Zoo-352 Principles of genetics
Lecture 9

The law of Independent assortment

- Mendel also analyzed the inheritance pattern of two traits at the same time (a dihybrid cross).
- For example, he examined plants that differed in both the form and color of their peas.
- He crossed homozygous plants that produced round, yellow seeds with plants that produced wrinkled, green seeds (Figure 1).
- In figure 1, the letter W is assigned to the dominant allele, round, and w to the recessive allele, wrinkled; G and g are used for yellow and green color, respectively.
- The F1 plants all had round, yellow seeds, which demonstrated that round was dominant to wrinkled and yellow was dominant to green.

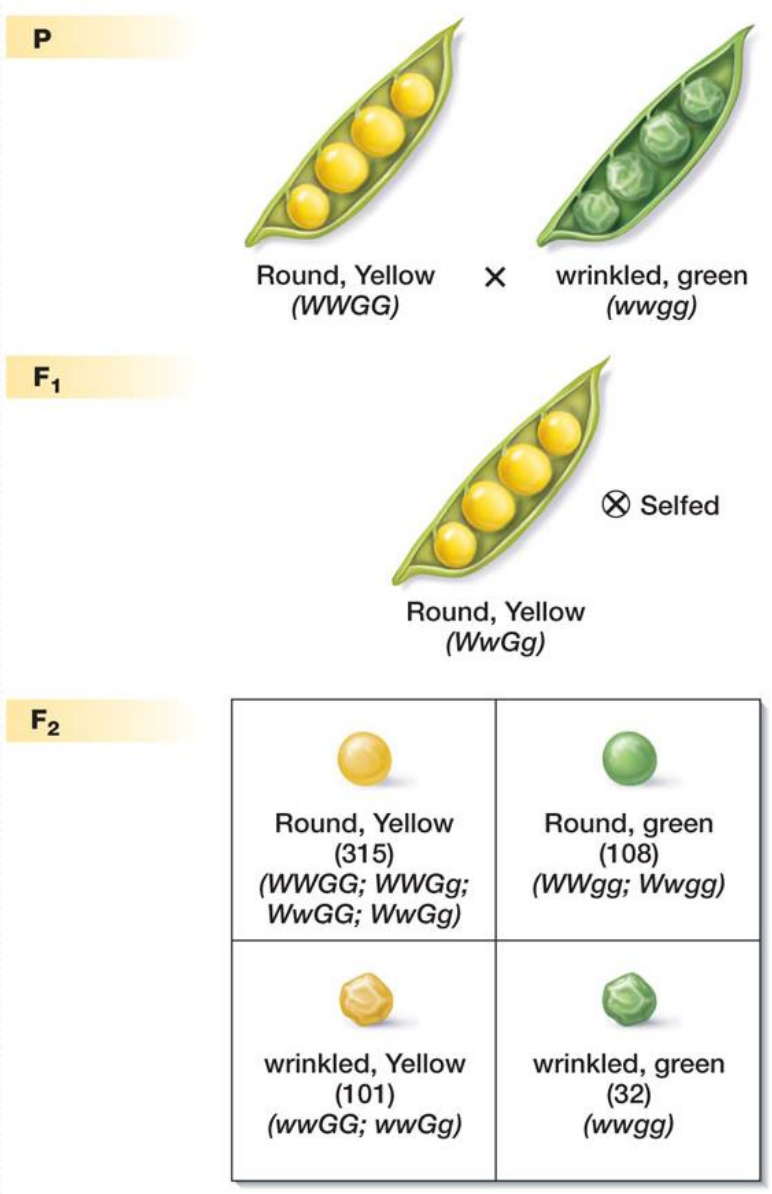

Figure 1: Independent assortment in garden peas

- When the F1 plants were self-fertilized, they produced an F2 generation of plants that had all four possible combinations of the two seed characteristics:
  - 9 plants with round, yellow seeds.
  - 3 plants with round, green seeds.
  - 3 plants with wrinkled, yellow seeds.
  - 1 plants wrinkled, green seeds.
- Dividing the number of plants by 32 (the number in the smallest group) gives a 9.84 to 3.38 to 3.16 to 1.00 ratio, which is very close to a 9:3:3:1 ratio (Figure 2).
- One way to visualize the different gametes fusions that can occur to produce the F2 generation is to use a Punnett square.
- Mendel's second law of independent assortment states that alleles for one gene will segregate independently of the alleles at another gene.

