

OUTLINE 12

IV. Mendel's Work

D. The dihybrid cross

- 1. qualitative results**
- 2. quantitative results**

E. Summary of Mendel's Rules

V. Probability Theory and Patterns of Inheritance

A. Definitions

B. Rules for probability

- 1. independent outcomes**
- 2. the product rule**
- 3. single event; multiple outcomes**
- 4. the addition rule**

C. Application to the dihybrid cross

VI. Extensions of Mendel's Rules

Fig 14.2

A monohybrid cross

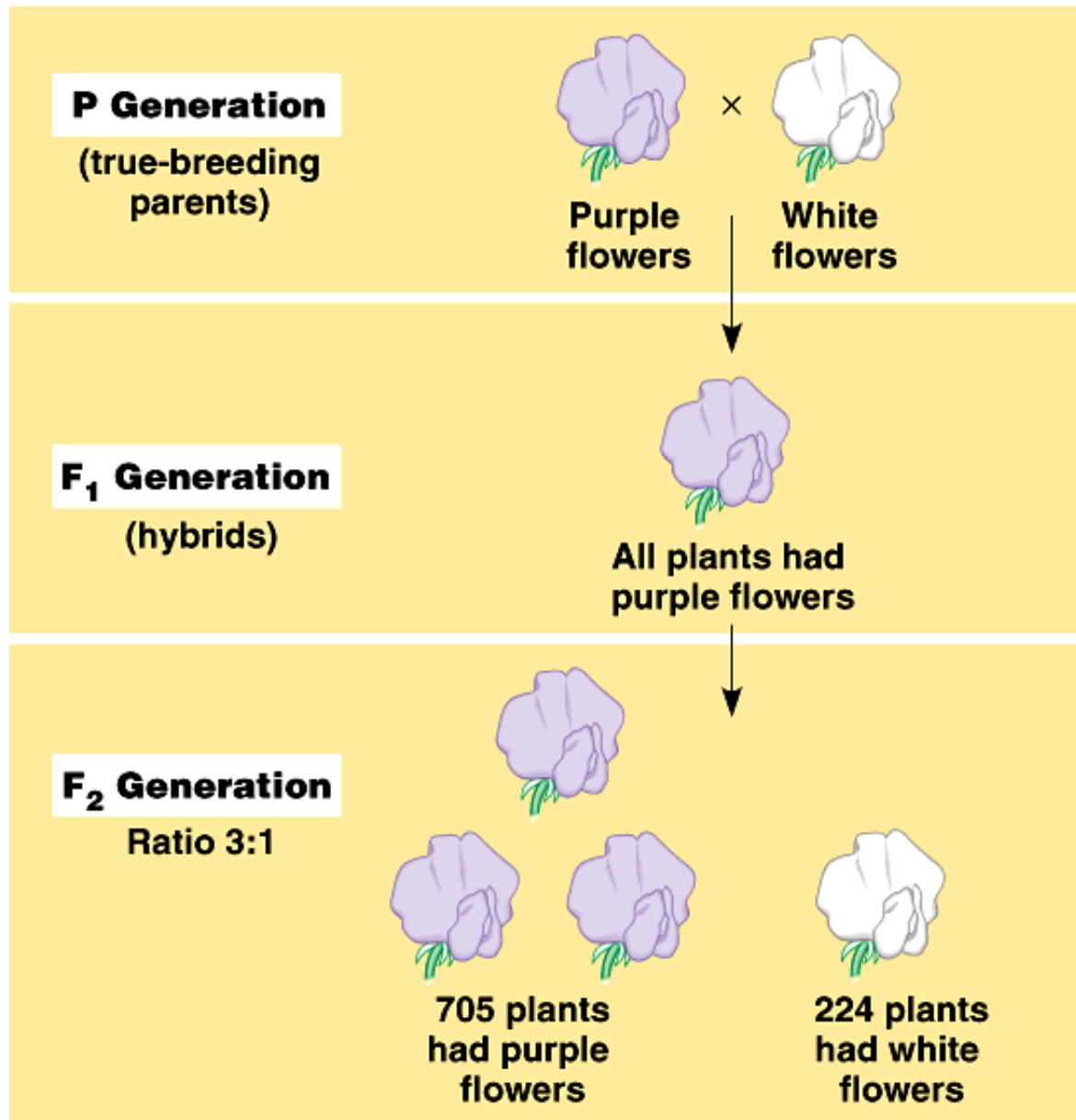
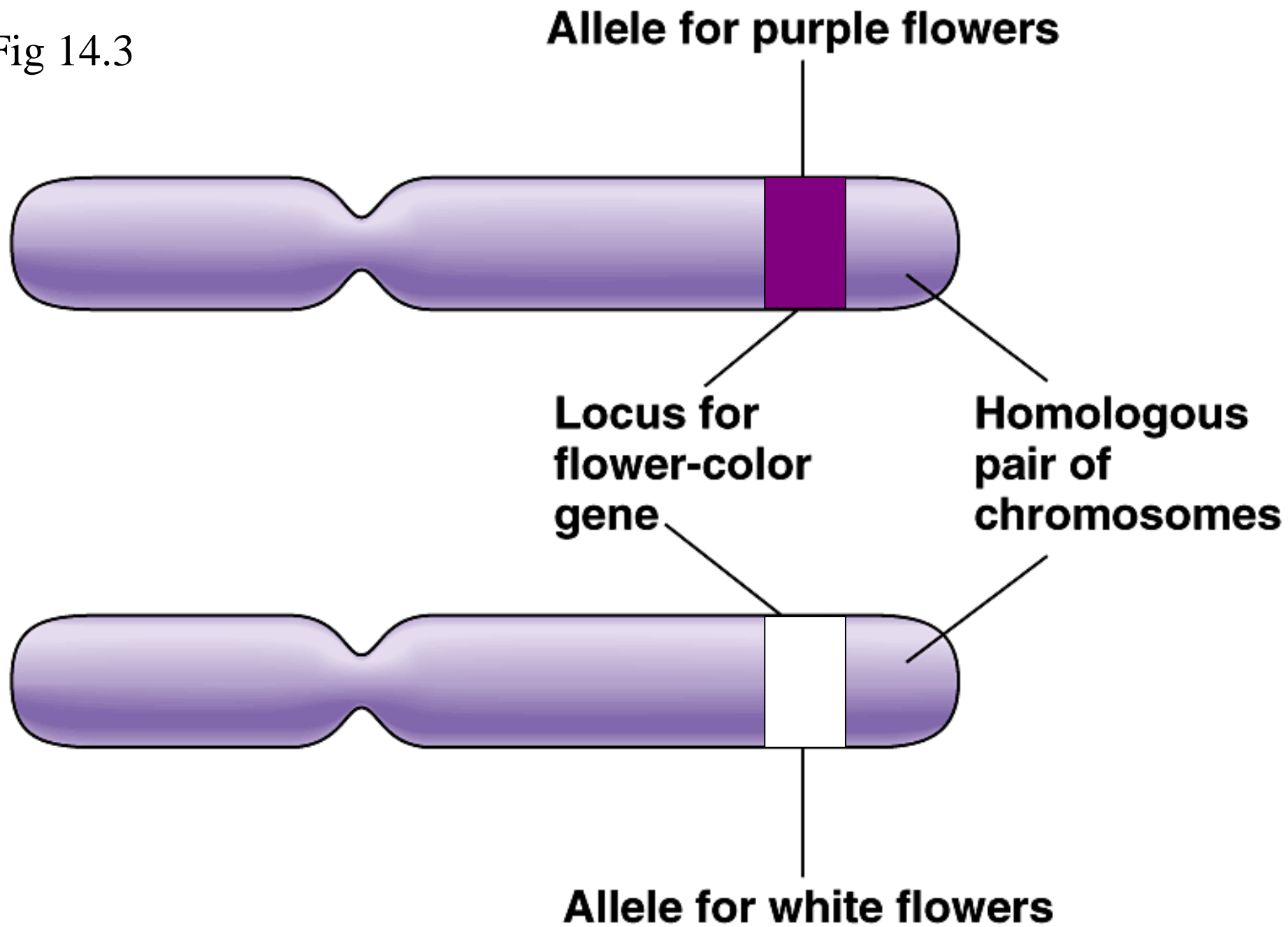
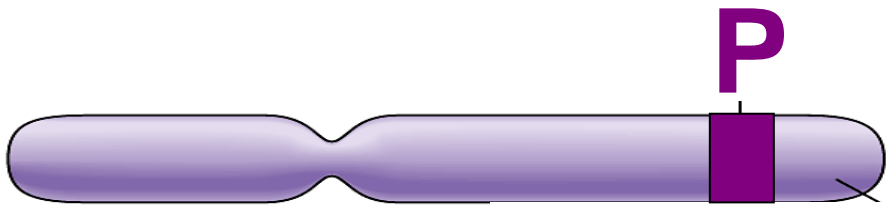
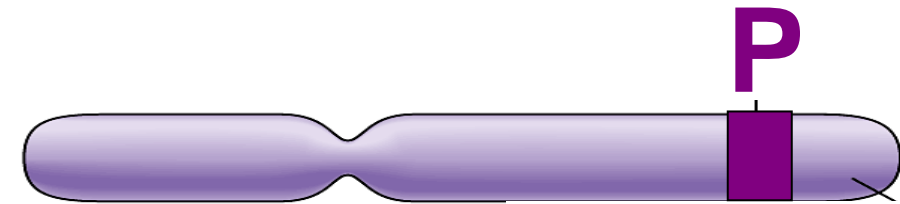
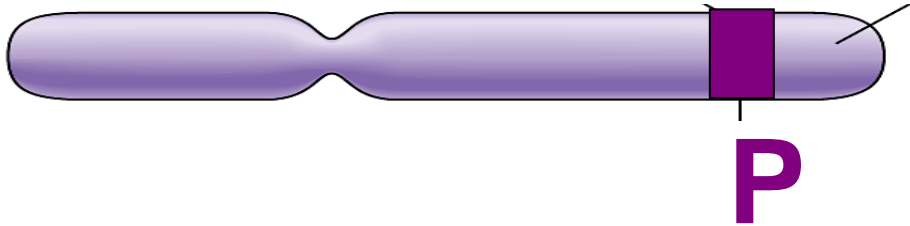


