Zoo-352 Principles of genetics
Lecture 7

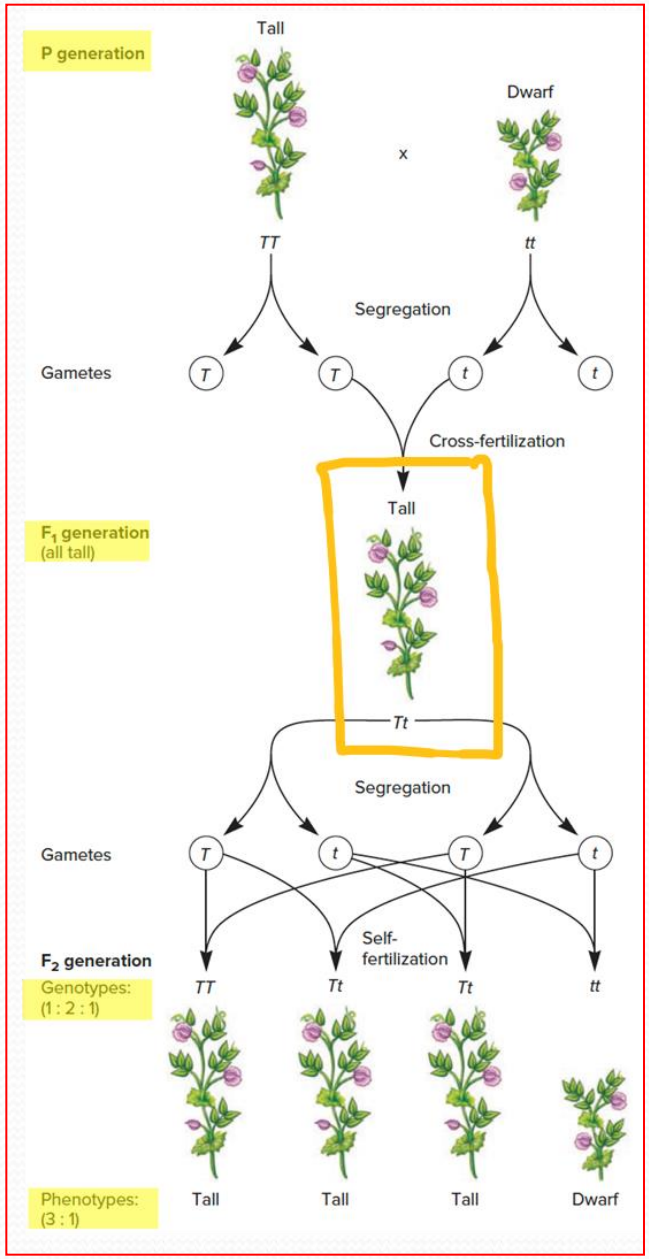
Testing the Law of Segregation

Outlines:

- Verifying genotype based on Mendel's first law.
- Methods to test the Mendel's law of segregation.
- Exercices on testing the dominant traits (heterozygous or homozygous genotype).
- Exercises on applying Mendel's first law.

First Principle (Mendelian Law I): The law of segregation

- In Mendel experiments on pea plant, the F2 generation would have a phenotypic ratio of 3:1, a standard Mendelian ratio for a monohybrid cross.
- We would also expect a genotypic ratio of 1:2:1 in the F2 generation and twice are heterozygotes.
- The challenge is to demonstrate that this genotypic ratio exists in the F2 offspring, when we can only observe phenotypes.



How could Mendel determine the F2 genotype as either homozygous dominant or heterozygous?

- The simplest way to test the hypothesis is to:
  1. Self-fertilize the F2 individuals to produce an F3 generation (Figure 1).
- Another way to test the segregation law is to use a:
  2. Testcross, which crosses any organism with a recessive homozygote.
- Another type of cross is a:
  3. Backcross, which crosses offspring with a parent or an individual with the parental phenotype.
- When the parent has the homozygous recessive phenotype, a backcross is also a testcross.
- The testcross can be used to distinguish the genotype of a phenotypically dominant individual (Figure 2).