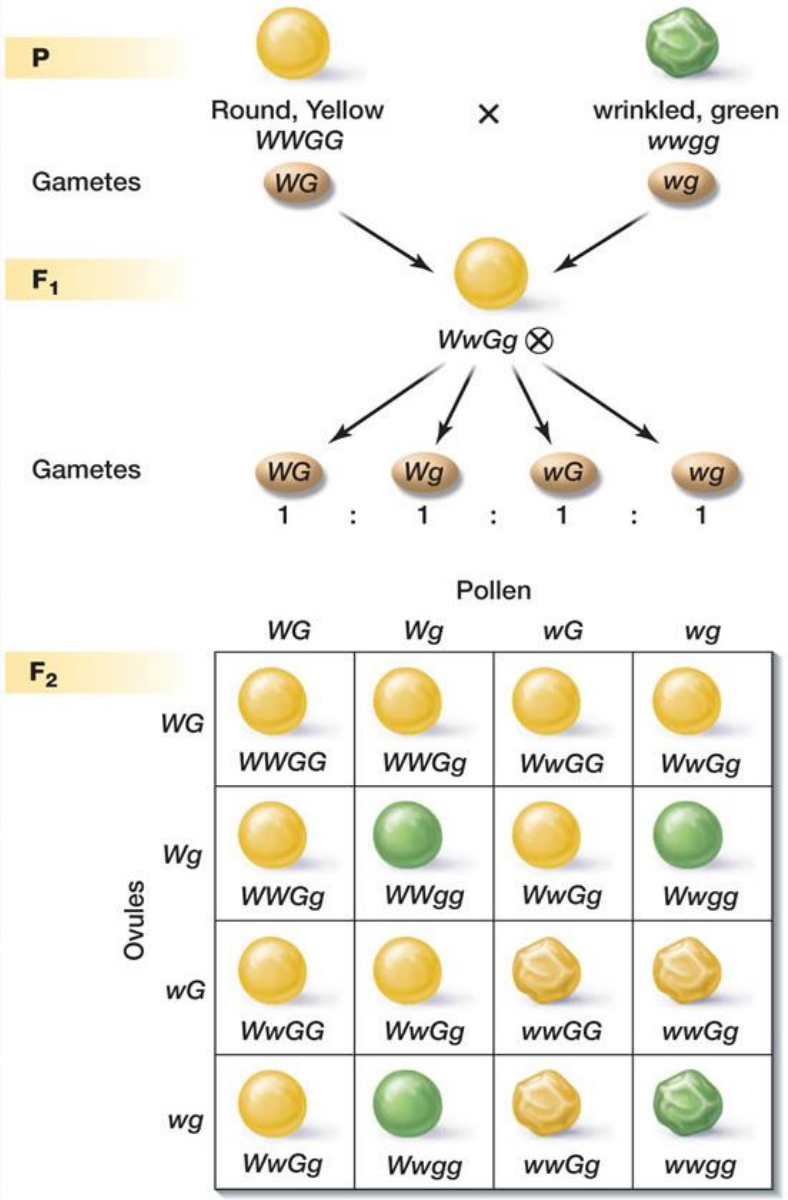

Figure 2: Assigning genotypes to the cross in Figure 1

Testing the law of independent assortment

- A simplest test of Mendel's law of independent assortment can be made by testcrossing the dihybrid plant.
- He testcrossed a **WwGg** F1 offspring with a **wwgg** individual the progeny would include four phenotypes in a 1:1:1:1 **ratio** as shown in figure 3.

