

Principles of Inheritance and Variation

Principles of Inheritance and Variation

- Have you ever wondered:
 - Why an elephant always gives birth to a baby elephant and not any other animal?
 - Why a mango seed always grows into a mango plant and not into any other species?
 - Why offspring sometimes resemble their parents or siblings, while at other times they look quite different?
- These observations raise important biological questions about how traits are passed from one generation to the next and why differences exist among individuals.
- These questions form the foundation of a branch of biology known as **Genetics**.

Introduction to Genetics

- Genetics is the scientific study of inheritance and variation.
- It explains how traits and characteristics are passed from parents to offspring and why individuals differ from each other.

Inheritance

- **Inheritance** is the process by which characteristics are passed from one generation to the next.
- It is the foundation of heredity, explaining why offspring resemble their parents.

Variation

- **Variation** refers to the differences observed among individuals of the same species.
- It is the degree to which offspring differ from their parents and from one another.
- Variations are essential for evolution and survival, as they create diversity within a population.

Historical Perspective

- Humans have long observed that sexual reproduction leads to variation.
- As early as **8000–1000 B.C.**, humans recognized that certain traits could be inherited and used this knowledge for:
 - Selective breeding of plants and animals
 - Domestication of wild species to produce desirable characteristics
- For example:
 - Early humans noticed desirable traits in wild plants and animals and began to selectively breed individuals to enhance those traits.

- This practice led to the development of improved varieties through **artificial selection** and **domestication**.

Example of Artificial Selection

- A classic example of artificial selection is the development of Indian cattle breeds.
- The Sahiwal cow of Punjab, known for its high milk production, was selectively bred from ancestral wild cattle.
- Such practices were based on observation and experience, even though the scientific mechanisms were unknown at the time.

Mendel's Laws of Inheritance

Introduction to Mendel's Work

- The scientific understanding of inheritance made significant progress in the mid-nineteenth century, largely due to the pioneering work of **Gregor Mendel**, known as the "Father of Genetics."
- Between **1856 and 1863**, Mendel conducted extensive hybridisation experiments on garden pea plants (*Pisum sativum*), which led him to propose the laws of inheritance in living organisms.

Significance of Mendel's Work

- Mendel was the **first biologist** to apply statistical analysis and mathematical logic to biological problems.
- His experiments involved:
 - A large sample size, enhancing the reliability of the results.
 - Successive generations of plants, confirming that the inheritance patterns he observed were repeatable and consistent.

Selection of Experimental Organism

- Mendel selected the **garden pea** due to its:
 - Easily distinguishable traits
 - Ability to self-pollinate and be cross-pollinated manually
 - Short life cycle and production of numerous seeds

True-Breeding Pea Lines

- Mendel used **true-breeding lines** — those that consistently produced offspring with the same traits after continuous self-pollination over generations.
- He selected 14 true-breeding pea plant varieties, each differing in one specific character with two contrasting traits.

- This allowed him to clearly observe how traits were inherited over generations

Mendel's Methodology

- Mendel conducted artificial pollination (cross-pollination) between plants with contrasting traits.
- By carefully observing the resulting generations (F_1 and F_2), he formulated the foundational principles of heredity.

Examples of Contrasting Traits Studied by Mendel

- Mendel focused on **seven characters**, each with two clearly contrasting traits:

Character	Dominant trait	Recessive trait
Seed shape	 Round	 Wrinkled
Seed colour	 Yellow	 Green
Flower colour	 Violet	 White
Pod shape	 Full	 Constricted
Pod colour	 Green	 Yellow
Flower position	 Axial	 Terminal
Stem height	 Tall	 Dwarf

Seven pairs of contrasting traits in pea plant studied by Mendel

S.No.	Character	Contrasting Traits
1	Stem height	Tall / Dwarf
2	Flower colour	Violet / White
3	Flower position	Axial / Terminal

