

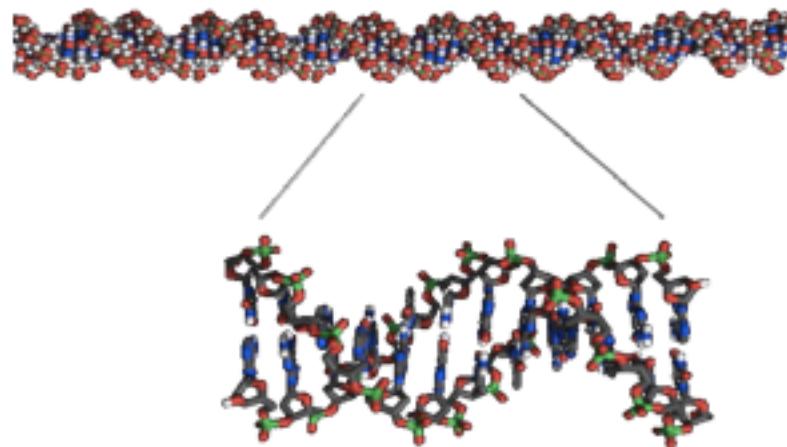


Mendelian Genetics

Life Science: Molecular

What is a gene?

- A **gene** is the chemical factor that determines traits.
- An **allele** is one of two or more forms of a specific gene.



Mendelian Genetics

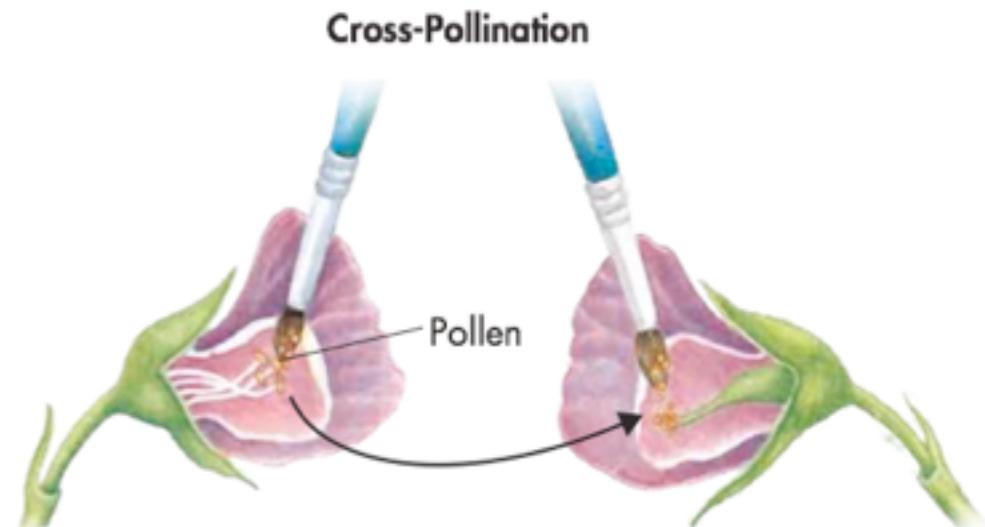
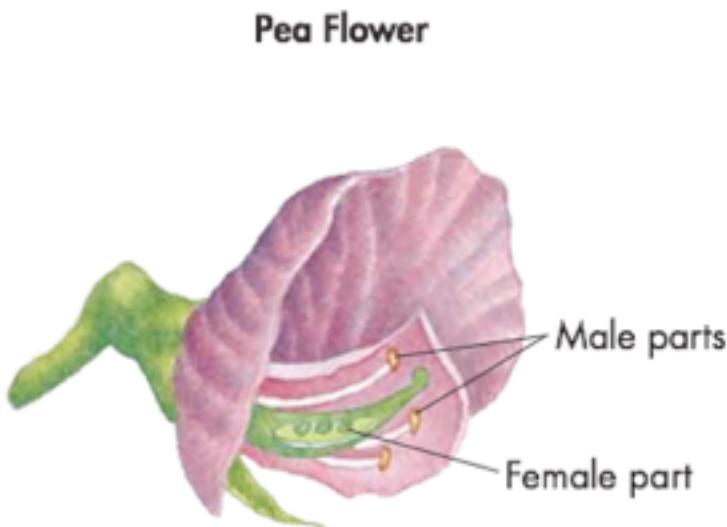
- The “Father of Genetics”
Gregor Mendel (1822-1884)
- An Augustinian monk teaching science in an Austrian monastery
- Experimented with peas in the garden of the monastery