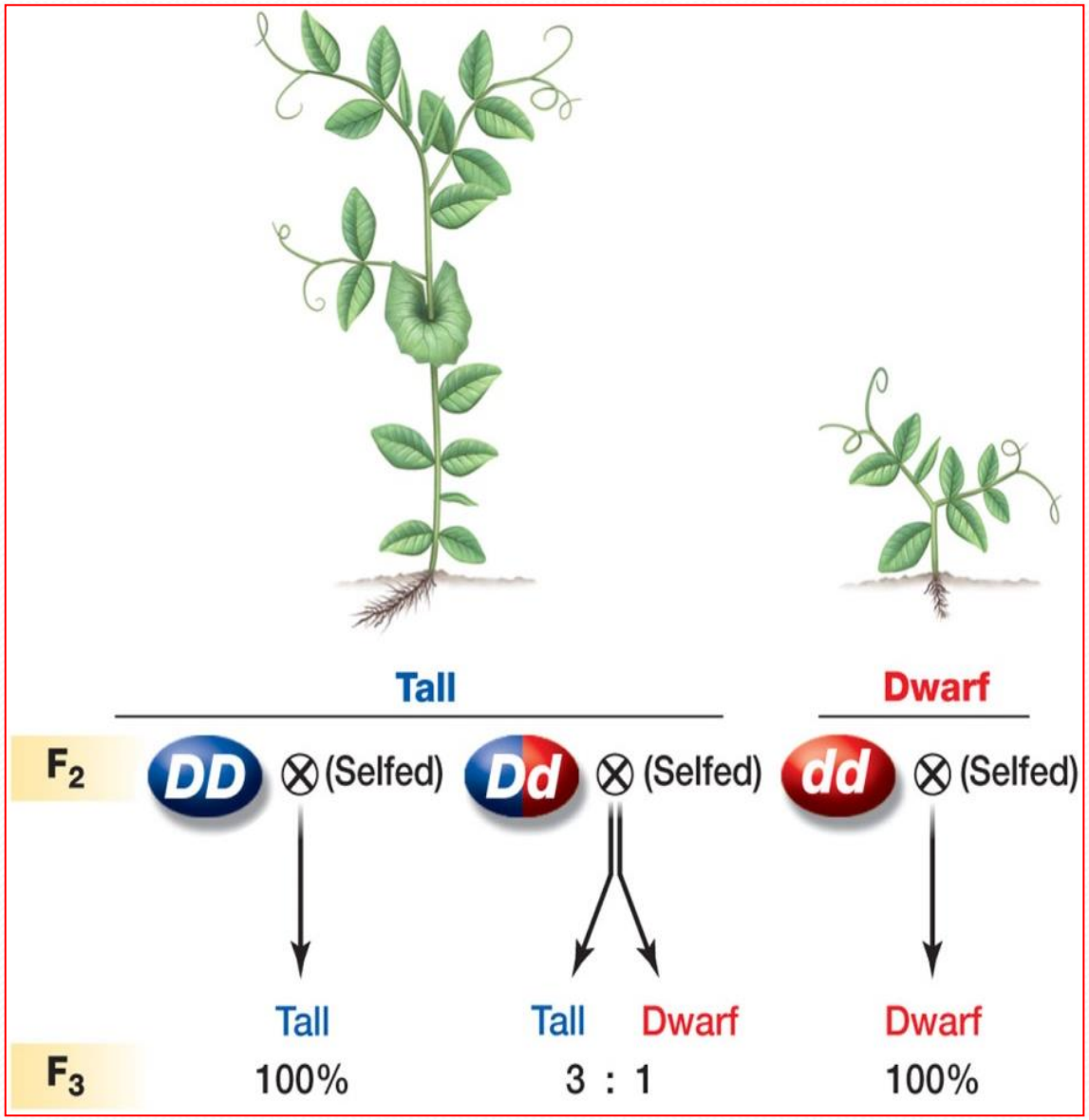


Figure 1. Mendel self-fertilized F2 tall and dwarf plants

