parental generation (P)

Carpel

3

4
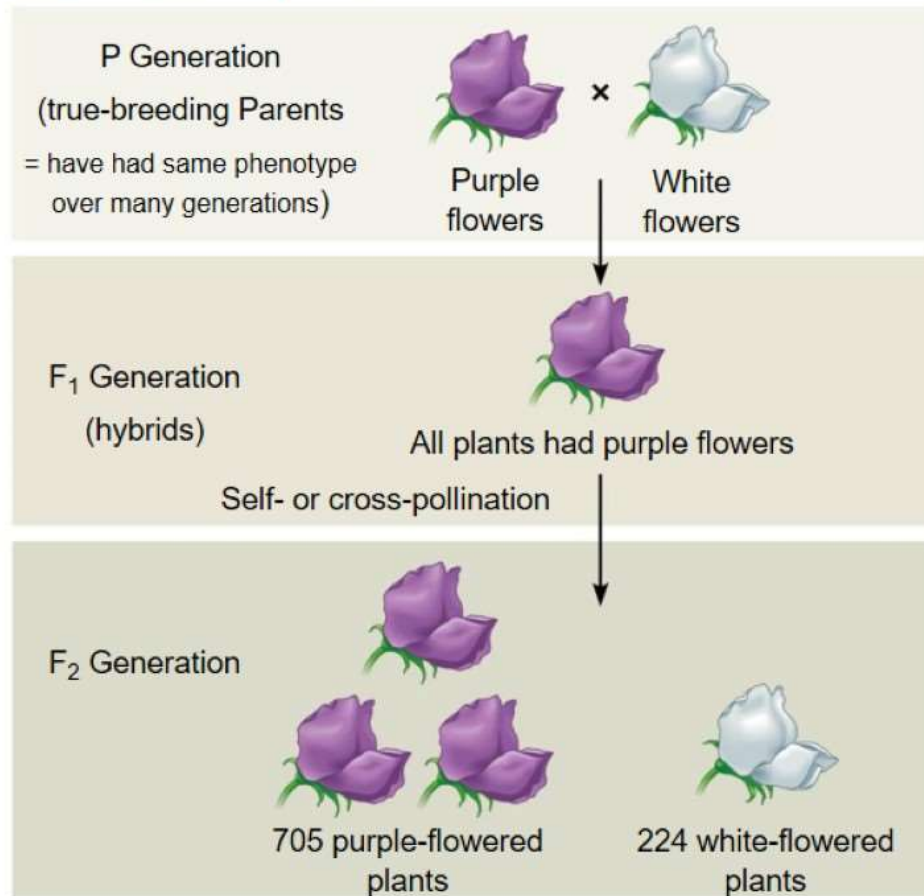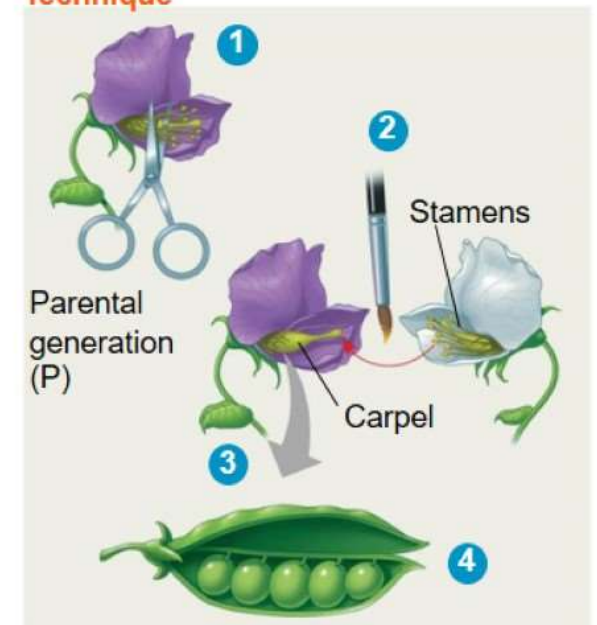
Results

First filial generation offspring (F$_1$)

5

Remember: Mendel and Darwin were contemporaries. All of their expts were based upon phenotypic observations. Amazing!