“Modern genetics began in the 1860's with the experiments of an Augustinian monk named Gregor Mendel who discovered the fundamental principles of inheritance.”

- Robert Ridge Ph.D.

Mendel's Experiments





Mendel's Research

- Mendel crossed **purebred** pea plants with **opposing characters**:
 - Flower color (purple vs. white)
 - Pea color (green vs. yellow)
 - Pea texture (round vs. wrinkled), etc.

P

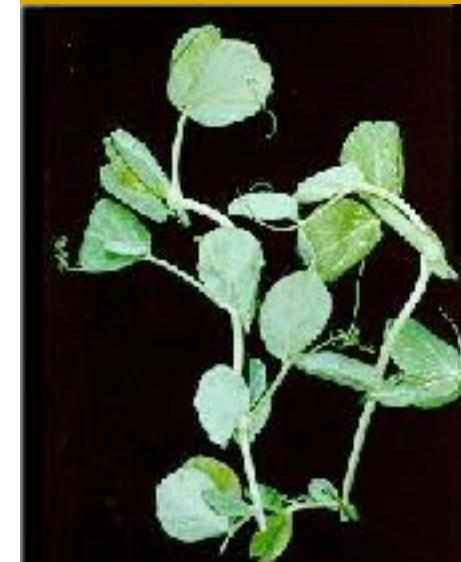


x



F₁

F₂



Pisum sativum
Garden Pea

Principle of Dominance

- The **principle of dominance** states that some alleles are dominant and others are recessive.
- **Dominant** is an allele that will always appear when it is present in an individual's genetic makeup.
- **Recessive** is an allele that will only show up when its matching allele is identical.