Two ways was used to test the segregation law

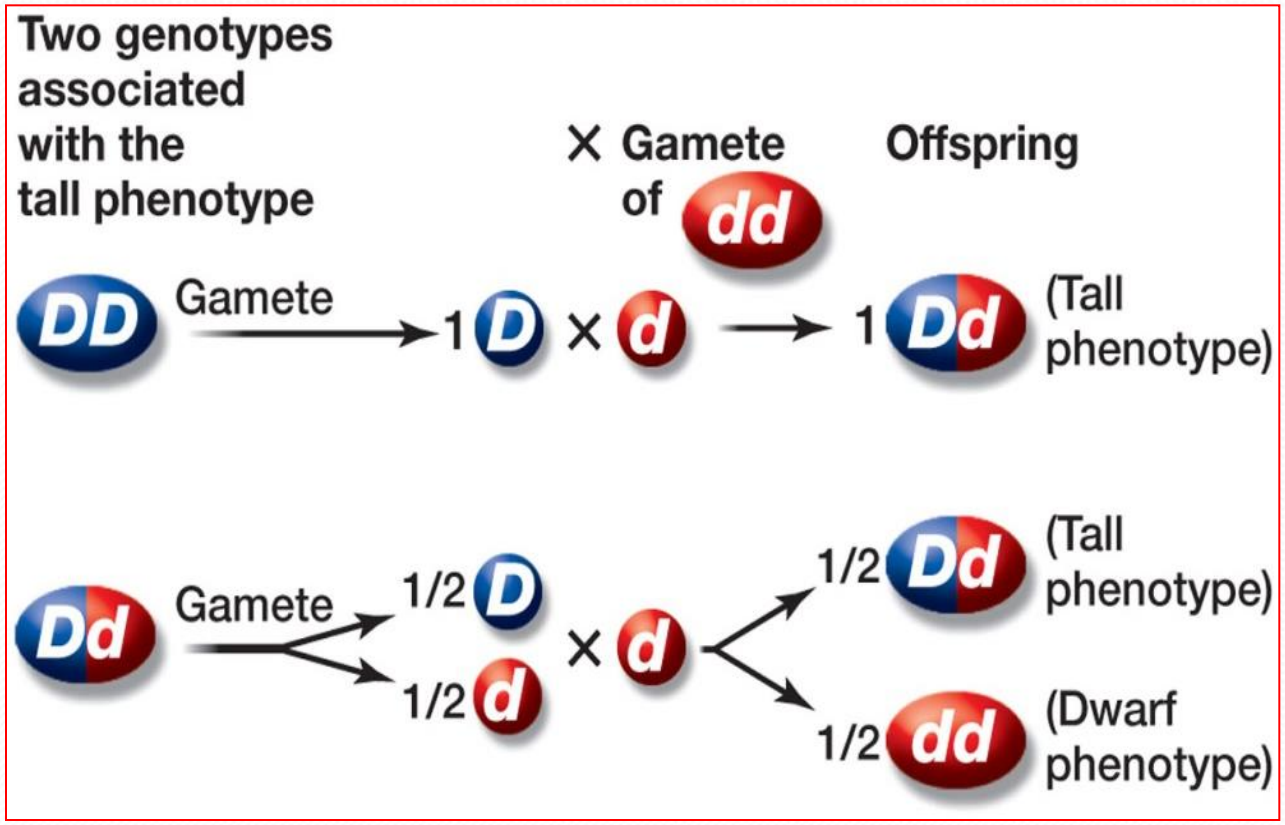
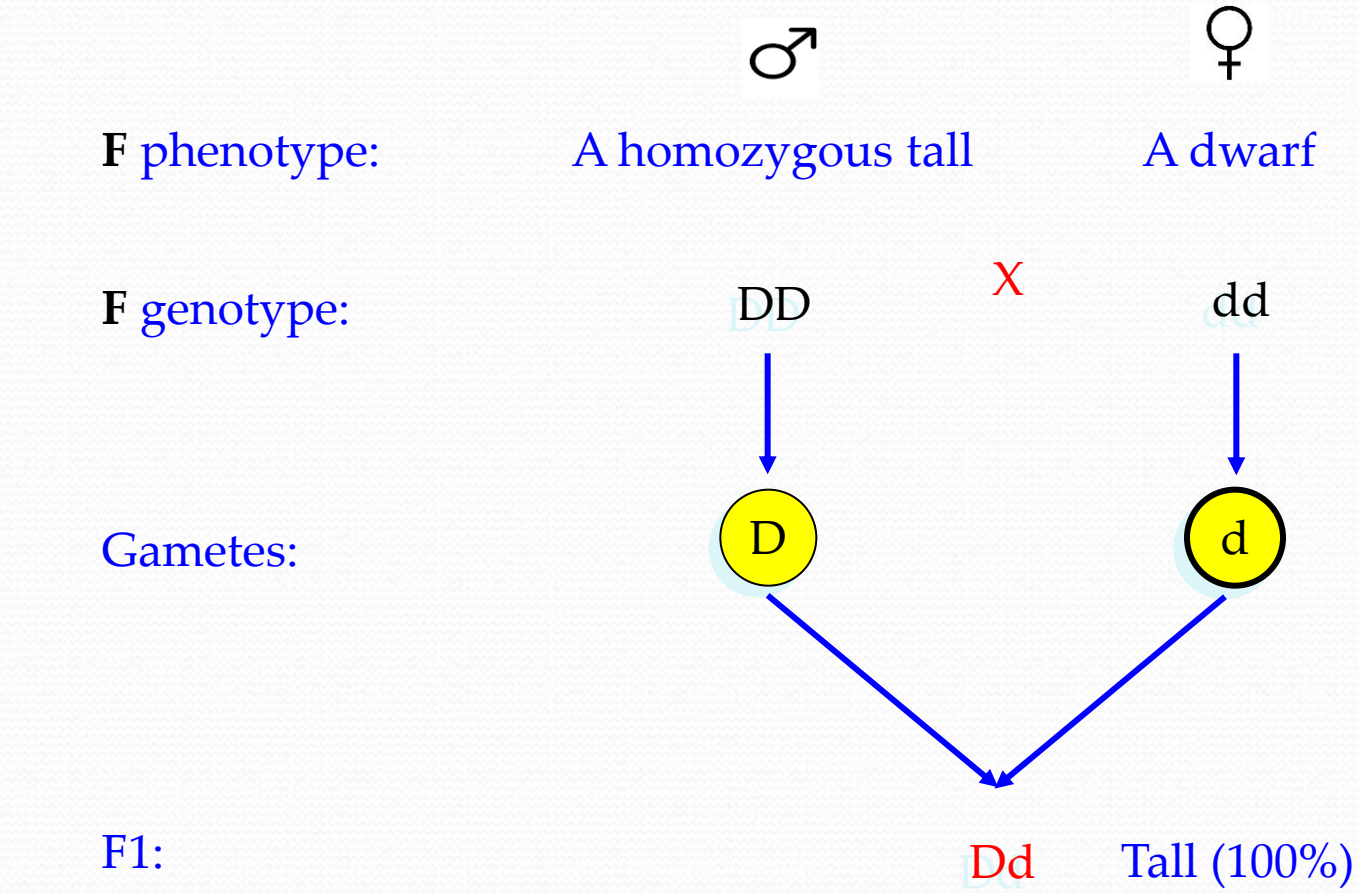