Table 14.1 The Results of Mendel's F_1 Crosses for Seven Characters in Pea Plants

Character	Dominant Trait	×	Recessive Trait	F_2 Generation Dominant: Recessive	Ratio
Flower color	Purple	×	White	705:224	3.15:1
Seed color	Yellow	×	Green	6,022:2,001	3.01:1
Seed shape	Round	×	Wrinkled	5,474:1,850	2.96:1
Pod shape	Inflated	×	Constricted	882:299	2.95:1
Pod color	Green	×	Yellow	428:152	2.82:1
Flower position	Axial	×	Terminal	651:207	3.14:1
Stem length	Tall	×	Dwarf	787:277	2.84:1

Punnet squares are talking about probability

Rr × *Rr*

Segregation of alleles into eggs — Segregation of alleles into sperm

Sperm

Eggs

P Generation

Appearance: Purple flowers × White flowers

Genetic makeup: PP   pp

Gametes: P   p

F₁ Generation

Appearance: Purple flowers

Genetic makeup: Pp

Gametes: ½ P   ½ p

F₂ Generation

Sperm from F₁ (Pp) plant

P   p

Eggs from F₁ (Pp) plant
P → PP, Pp
p → Pp, pp

3 : 1

Phenotype
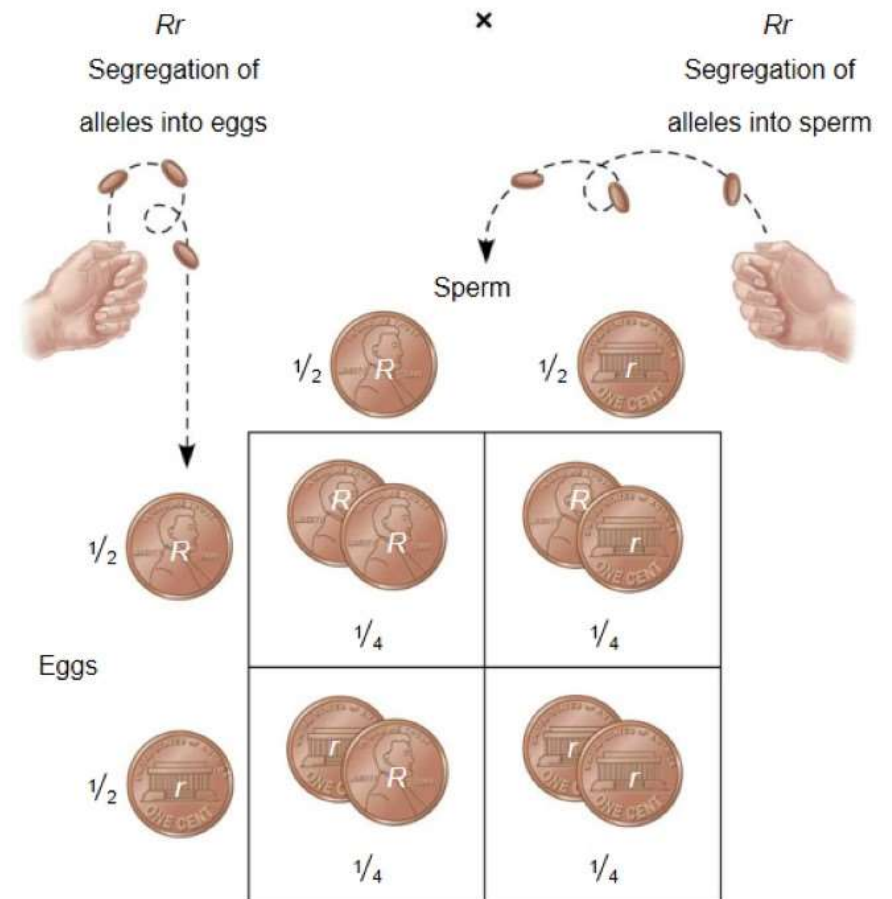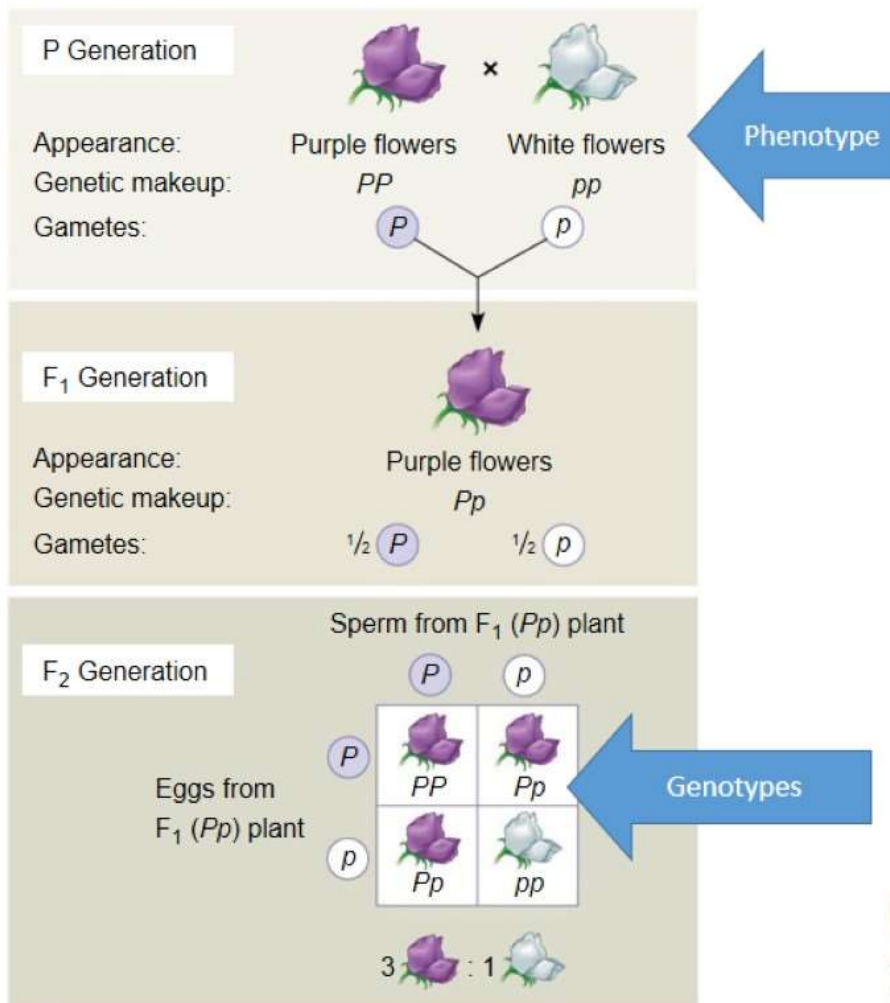
Genotypes

Test – Cross

-to determine genotype of Dominant phenotype organism

Technique

Dominant phenotype, unknown genotype: PP or Pp?