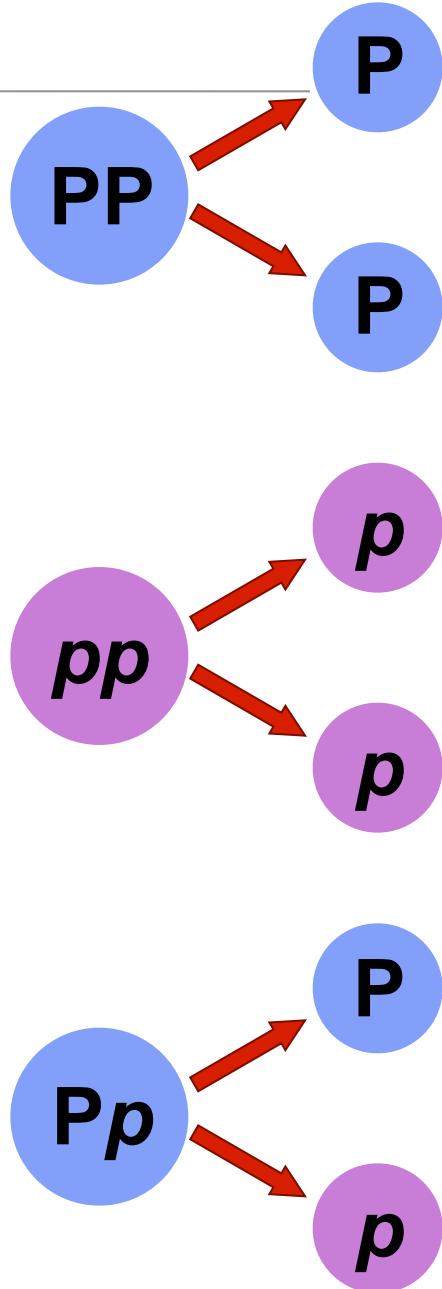
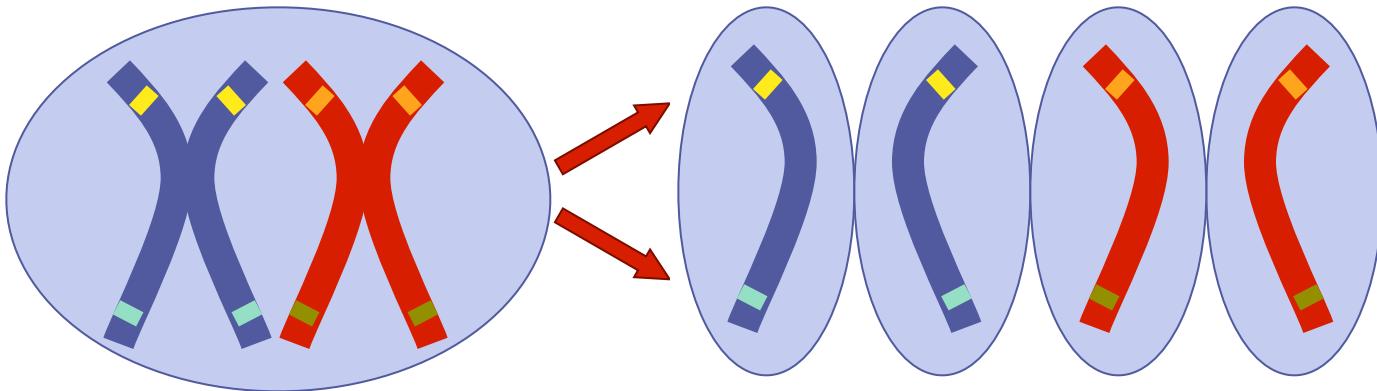
BB or Bb



bb

Mendel's 1st Law of Heredity

- **Law of segregation**
- Homologous chromosomes are randomly segregated into gametes.
 - Alleles don't blend.
 - One of two alleles is passed on in gametes.
 - Foundation of Punnett squares.



Reproductive Generations

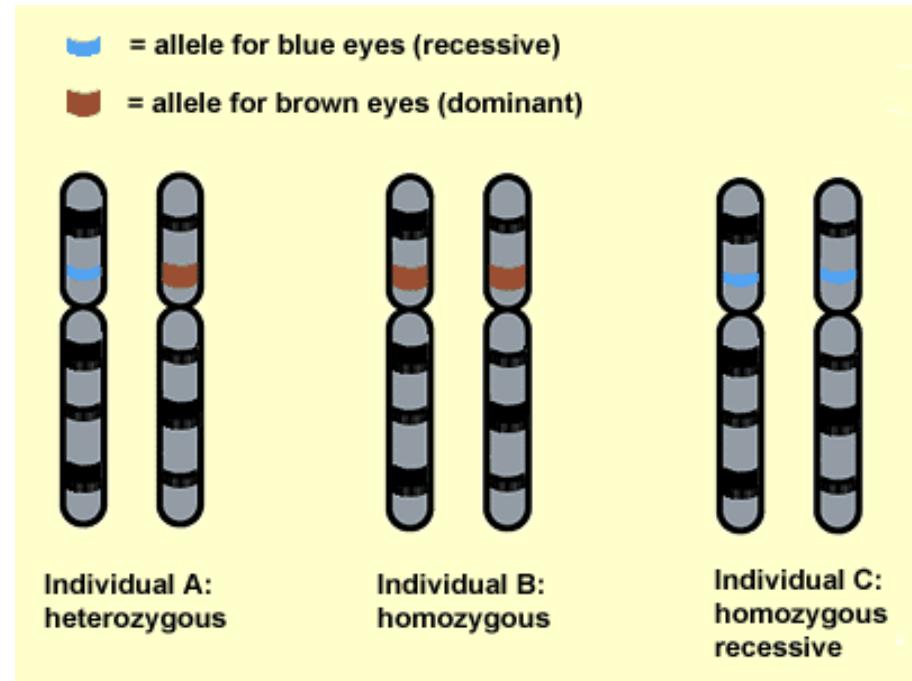
- P generation: Pure generation
- F₁ generation: Offspring from P generation.
- F₂ generation: Offspring from F₁ generation.