Figure 2. Testcrossing the phenotypically dominant F2 individuals

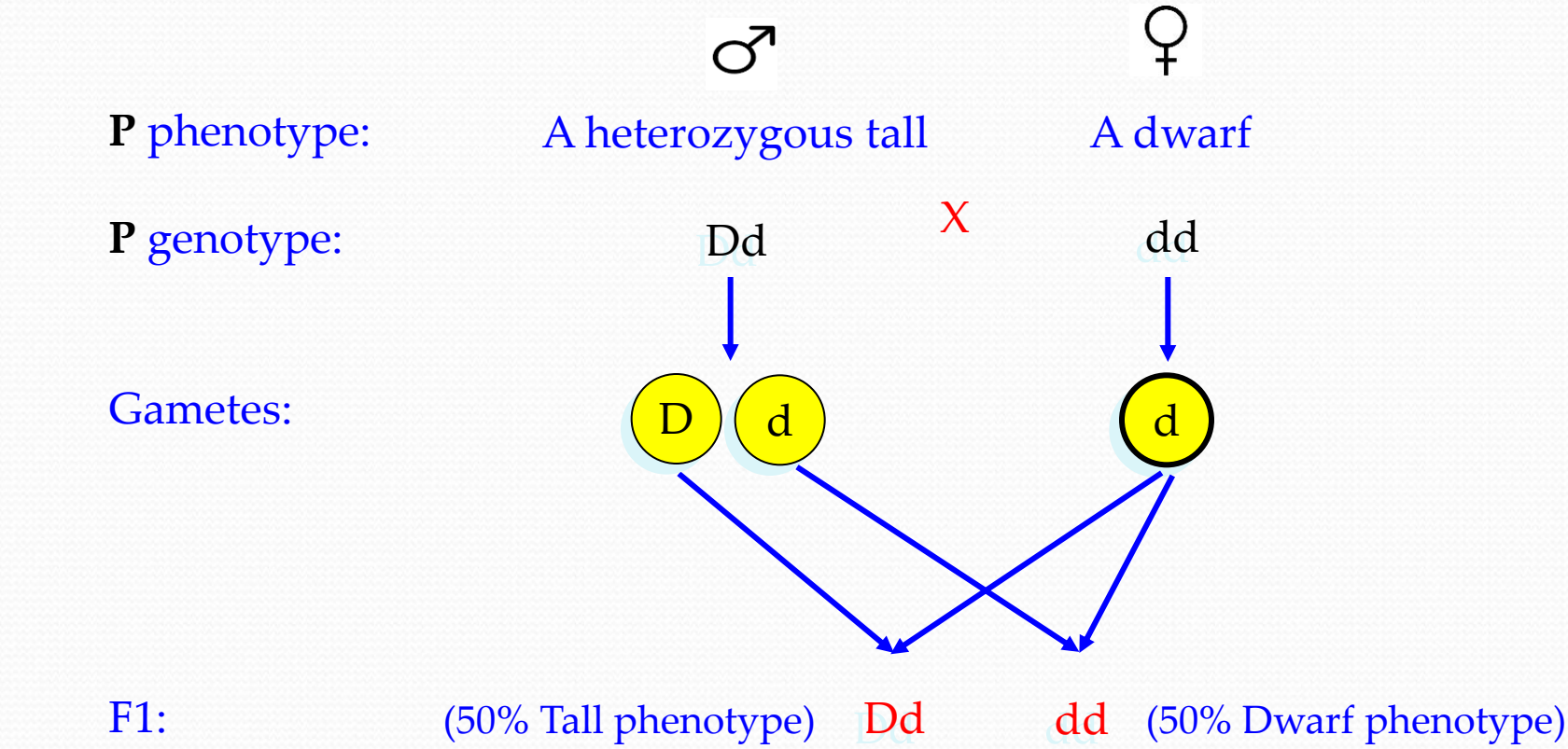
Results of Testcross (Homozygous Dominant with a Recessive Homozygote)