Recessive phenotype, known genotype: pp

Predictions

If purple-flowered parent is PP   or   If purple-flowered parent is Pp

Sperm
p   p

Eggs
P → Pp, Pp
P → Pp, Pp

Sperm
p   p

Eggs
P → Pp, Pp
p → pp, pp

All offspring purple   or   ½ offspring purple and ½ offspring white

Results
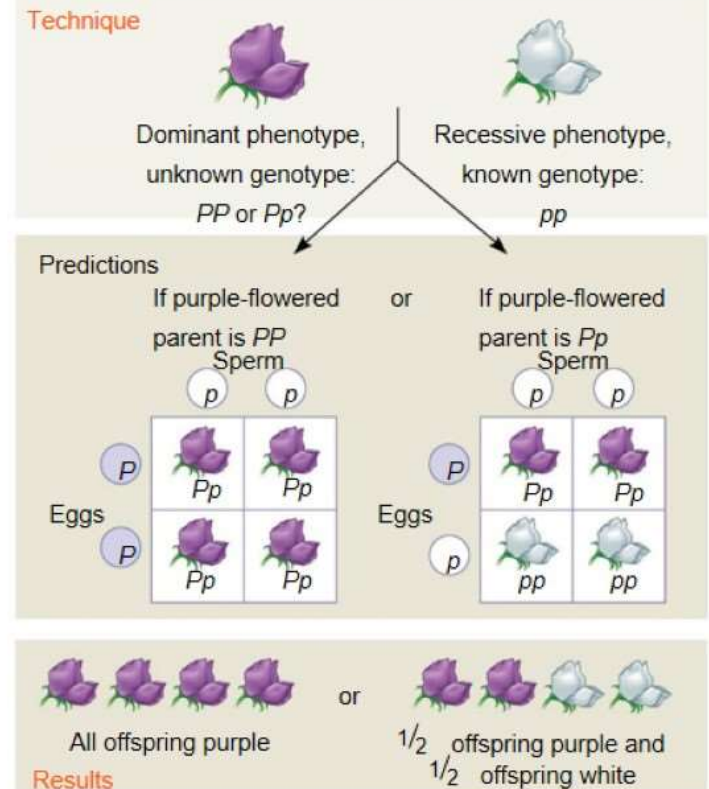
Dominant/ Recessive inheritance

Alleles named after the Dominant phenotype eg. Color:
P (dominant phenotype/ allele), p (recessive phenotype/ allele)

Character = a quality such as flower color or height

Genotype = Alleles of the gene present (max 2/ genome)

Phenotype = the expression of the character as governed by the genotype (ie. The readout of the genotype)

Allele for
purple flowers

Locus for
flower-color gene

Pair of
homologous
chromosomes

Allele for
white flowers
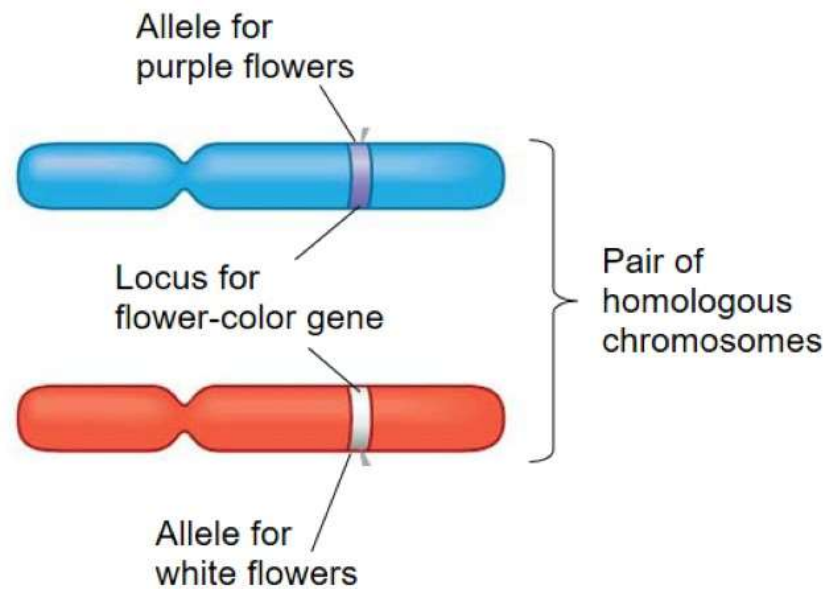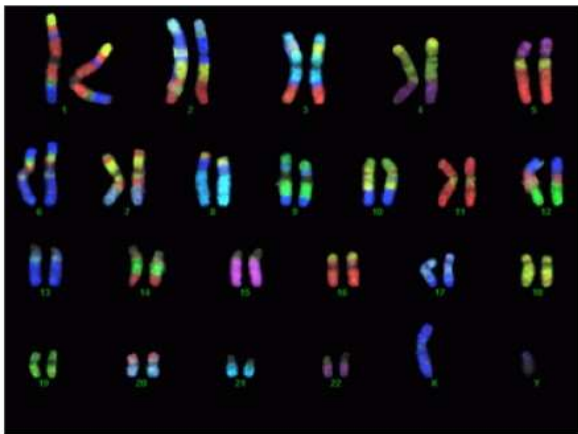
What underlies Dominant-Recessive Inheritance Patterns

