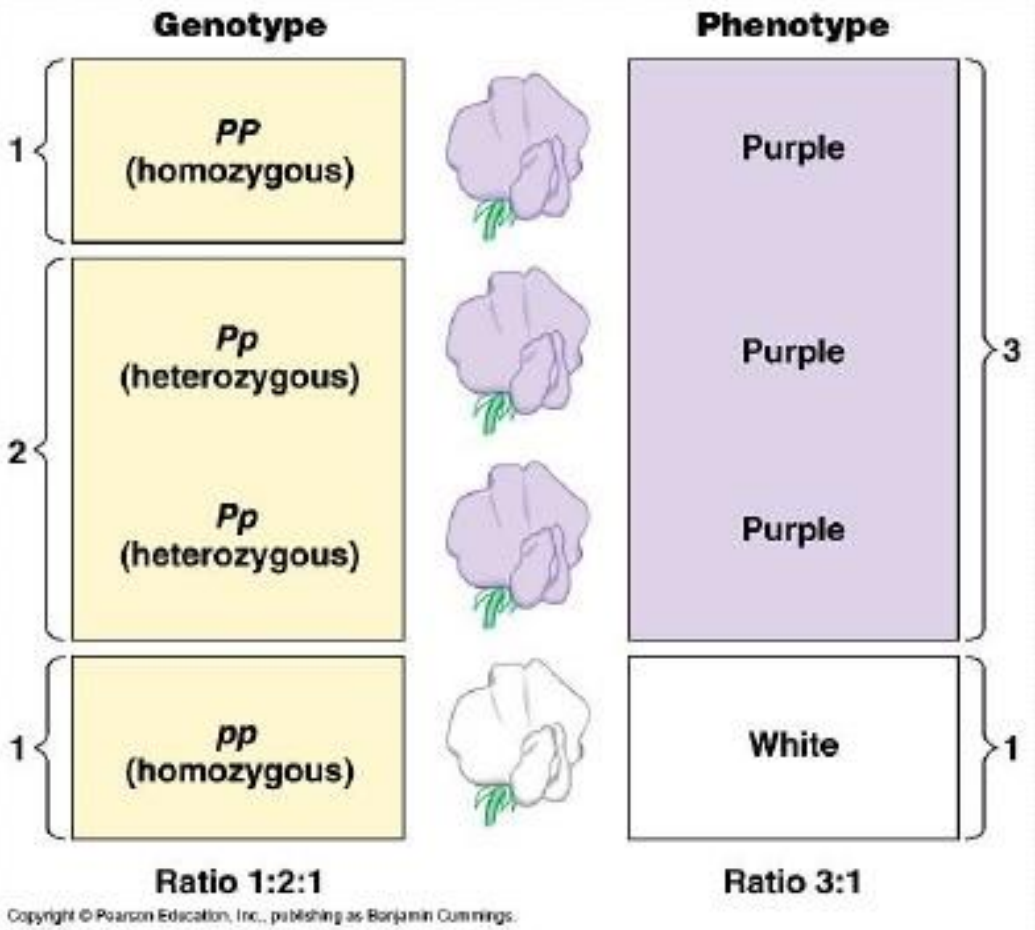
Mendel and Monohybrid Crosses

Gregor Mendel

- When two heterozygous plants are crossed the expected and observed phenotypic ratio will always be 3:1
- This was the same for all 7 of his tests