Testcross 1:



Results of Testcross (Heterozygous Dominant with a Recessive Homozygote)

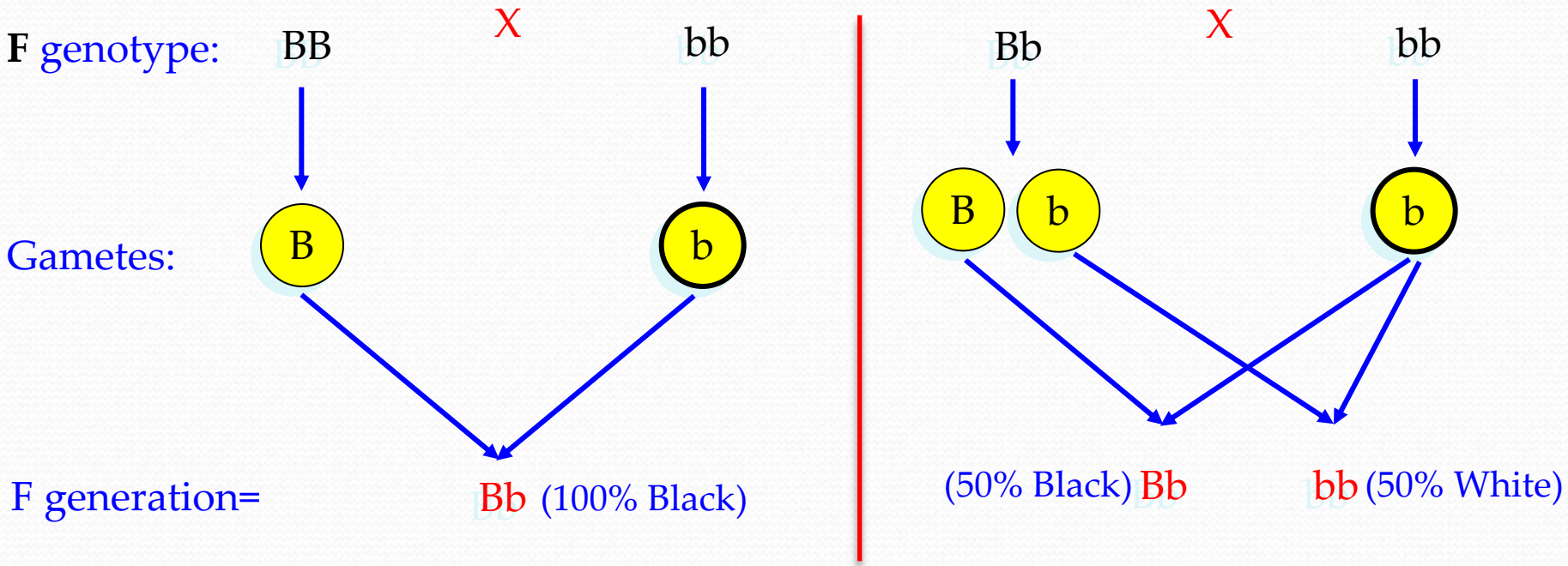
Testcross 2:



Exercise in a Testcross

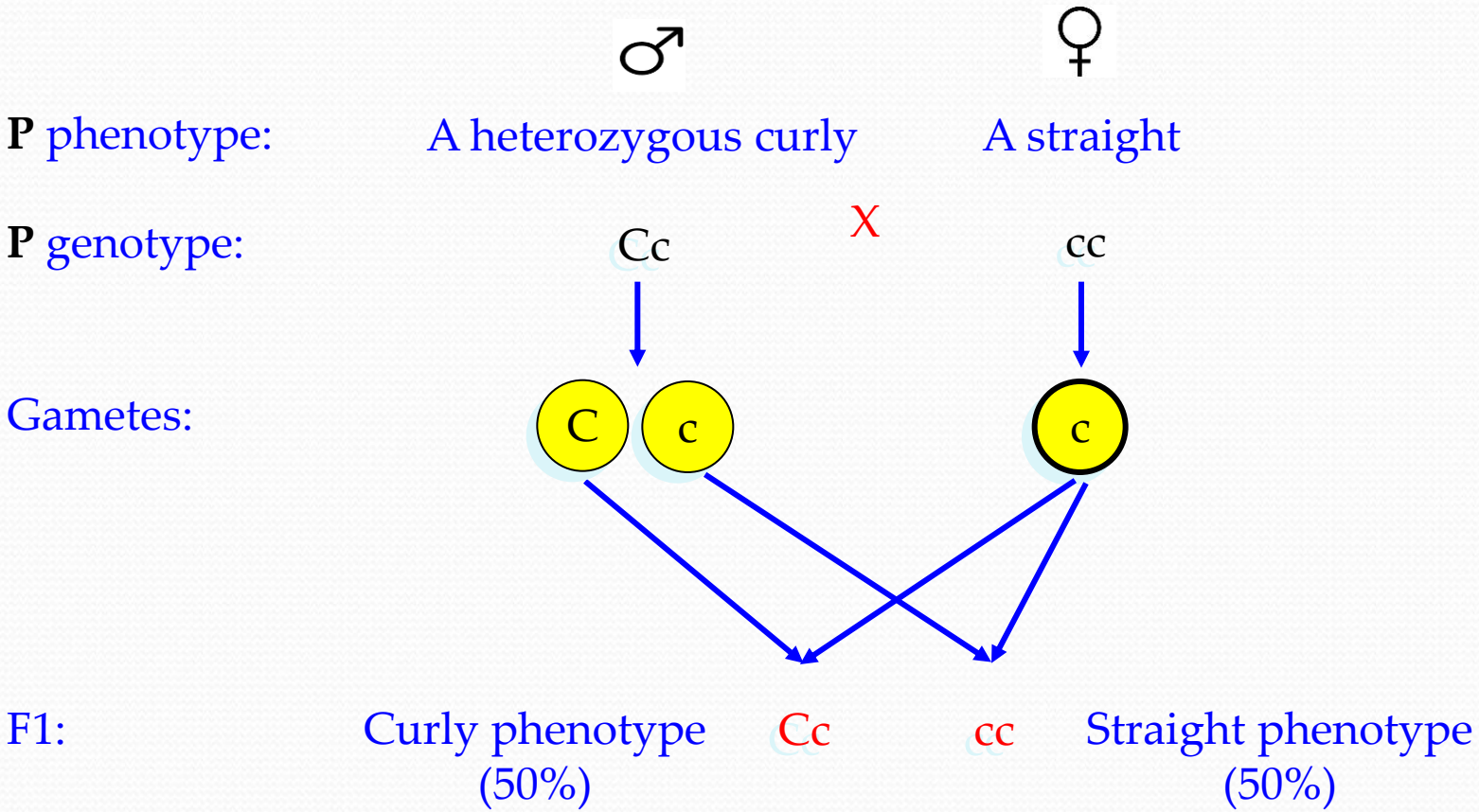
In Guinea pigs, black color is dominant over white. How would you find out whether a black is homozygous (BB) or heterozygous (Bb)?