Allele for purple flowers

CTAAATCGGT

Enzyme

Enzyme that helps synthesize purple pigment

Locus for flower-color gene

Pair of homologous chromosomes

Allele for white flowers

ATAAATCGGT

Absence of enzyme
 – recessive allele
 often a null/ non-functional allele

One allele results in sufficient pigment
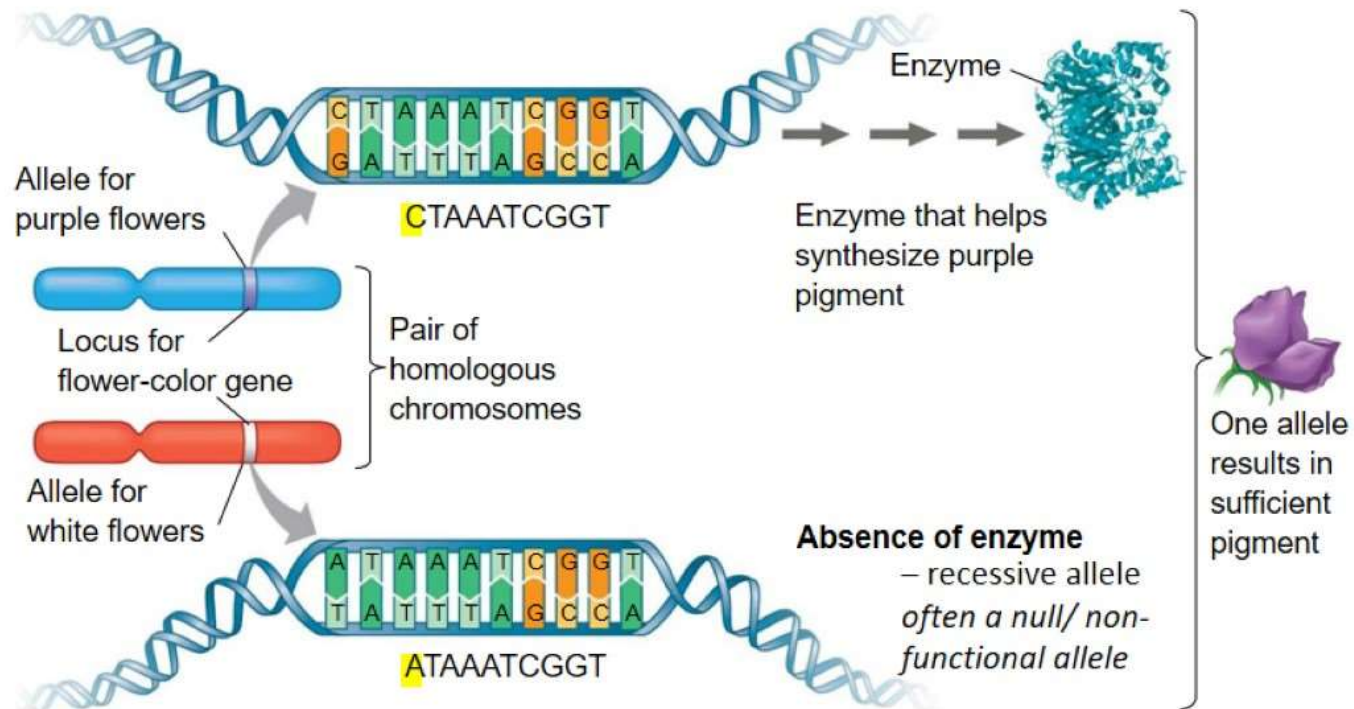
Inheritance of Recessive disorders