Fig 14.3

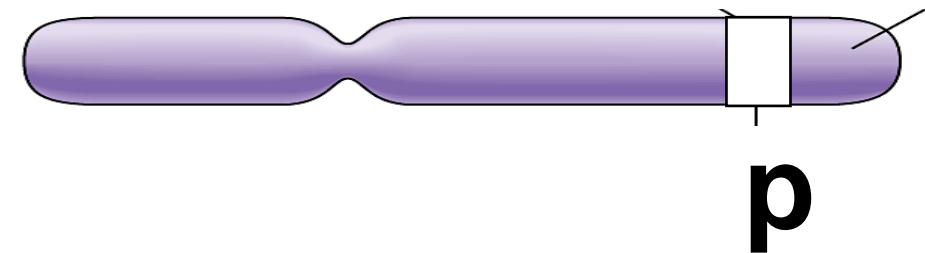


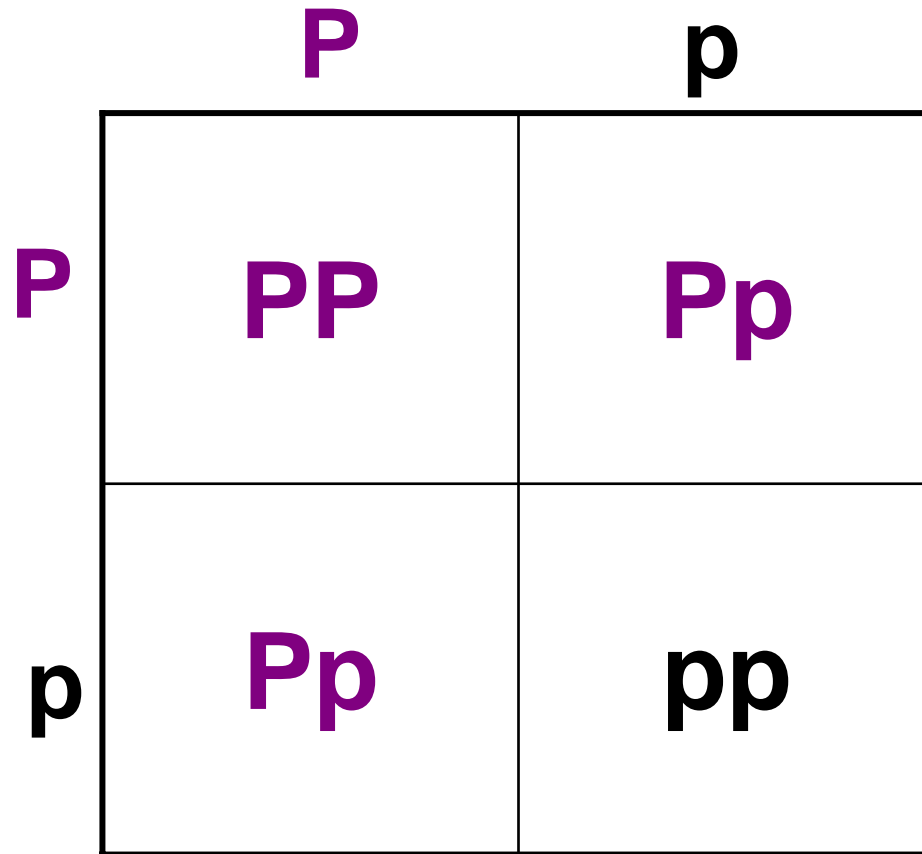


Homozygous



Heterozygous





Genotypes: PP, Pp, pp

genotype ratio: 1:2:1

Phenotypes: Purple, white

phenotype ratio: 3:1

Fig. 14.6

A Test Cross

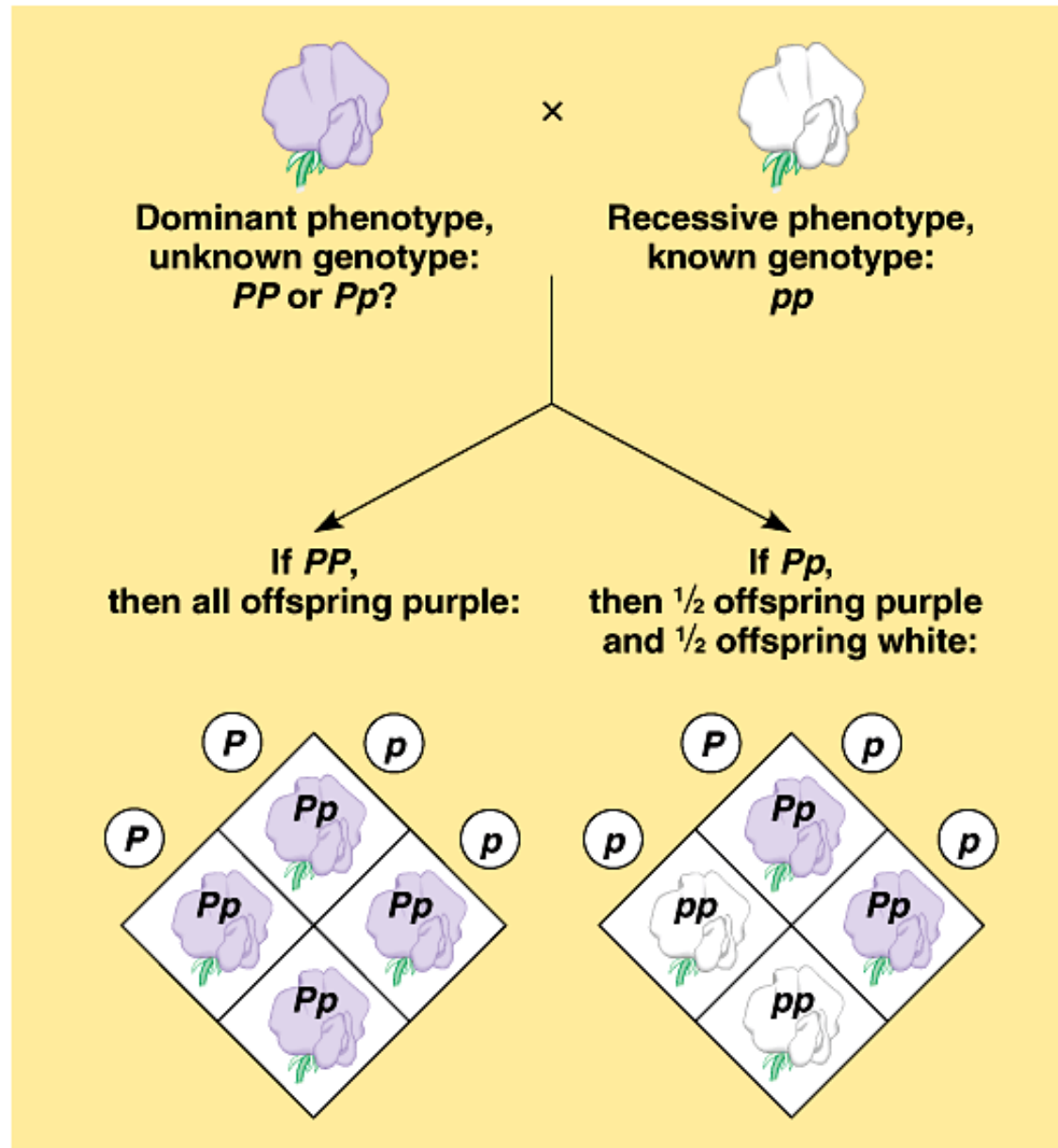