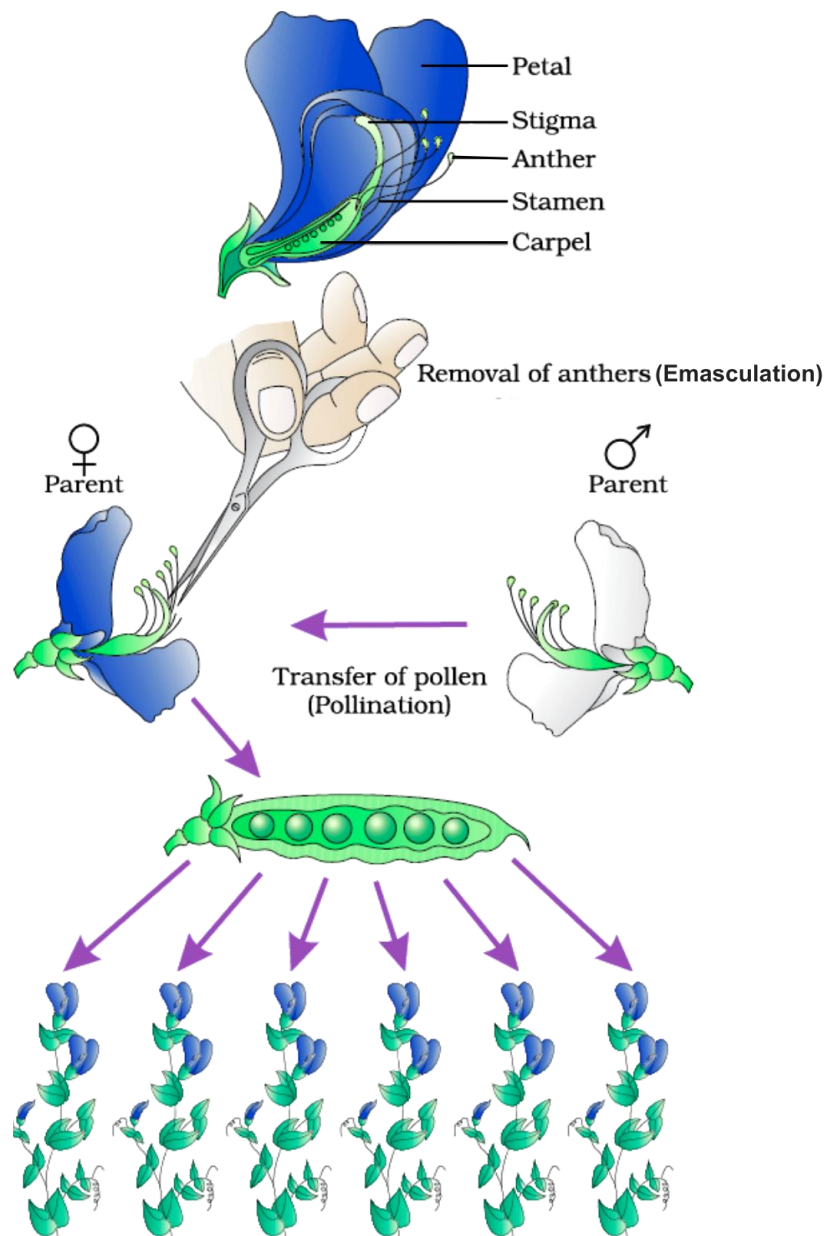
4	Pod shape	Inflated / Constricted
5	Pod colour	Green / Yellow
6	Seed shape	Round / Wrinkled
7	Seed colour	Yellow / Green

- By studying traits with two opposing expressions (e.g., tall vs. dwarf, round vs. wrinkled), Mendel established a **basic framework of genetic rules**.
- His findings provided a foundation for modern genetics and were later expanded to explain the **complexities** observed in natural inheritance.

Inheritance of One Gene

Mendel's Monohybrid Cross Experiment

- Mendel conducted hybridisation experiments by crossing **tall and dwarf pea plants** to study the inheritance of a single gene (monohybrid cross).
- The seeds produced from this cross were sown to raise the first hybrid generation, called the **F₁ generation (Filial 1)**.



Steps in making a cross in pea

Observations in the F₁ Generation

- All F₁ progeny were tall, resembling one of the parent types.
- The **dwarf** trait was not expressed in any F₁ plant.
- Similar results were seen with other contrasting traits: only one parental trait appeared in F₁, while the other was absent.



FREE PREVIEW

[Click here to visit our website](#)

SCHOOL NOTES & NCERT SOLUTIONS

Complete notes and
NCERT solutions are
available on
FirstHope app only.



[Scan or click here](#)

Click here to get the app



Available on Google Play

JOIN THE FIRSTHOPE COMMUNITY

Join our Telegram channel

Click here to join Telegram



[Scan or click here](#)

@FirstHope_CBSE_Notes

Instagram

@firsthope.school

[Click here to follow >](#)

YouTube channel

@firsthope.school

[Click here to watch >](#)

FirstHope website

firsthope.co.in

[Click here to visit our website >](#)

CBSE / Class 9 / Class 10 / Class 11 / Class 12

Preview notes and NCERT solutions. Full PDFs in the FirstHope app.