Parents

Normal × Normal
Aa   Aa

Sperm

(A)   (a)

Eggs

(A)

	A	a
A	AA Normal	Aa Normal (carrier)
a	Aa Normal (carrier)	aa Albino
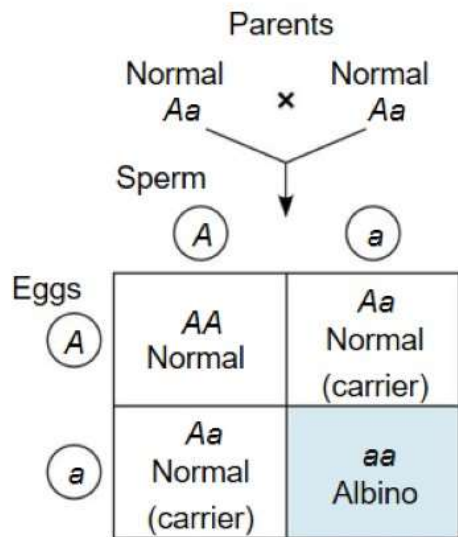
Inheritance of Dominant disorders

Parents

Dwarf × Normal
Dd   dd

Sperm

(D)   (d)

Eggs

	D	d
d	Dd Dwarf	dd Normal
d	Dd Dwarf	dd Normal
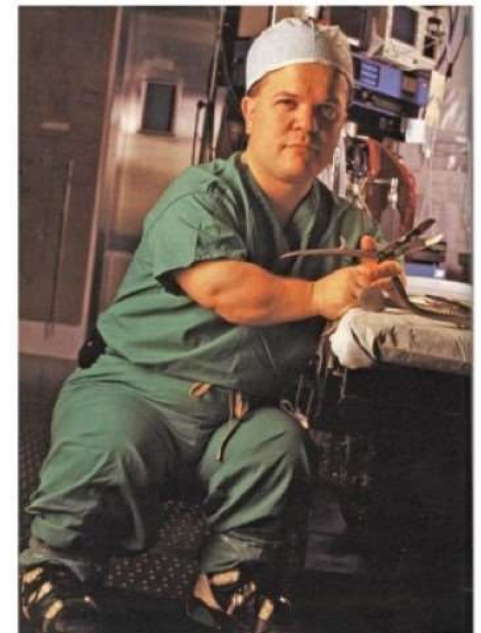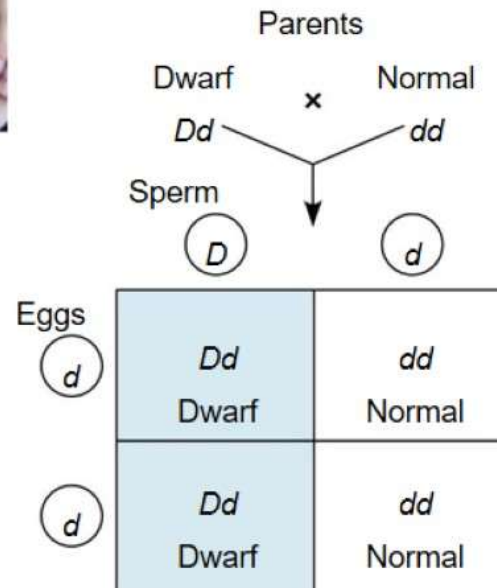
Pedigree charts: *guessing the genotypes from the phenotypes*