Table 14.1















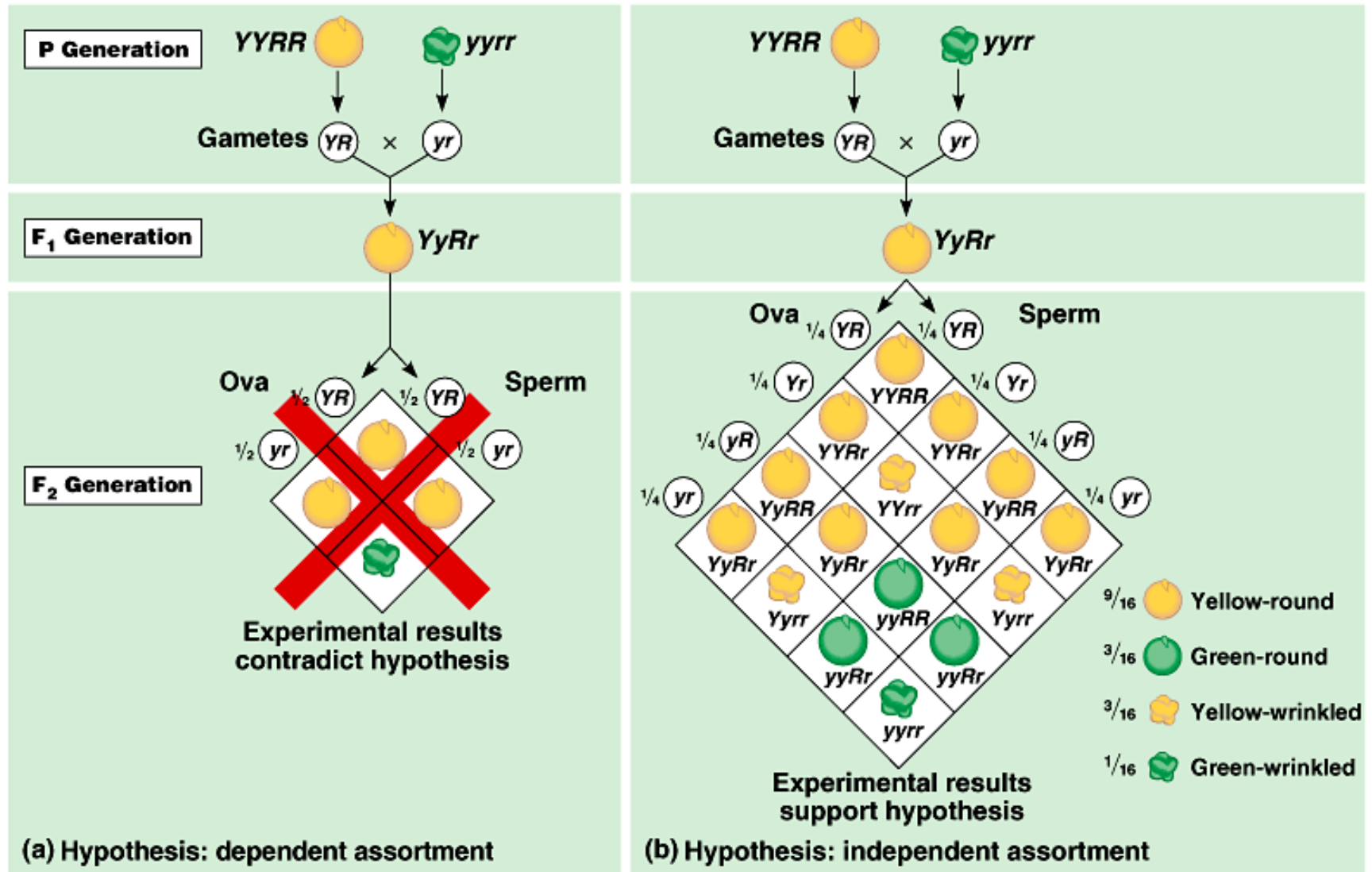
Table 14.1 The Results of Mendel's F ₁ Crosses for Seven Characters in Pea Plants					
Character	Dominant Trait	×	Recessive Trait	F ₂ Generation Dominant:Recessive	Ratio
Flower color	 Purple	×	 White	705:224	3.15:1
Flower position	 Axial	×	 Terminal	651:207	3.14:1
→ Seed color	 Yellow	×	 Green	6022:2001	3.01:1
→ Seed shape	 Round	×	 Wrinkled	5474:1850	2.96:1
Pod shape	 Inflated	×	 Constricted	882:299	2.95:1
Pod color	 Green	×	 Yellow	428:152	2.82:1
Stem length	 Tall	×	 Dwarf	787:277	2.84:1