By Testcross: BB × bb and Bb × bb



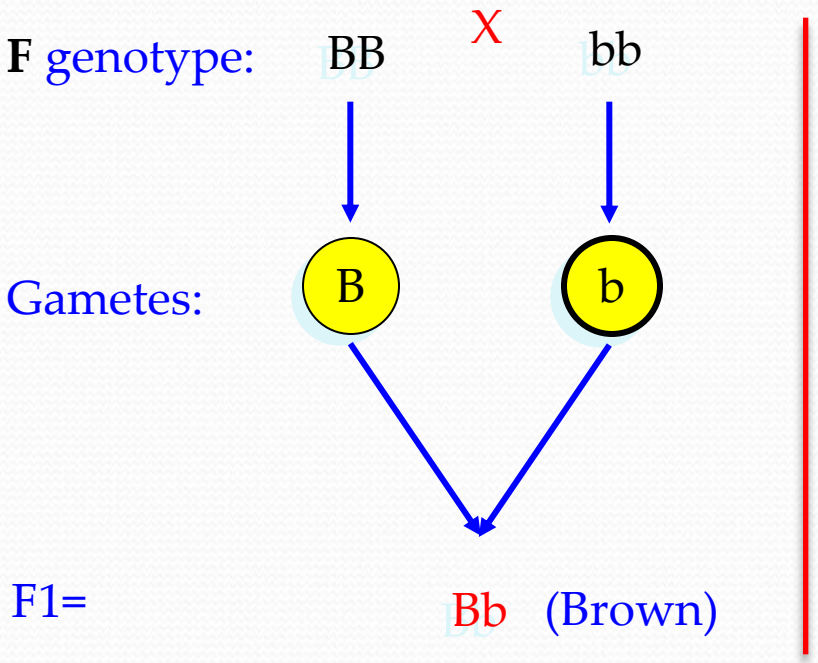
Monohybrid Crosses Practice Exercises

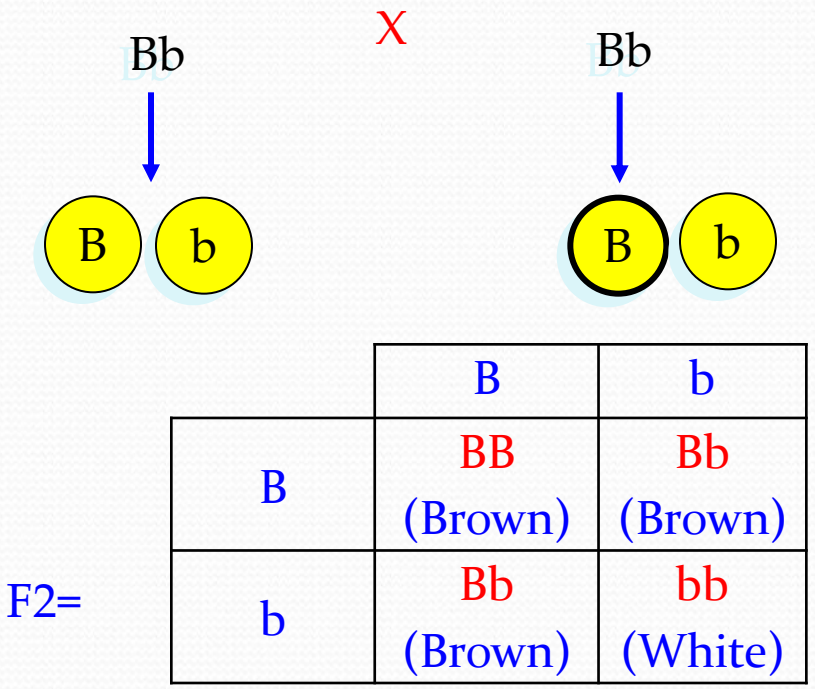
Question 1: Curly hair is dominant to straight hair in humans. Show a cross between a heterozygous curly haired parent with a pure homozygous straight-haired parent.



Question 2: A brown mouse is mated to a white mouse and all of their offspring are brown.