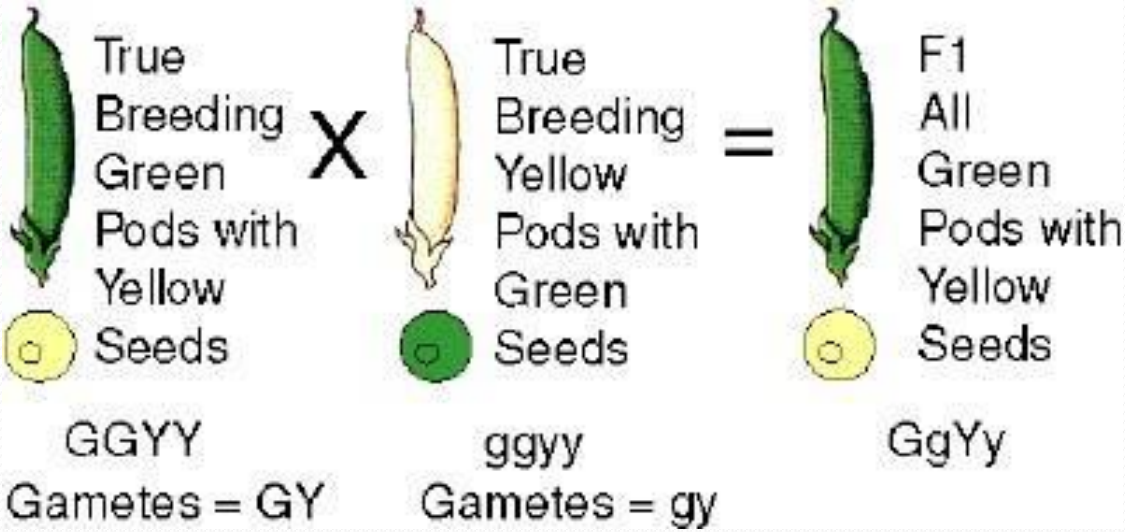


Gregor Mendel

- Mendel concluded that the two alleles for each characteristic separate during gamete production.
- This segregation of alleles corresponds to the distribution of homologous chromosomes to different gametes in meiosis
- Known as the **law of segregation**

Independent assortment

- states that 2 pairs separate independently during the formation of a gamete. This means that traits are transmitted to offspring independently of one another.



Gregor Mendel

Genotype of alleles:

R = red flower

r = orange flower

All genes occur in pairs, so 2 alleles affect a characteristic

Possible combinations are:

Genotypes	RR	Rr	rr
Phenotypes	RED	RED	ORANGE

Possible Genotypes

- An individual can be;
  - **Homozygous (pure bred)**: 2 of the same alleles
    - Homozygous _____ RR (red)
    - Homozygous _____ rr (orange)
  - **Heterozygous (hybrid)**: 2 different alleles
    - Heterozygous Rr (Red)

Genotype vs. Phenotype

- **Genotype**: the genetic makeup of an individual that indicates the specific copies of alleles present for a particular trait.
  - The flower can be heterozygous (Rr), homozygous dominant (RR) or homozygous recessive (rr).
- **Phenotype**: the way an individual expresses the traits as a results of the genotype.
  - Ex. Flower can appear RED (RR or Rr) or ORANGE (rr).

Practice

For each genotype: heterozygous (He) or homozygous (Ho)

TT_____	Bb_____	DD_____	Ff _____	tt _____
Dd_____	ff _____	Tt _____	BB_____	dd_____

Which of the genotypes would be purebred?

_____

Which of the genotypes would be hybrid?

_____

Practice

Determine the phenotype for each genotype

- Yellow body color is dominant to blue

YY_____ Yy _____yy _____

- Square shape is dominant to round

SS_____Ss_____ ss_____

Genetic Crosses

- **Monohybrid cross**: cross involving a single trait
  - Flower color, plant height
- **Dihybrid cross**: cross involving two traits
  - Flower color & plant height
- Punnett squares help determine the possible combinations of genotypes that can occur in the offspring.
- It also shows the probability of each genotype occurring

Genetic Crosses

Solving Punnett squares only takes a few steps:

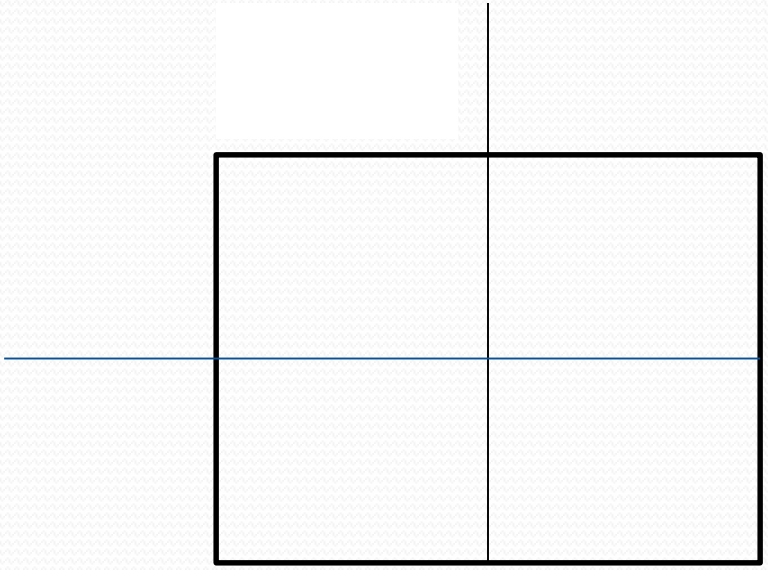
1. Determine the genotypes of the parent organisms
2. Write down your 'cross'
3. Draw your Punnett square
4. 'Split' the letters of the genotype for each parent & put them 'outside' the Punnett square
5. Determine the possible genotypes of the offspring by filling in the Punnett square
6. Summarize the results (both genotype and phenotype of the offspring)

Example:

1. A cross between a pea plant that is heterozygous for purple flowers (Pp) is crossed with a pea plant with white flowers (pp). Determine the genotypes and phenotypes of the possible offspring.