Homozygous (purebred) are organisms that always yield progeny with the same appearances for a certain trait.

Heterozygous (hybrid) are formed when true-breeding plants with opposing traits for the same characteristic are crossed.

Where are Genes?

- **Genes** are found on chromosomes.
- Every adult receives one copy of each chromosome from each parent.¹



¹ In the case of certain genetic disorders an adult may have more than two copies of a gene (e.g. Down Syndrome).

Genotype

The **genotype** is the specific combination of alleles an organism carries for a particular trait.

- **Homozygous** means two identical alleles for a trait.
Homozygous Dominant (TT)
Homozygous Recessive (tt)
- **Heterozygous** means two different alleles for a trait.
Heterozygous (Tt)

In this example **blue** represents paternal and **red** represents maternal homologs.

Phenotype

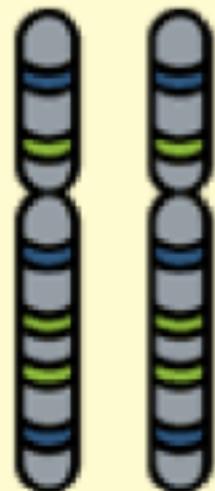
The **phenotype** is the physical (observable) characteristic of the organism based on the genotype.

- A **Homozygous Dominant** (TT) individual would have...
the phenotype of the dominant trait, rolling tongue.
- A **Homozygous Recessive** (tt) individual would have...
the phenotype of the recessive trait, non-rolling tongue.
- **Heterozygous** (Tt) individual would have...
the phenotype of the dominant trait, rolling tongue.

In this example **T** represents the rolling tongue characteristic and **t** represents the non-rolling characteristic.

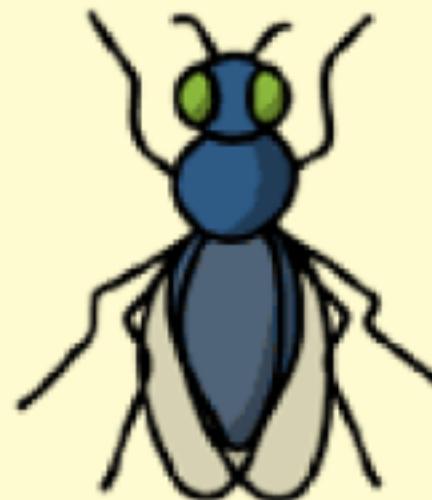
Genotype vs. Phenotype

genotype



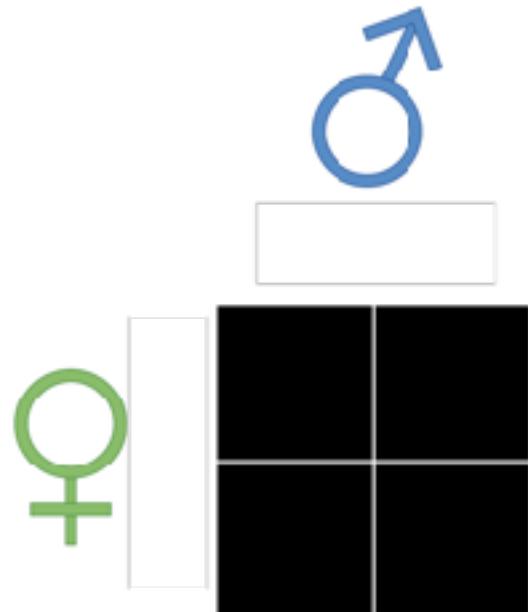
phenotype

codes for



Solving Mendelian Genetics

- A **Punnett square** is a bookkeeping tool for genetics.
- A Punnett square shows possible gene combinations from the sperm and egg.



