



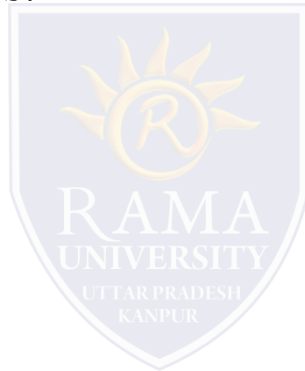
FACULTY OF ENGINEERING & TECHNOLOGY  
DEPARTMENT OF BIOTECHNOLOGY

# Mendel's Laws

- A scientific law is an evidence-based **description** of a natural phenomenon in a given set of circumstances.
- Mendel's three Laws of Heredity describe what Mendel observed in patterns of inherited traits.

- Monohybrid Cross

- Dihybrid Cross



## Hybrid

The offspring of parents that have different forms of a trait, such as tall and short

Monohybrid cross (*mono* = one)

The two parent plants differed by a single trait – height

P<sub>1</sub> – parent generation

F<sub>1</sub> – first generation

F<sub>2</sub> – second generation

## The First Generation

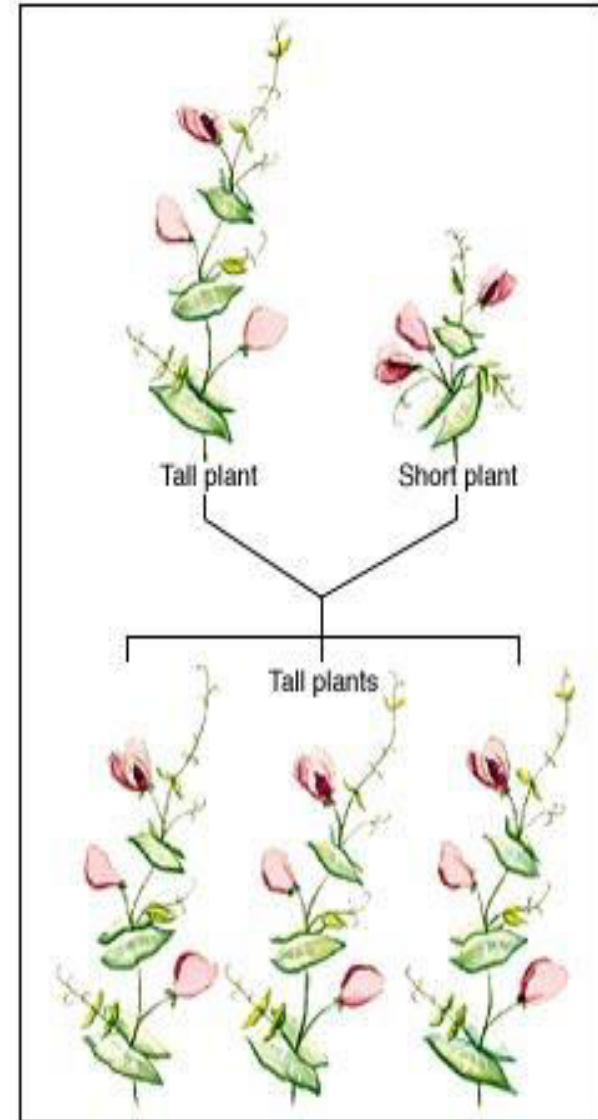
- Crossed 2 true breeding plants  
1 tall and 1 short
- All offspring of the 2 parent plants were tall

## The Second Generation

- Self-pollinated the plants from the first generation
- $\frac{3}{4}$  the offspring were as tall as the tall plants in the parent and first generation
- $\frac{1}{4}$  the offspring were as short as the short plant in the parent generation
- 3:1 ratio tall to short

## The rule of unit factors

- Each organism has 2 factors that control each of its traits
- These factors are genes
  - Genes exist in alternative forms called alleles  
Ex. Plant height – one allele is for tall and another is for short  
One comes from the mother and one from the father