- Which allele is dominant? Brown
- What are the genotypes of the mice that were crossed? BB, bb
- If two of the F1 brown offspring were mated together, what percentage of the F2 mice would be brown? 75%

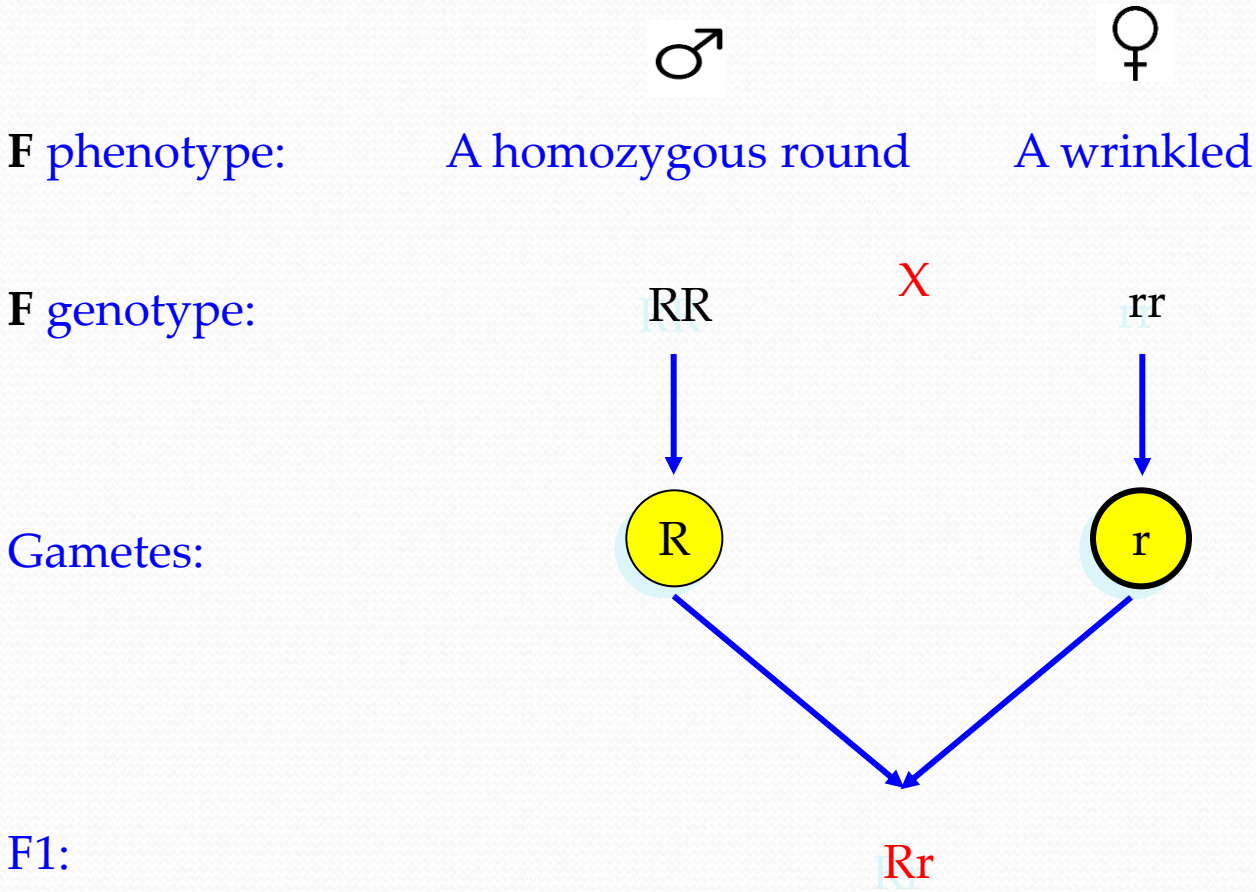




	B	b
B	BB (Brown)	Bb (Brown)
b	Bb (Brown)	bb (White)

Question 3: A homozygous round seeded plant is crossed with a homozygous wrinkled seeded plant.

- What are the genotypes of the parents? RR, rr
- What percentage of the offspring will also be homozygous? 0 %



Quiz: Testing the Law of Segregation

1. _____ is a genetic cross between an individual exhibiting a recessive trait and one exhibiting a dominant trait, used to determine whether the dominant trait is heterozygous or homozygous.
   - Testcross
   - Backcross
   - Self-fertilization
   - Monohybrid cross

2. If a homozygous dominant individual (RR) is crossed with a homozygous recessive individual (rr), what is the phenotype ratio in the F2 generation?
   - 2:2
   - 1:2:1
   - 3:1
   - 4:0

3. Crossing _____ represents a monohybrid cross.
   - MM x Mm
   - Mm x Mm
   - Mm x mm
   - All of the above