Fig. 14.7 A Dihybrid Cross



Mendel's Laws (as he stated them)

Law of unit factors

“Inherited characters are controlled by discrete factors in pairs”

Law of segregation

“When gametes are formed, the factors segregate...and recombine in the next generation.”

Law of dominance:

“of the two factors controlling a trait, one may dominate the other.”

Law of independent assortment:

“one pair of factors can segregate from a second pair of factors.”

**When all outcomes of an event are equally likely,
the probability that a particular outcome will occur is
#ways to obtain that outcome / total # possible outcomes**

Examples:

In a coin toss $P[\text{heads}] = 1/2$ (or 0.5)

In tossing one die $P[2] = 1/6$

In tossing one die $P[\text{even \#}] = 3/6$

Drawing a card $P[\text{Queen of spades}] = 1/52$

The “AND” rule

Probability of observing event 1 AND event 2 =
the product of their independent probabilities.

Example:

Pr: 2 heads in 2 coin flips?



Probability of each head = $1/2$

Probability of 2 heads = $1/2 \times 1/2 = 1/4$

The “AND” rule

Probability of observing event 1 AND event 2 =
the product of their independent probabilities.

EXAMPLE

Throwing one red and one white die:

$$P[\text{red is 6}] = 1/6$$

$$P[\text{white is 2}] = 1/6$$

$$\text{So, } P[\text{red is 6 and white is 2}] = 1/6 * 1/6 = 1/36$$

The “OR” rule:

Probability of observing outcome 1 OR outcome 2 =
the **sum** of their independent probabilities.

Example:

Pr: a die will roll a 2 OR a 6?