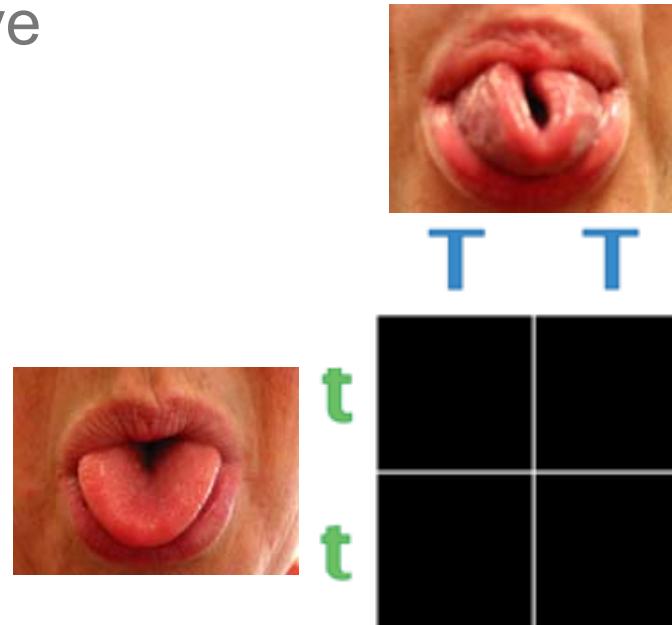
Solving Mendelian Genetics

- In this situation

Male - homozygous dominant

Female - homozygous recessive

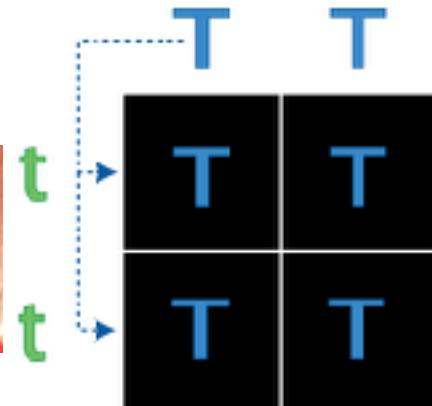
Cross: TT x tt



Father's Contribution

- The male passes on his alleles, one per gamete (reproductive cell).

Cross: $TT \times tt$



Mother's Contribution

- The female passes on her alleles, one per egg.
- Crossing these two parents yields all **Tt** offspring.
- 100% of the offspring show the dominant tongue-rolling trait.

Cross: **TT** x **tt**



T T



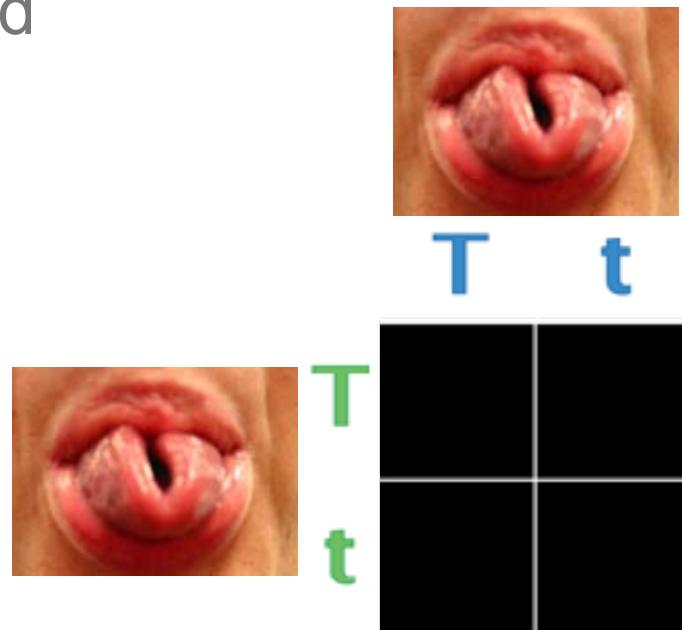
t	Tt	Tt
t	Tt	Tt

A Punnett square showing the results of a cross between a homozygous dominant parent (TT) and a homozygous recessive parent (tt). The top row and left column are labeled with the alleles: T (top) and t (left). All four resulting offspring are Tt, indicating they are all tongue-rollers. Two green arrows at the bottom indicate the presence of the trait in all offspring.