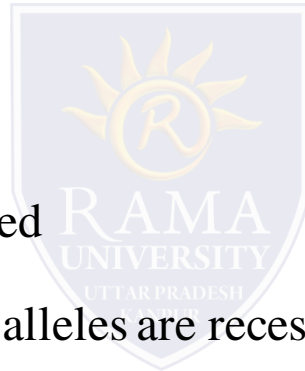
## The rule of dominance

- Each trait has an allele that will be observed more than the other
- Dominant (gene)

The observed trait  
Tall plant

- Recessive (gene)















The trait that disappeared  
Short plant  
Only shows when both alleles are recessive



- Recording the results for crosses
  - Dominate allele is always written first
  - Uppercase letter is used for dominate  
T – tall
  - Lowercase letter is used for recessive  
t – short

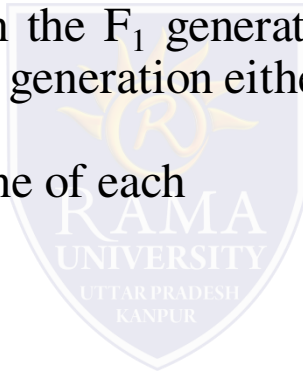
# Dominant and Recessive

Pea Traits Mendel Studied

	Seed form	Seed color	Pod form	Pod color	Flower position	Seed coat color	Stem length
Dominant	 Round ( <i>R</i> )	 Yellow ( <i>Y</i> )	 Inflated ( <i>V</i> )	 Green ( <i>G</i> )	 Axial ( <i>F</i> ) along stem	 Gray or gray-brown ( <i>A</i> )	 Tall ( <i>L</i> )
Recessive	 Wrinkled ( <i>r</i> )	 Green ( <i>y</i> )	 Restricted ( <i>v</i> )	 Yellow ( <i>g</i> )	 Terminal ( <i>f</i> ) on top	 White ( <i>a</i> )	 Short ( <i>l</i> )

## Law of segregation

- During fertilization, male and female gametes randomly pair to produce 3 combinations of alleles.
- Concluded that each plant in the  $F_1$  generation carried one dominant allele and one recessive allele and the  $F_2$  generation either received
- 2 dominant; 2 recessive; or one of each



# Phenotypes and Genotypes

- Two organisms can look alike but have different underlying gene combinations

- Phenotype

  - ✓ The way an organism looks or behaves

  - ✓ What you see

- Genotype

  - ✓ The gene combination an organism contains

  - ✓ The genetic makeup



- Homozygous

  - ✓ The two alleles for the trait are the **same**

  - ✓ TT or tt

- Heterozygous

  - ✓ The two alleles for the trait are **different**

  - ✓ Tt



# Dihybrid Crosses

## The First Generation

Two true breeding plants ( $P_1$ )

$RRYY$  = round yellow seed (homozygous dominant)

$rryy$  = wrinkled green seed (homozygous recessive)

When they were crossed all the plants had round yellow seeds ( $F_1$ )

## The Second Generation ( $F_2$ )

Self-pollinated plants from the first generation

Resulted in 9 round yellow, 3 round green, 3 wrinkled yellow, 1 wrinkled green A ratio of 9:3:3:1

Dihybrid Cross = round yellow X wrinkled green

	RY	RY	RY	RY
ry	RrYy	RrYy	RrYy	RrYy
ry	RrYy	RrYy	RrYy	RyYy
ry	RrYy	RrYy	RrYy	RrYy
ry	RrYy	RrYy	RrYy	RrYy

Heterozygous Cross = round yellow X round yellow

	RY	Ry	rY	ry
RY	RRYY	RRYy	RrYY	RrYy
Ry	RRYy	RRyy	RrYy	Rryy
rY	RrYY	RrYy	rrYY	rrYy
ry	RrYy	Rryy	rrYy	rryy