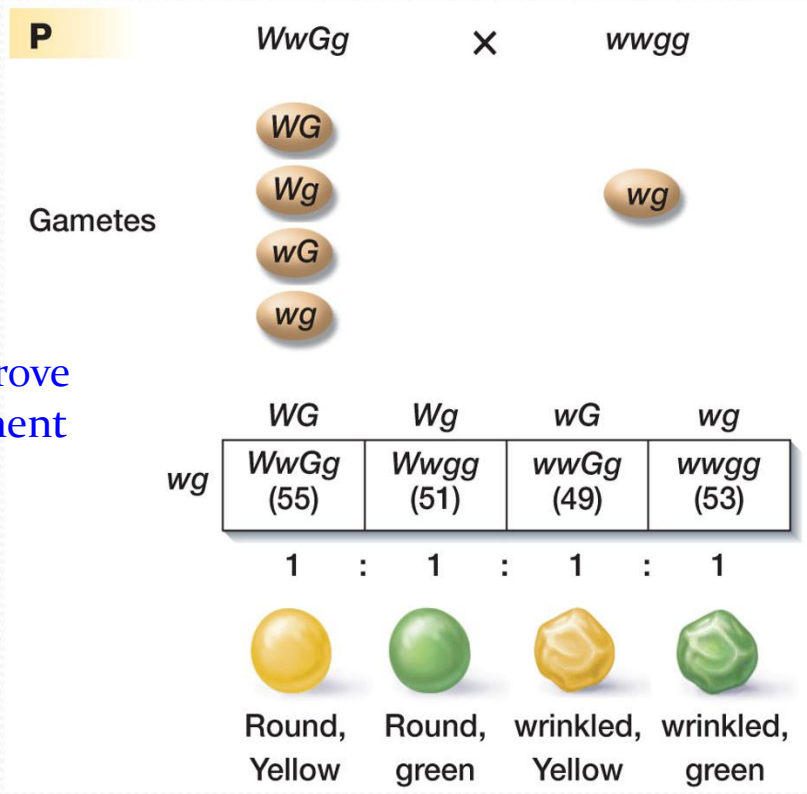

Figure 3: Testcross of a dihybrid to prove Mendel's law of independent assortment

Dihybrid Crosses Practice Exercises

Question 1: In rabbit, short hair is controlled by a dominant allele (S) while long hair is controlled by its recessive allele (s). On the other hand, black hair is controlled by a dominant allele (B) while brown hair is controlled by a recessive allele (b). Based on the information given, answering the following questions:

A heterozygous rabbit with short black hair is cross with homozygous rabbit with short brown hair. Determine the phenotypic and genotypic ratio among the F1 progeny?

♂ ♀

P phenotype: A heterozygous short black A homozygous short brown

P genotype: SsBb X SSbb

Gametes: SB Sb sB sb Sb

F1:

	SB	Sb	sB	sb
Sb	SSBb Short black	SSbb Short brown	SsBb Short black	Ssbb Short brown

- Phenotypic ratio = 2 (short black) : 2 (short brown)
- Genotypic ratio = 1 (SSBb) : 1 (SSbb) : 1 (SsBb) : 1 (Ssbb)

Question 2: How many different types of gametes can be produced from the following genotypes?

a) AAbb b) Aabb c) AaBbCc d) AaBbCcDd

The number of gamete produced = $\mathbf{2^n}$

n= the number of heterozygous gene pairs from one parent

a) AAbb = $\mathbf{2^n} = 2^0 = 1$

b) Aabb = $\mathbf{2^n} = 2^1 = 2$

c) AaBbCc = $\mathbf{2^n} = 2^3 = 8$

d) AaBbCcDd = $\mathbf{2^n} = 2^4 = 16$

Question 3: Suppose that black hair (B) is dominant over blonde hair and brown eyes (E) are dominant over blue eyes. The father has black hair (homozygous) and brown eyes (heterozygous) and the mother has blonde hair and blue eyes. Answer the following questions:

a) Draw a Punnett square to show all possible offspring.

b) What percent of the offspring will be totally heterozygous?

c) What is the phenotypic ratio?

d) What percent of the offspring will have blonde hair and blue eyes?

♂ ♀

P phenotype: black hair (homo) and brown eyes (hetero) Blonde hair and brown eyes

P genotype: BBEe X bbee

Gametes: BE Be be

F1 (a):

	BE	Be
be	**BbEe** Black hair brown eyes	**Bbee** Black hair blue eyes

b) What percent of the offspring will be totally heterozygous? 50%

c) What is the phenotypic ratio? 1 : 1

d) What percent of the offspring will have blonde hair and blue eyes? 0%