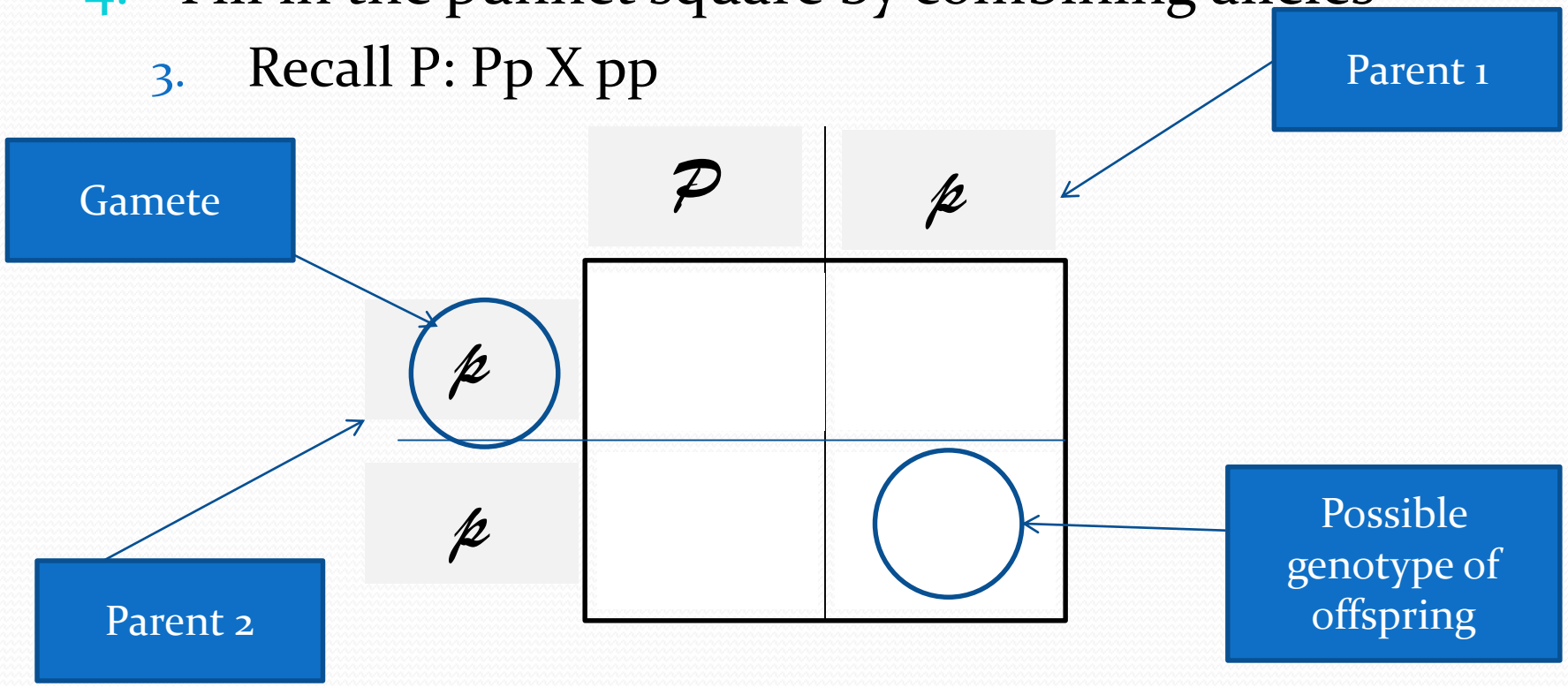
Making a Punnet Square

1. State the parent generation and the possible gametes
   - Ex. P: Pp X pp Gametes: parent 1 – P, p ; parent 2: p, p
2. Draw the Punnet square using a ruler!



Making a Punnet Square

3. Write the possible gametes
4. Fill in the punnet square by combining alleles
    3. Recall P: Pp X pp



Genetic Crosses

5. Determine the genotype and phenotype
6. Answer the question (As a ratio or percentage).

As a ratio:

G:_____

Ph: _____

As a percent:

G: _____

Ph: _____

Genetic Crosses

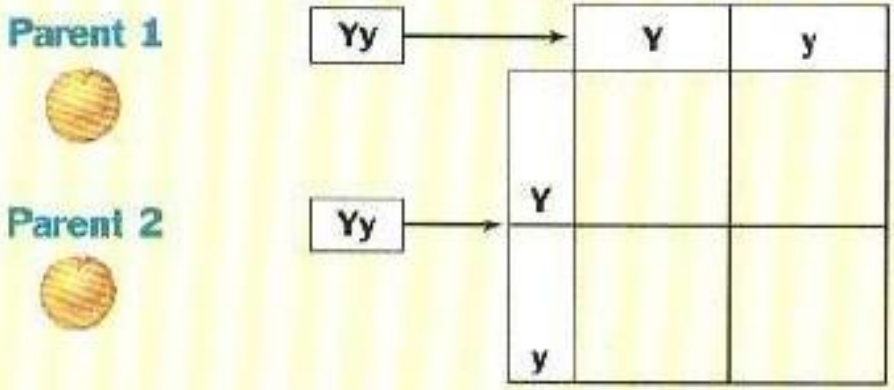
How to Make a Punnett Square

Punnett squares allow geneticists to predict the possible genotypes and phenotypes of offspring.

In this example, both parents are heterozygous for yellow-pea allele (*Yy*).

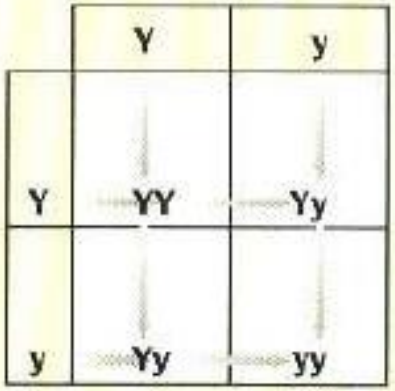
1 Make the grid

Place the alleles of the gametes of one parent along the top of a grid and those of the other parent along the left-hand side.