The Next Generation

- Crossing two pure individuals yields all heterozygous offspring. The result is called the **F₁** generation.
- Now, cross two individuals from the F₁ generation (Tt x Tt).

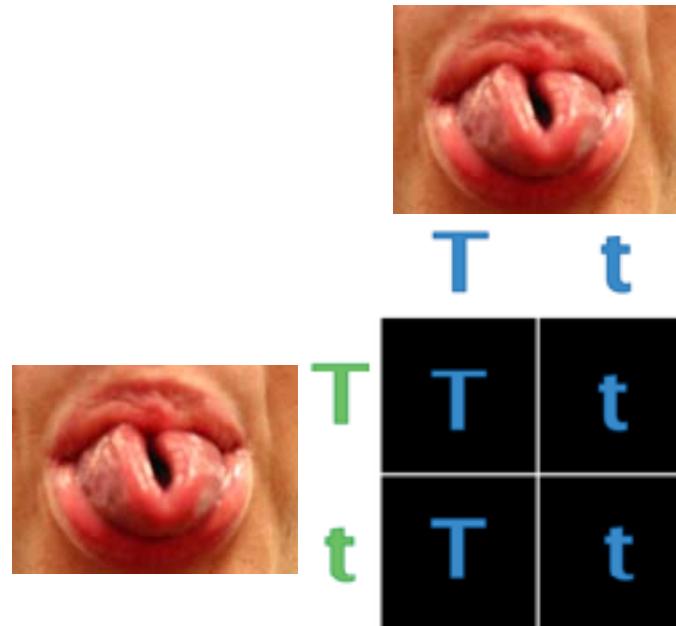
Cross: Tt x Tt



The Next Generation

- The male passes on his alleles, one per gamete.
- Each box represents one haploid sperm cell.

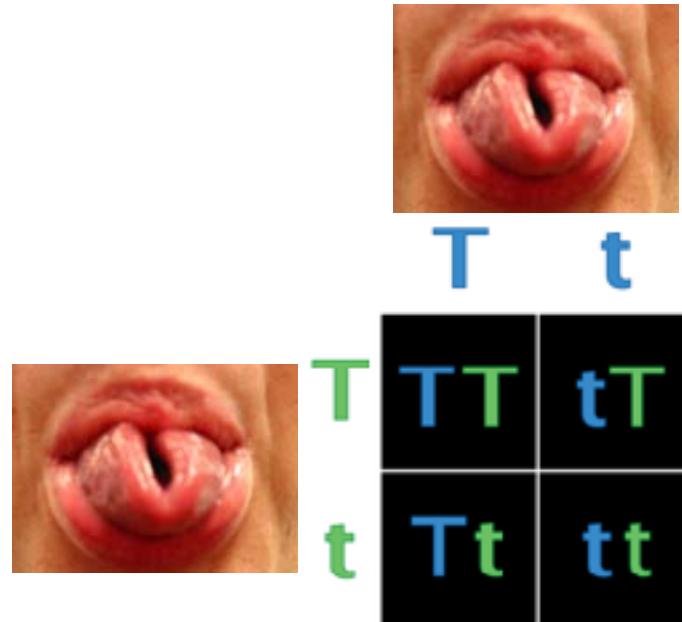
Cross: Tt x Tt



The Next Generation

- The female passes on her alleles, one per egg.

Cross: $Tt \times Tt$



Genotype Percentages

Cross: $Tt \times Tt$



	T	t
T	TT	tT
t	Tt	tt

Phenotype Percentages

Cross: $Tt \times Tt$



T t



T	TT	tT
t	Tt	tt