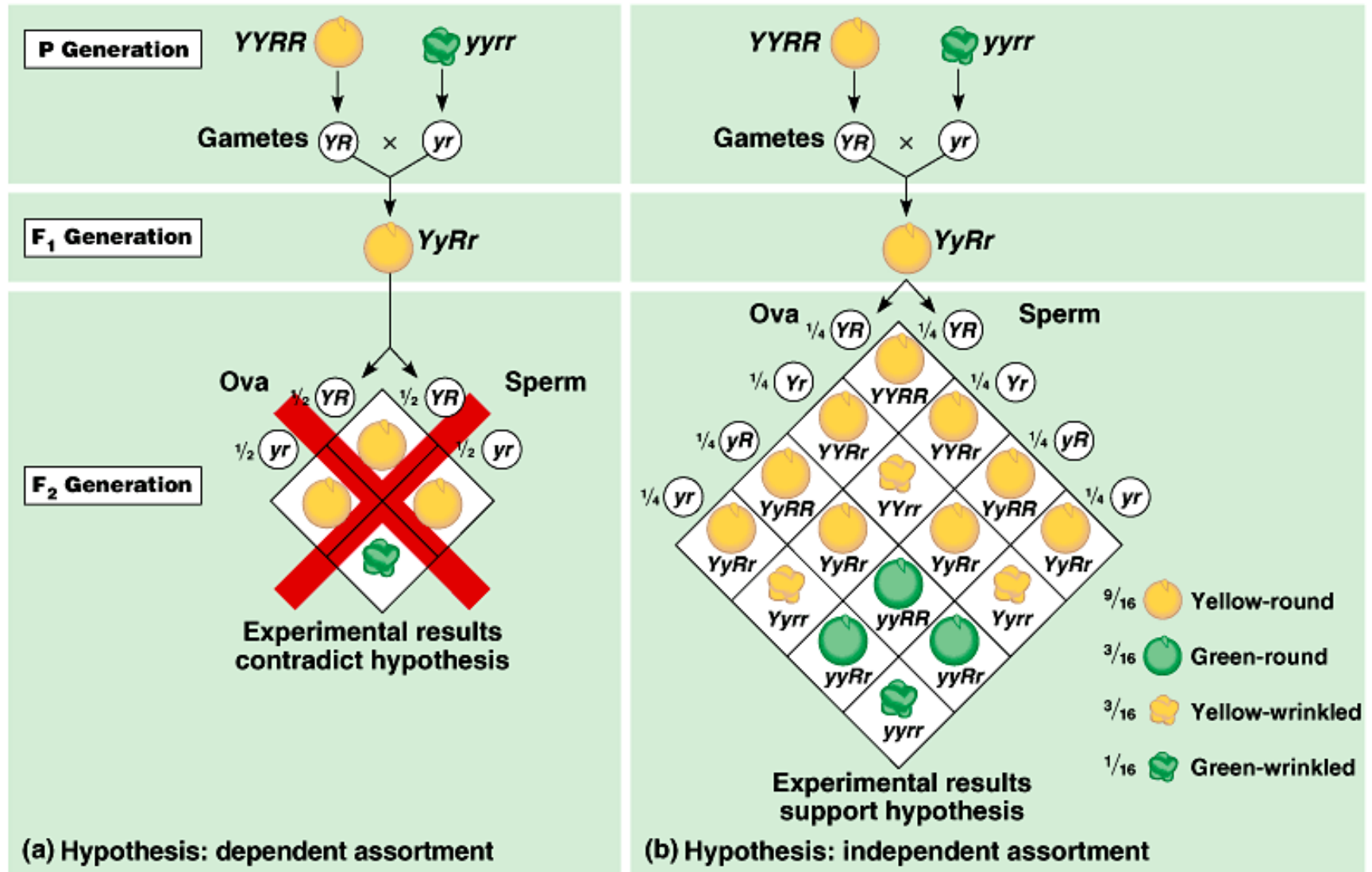
Probability of rolling 2 = $1/6$

Probability of rolling 6 = $1/6$

Probability of rolling 2 **or** 6 = $1/6 + 1/6 = 1/3$



Fig. 14.7 A Dihybrid Cross



RULES OF PROBABILITY

1. When all outcomes equally likely, the probability that a particular outcome will occur is

#ways to obtain that outcome / total # possible outcomes

2. The product rule = the "AND" rule

For 2 independent events, the probability of observing 2 particular outcomes (outcome 1 AND outcome 2) is the PRODUCT of their independent probabilities.

3. The addition rule = the "OR" rule

The probability of observing either one OR another outcome is equal to the SUM of their independent probabilities.

Application of Mendel's Rules assumes:

- 1. One allele completely dominates the other**
- 2. All genes have 2 allelic forms**
- 3. All traits are monogenic (affected by only one locus)**
- 4. All chromosomes occur in homologous pairs**
- 5. All genes assort independently**
- 6. An allele is completely expressed when either dominant or heterozygous**
- 7. Each trait is controlled by a different set of factors**