Key

☐ Male   ○ Female   ■ Affected male   ● Affected female   ☐—○ Mating   Offspring, in birth order (first-born on left)
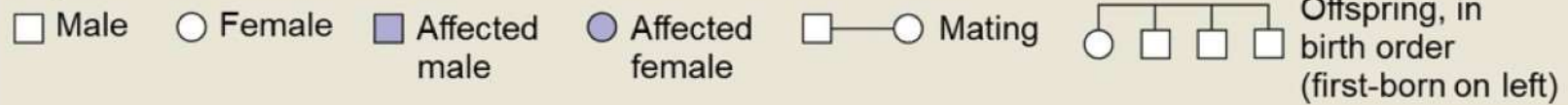
1st generation (grandparents)

■—○   ☐—●
Ww ww   ww Ww

■—○   ■—○
Ff Ff   ff Ff

2nd generation (parents, aunts, and uncles)

● ☐ ☐ ■ ● ○
Ww ww ww Ww Ww ww

○ ■ ■ ☐ ○ ●
FF or Ff ff ff Ff Ff ff
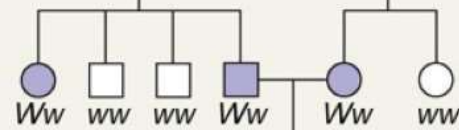
3rd generation (two sisters)

Widow's peak

● ○
WW or Ww   ww
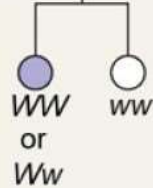
No widow's peak

(a) Is a widow's peak a dominant or recessive trait?

● ○
ff   FF or Ff

Attached earlobe

Free earlobe

(b) Is an attached earlobe a dominant or recessive trait?

Dihybrid Crosses

Each pair of alleles is inherited independently of the other

- as though the other pair weren't there
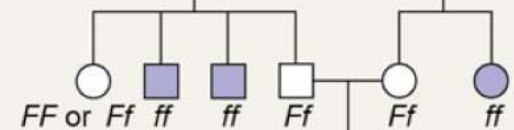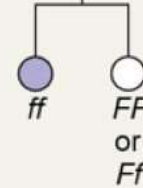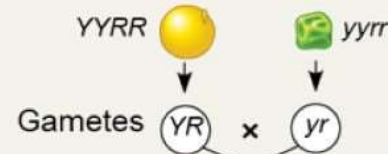- the genes are located on separate chromosomes, or at least at opposite ends of the same chromosome (they aren't linked)

Results

315 ● 108 ● 101 ▨ 32 ▨

Phenotypic ratio approximately 9:3:3:1

Experiment

P Generation — YYRR × yyrr

Gametes (YR) × (yr)

F₁ Generation — YyRr

Predictions

Hypothesis of dependent assortment or Hypothesis of independent assortment

Predicted offspring of F₂ generation

Sperm ½ (YR) ½ (yr)

Eggs ½ (YR), ½ (yr)

| | YYRR | YyRr |
| YyRr | yyrr |

¾ ● ¼ ▨
Phenotypic ratio 3:1

Sperm ¼ (YR) ¼ (Yr) ¼ (yR) ¼ (yr)

Eggs ¼ (YR), ¼ (Yr), ¼ (yR), ¼ (yr)

YYRR	YYRr	YyRR	YyRr
YYRr	YYrr	YyRr	Yyrr
YyRR	YyRr	yyRR	yyRr
YyRr	Yyrr	yyRr	yyrr

9/16 ● 3/16 ● 3/16 ▨ 1/16 ▨
Phenotypic ratio 9:3:3:1

1. In peas the allele for purple flower color is dominant over the allele for white flower color. The allele for smooth leaves is dominant over the allele for rough leaves.

   If two pea plants with the genotypes *SsPp* and *Sspp* are crossed together, what ratio of phenotypes is expected in the offspring?

   A. 3 purple smooth : 1 purple rough : 3 white smooth : 1 white rough

   B. 9 purple smooth : 3 purple rough : 3 white smooth : 1 white rough

   C. 3 purple smooth : 3 purple rough : 1 white smooth : 1 white rough

   D. 1 purple smooth : 1 purple rough : 1 white smooth : 1 white rough