2 Fill in the grid

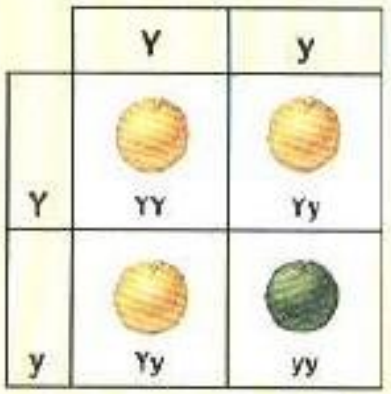
Combine the parent alleles inside the boxes. The letters show the genotypes of the offspring.



The genotype ratio is 1:2:1, meaning 1 *YY*, 2 *Yy*, 1 *yy*.

3 Fill in the offspring

Use the Law of Dominance to determine the phenotypes and phenotype ratio of the offspring.



The phenotype ratio is 3:1, meaning 3 yellow peas to 1 green pea.

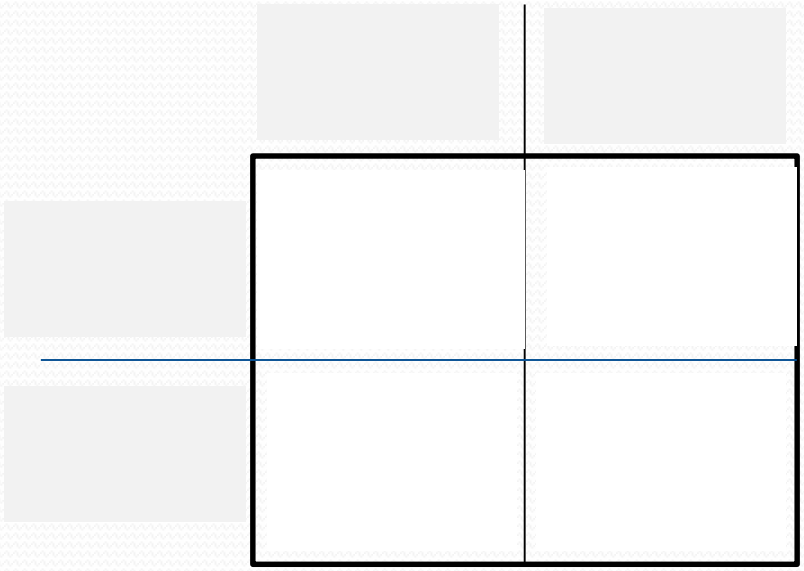
Example 2:

- In guinea pigs a black coat (B) is dominant over a white coat (b). Determine the phenotype and genotype ratios if a homozygous dominant parent is crossed with a heterozygous parent.

P: _____

Gametes: _____

F1:



G: _____

Example 3:

- In humans, free ear lobes (F) are dominant over attached ear lobes (f). What are the phenotype and genotype ratios of the offspring:

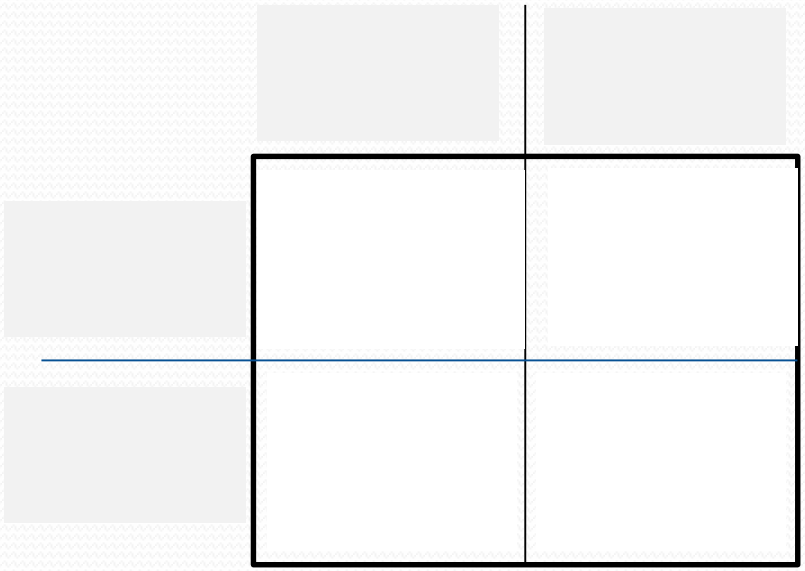
a) When a homozygous dominant female is crossed with a homozygous recessive male
b) Based on these results, what is the chance (percentage)of the child having attached ear lobes
c) What is the phenotype of the F2 generation

- P: _____
- Gametes: _____

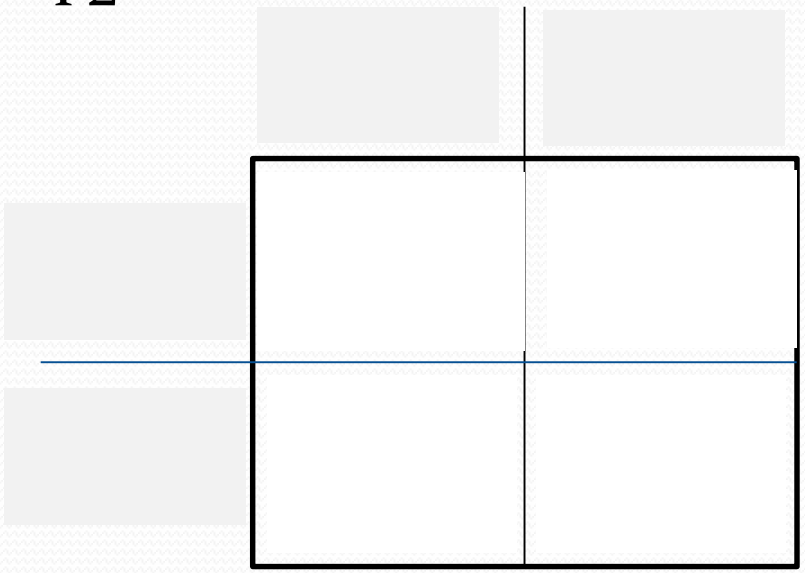
P: _____

Gametes: _____

F1



F2



- G: _____
- Ph: _____

G: _____

Ph: _____

b) _____

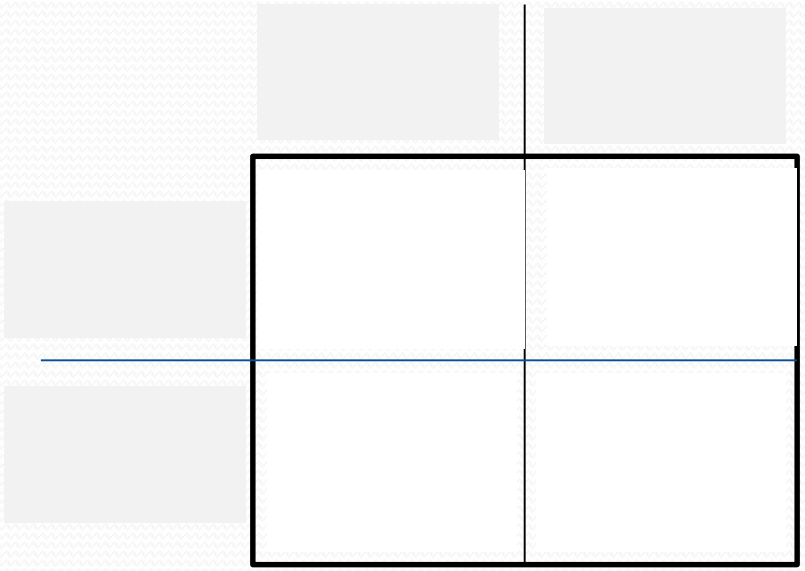
Example 4

- In unicorns, a large horn (H) is dominant over a small horn (h).

a) If two heterozygous parents are crossed, what are the phenotypic and genotypic ratios of the F1 generation.

b) How many offspring will be born with a small horn if the parents have 100 offspring.

- P: _____
- Gametes: _____



a) G: _____

Ph: _____

b) _____