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CHAPTER NOTES

Heredity Class 10 Notes | CBSE Chapter 8 Science

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Heredity Class 10 Notes | CBSE Chapter 8 Science

Heredity is Chapter 8 of CBSE Class 10 Science. This chapter explains how traits are passed from parents to offspring, the rules of inheritance discovered by Gregor Mendel, how sex is determined in humans, and the basics of evolution. Understanding heredity helps explain why children resemble their parents yet are not identical to them.

This chapter carries 5–8 marks in board exams. Mendel's experiments, monohybrid and dihybrid crosses, sex determination, and the difference between acquired and inherited traits are the most frequently tested topics.

Key Concepts

1. Heredity and Variation

Heredity is the transmission of characters (traits) from parents to offspring. **Variation** is the difference in characters between individuals of the same species.

- Offspring inherit traits from both parents (in sexual reproduction)
- No two offspring are exactly alike — variations arise due to different combinations of parental genes
- Inherited traits are coded in **DNA**, organised into units called **genes**

Inherited Traits vs Acquired Traits

Inherited Traits	Acquired Traits
Present from birth, coded in DNA	Developed during lifetime due to environment or practice
Can be passed to offspring	Cannot be passed to offspring
Example: eye colour, blood group, attached/free earlobes	Example: muscular body from exercise, knowledge from studying, scars

Key point: Only changes in the DNA of reproductive cells (germ cells) can be inherited. Changes in body cells (somatic cells) — like a scar or a learned skill — are NOT passed to the next generation.

2. Mendel's Experiments

Gregor Johann Mendel (1822–1884), an Austrian monk, is known as the “Father of Genetics”. He performed breeding experiments on **garden pea plants (*Pisum sativum*)** and discovered the fundamental laws of inheritance.

Why Pea Plants?

- Short generation time (grows and reproduces quickly)
- Many easily distinguishable contrasting traits
- Self-pollinating (but can be cross-pollinated manually)
- Large number of offspring produced

Seven Contrasting Traits Mendel Studied

Trait	Dominant	Recessive
Seed shape	Round	Wrinkled
Seed colour	Yellow	Green
Flower colour	Violet	White
Pod shape	Inflated	Constricted
Pod colour	Green	Yellow
Flower position	Axial	Terminal
Plant height	Tall	Dwarf

3. Monohybrid Cross (One Trait at a Time)

Mendel crossed a **pure tall plant (TT)** with a **pure dwarf plant (tt)**.

F₁ generation (First filial generation):

- ALL plants were **tall**
- This means the tall trait is **dominant** and the dwarf trait is **recessive**
- F₁ plants are genotype **Tt** (heterozygous) — they carry both alleles but only tall appears

F₂ generation (F₁ × F₁ cross — Tt × Tt):

	T	t
T	TT (Tall)	Tt (Tall)
t	Tt (Tall)	tt (Dwarf)

Results:

- **Phenotypic ratio:** 3 Tall : 1 Dwarf (3:1)
- **Genotypic ratio:** 1 TT : 2 Tt : 1 tt (1:2:1)

- The dwarf trait reappeared in F_2 — it was hidden (not lost) in F_1

Key Terms

Term	Meaning
Gene	Unit of inheritance; a segment of DNA that codes for a specific protein/trait
Allele	Different forms of the same gene (e.g., T for tall, t for dwarf)
Dominant	Allele that expresses itself even in heterozygous condition (e.g., T)
Recessive	Allele that is masked in heterozygous condition; shows only in homozygous state (e.g., tt)
Homozygous	Both alleles same (TT or tt)
Heterozygous	Alleles different (Tt) — also called hybrid
Genotype	Genetic makeup (e.g., TT, Tt, tt)
Phenotype	Physical appearance (e.g., tall or dwarf)

4. Dihybrid Cross (Two Traits at a Time)

Mendel crossed pea plants with **round yellow seeds (RRYY)** × **wrinkled green seeds (rryy)**.

F_1 generation: All plants had **round yellow seeds (RrYy)** — both dominant traits appeared.

F_2 generation ($F_1 \times F_1$): Four types of offspring appeared:

Phenotype	Ratio
Round Yellow	9
Round Green	3
Wrinkled Yellow	3
Wrinkled Green	1

F_2 phenotypic ratio: 9:3:3:1

Key conclusion: The two traits (seed shape and seed colour) are inherited **independently** of each other. This is Mendel's **Law of Independent Assortment**.

New combinations appeared (round green, wrinkled yellow) that were not present in either parent — showing that genes for different traits are sorted independently during gamete formation.

5. How Do Traits Get Expressed?

The pathway from gene to trait:

1. A **gene** (segment of DNA) provides the instruction
2. The gene codes for a specific **protein** (enzyme or structural protein)
3. The protein controls a specific **biochemical process**
4. The process determines the **trait** (observable characteristic)

Example: The gene for plant height codes for an enzyme that produces a growth hormone. If the gene is functional (T), the plant grows tall. If the gene is altered (t), less hormone is produced, and the plant is dwarf.

Important: Both parents contribute one copy of each gene. So every individual has **two alleles** for each trait — one from the father, one from the mother.

- Humans have 23 pairs of chromosomes (46 total) — 23 from each parent
 - Each chromosome carries many genes
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6. Sex Determination

Sex Determination in Humans

Humans have **23 pairs of chromosomes** — 22 pairs are **autosomes** (same in males and females) and 1 pair is **sex chromosomes**.

- **Females:** XX (two X chromosomes)
- **Males:** XY (one X and one Y chromosome)

How sex is determined:

- All eggs from the mother carry one **X** chromosome
- Sperm from the father carry either **X** or **Y**
- If X-sperm fertilises the egg → XX → **Girl**
- If Y-sperm fertilises the egg → XY → **Boy**

	X (from mother)	X (from mother)
X (from father)	XX (Girl)	XX (Girl)
Y (from father)	XY (Boy)	XY (Boy)

Key point: The sex of the child is determined by the **father's sperm** (whether it carries X or Y), not the mother. There is a 50:50 chance of having a boy or girl.

7. Evolution — Brief Overview

Accumulation of Variations

Sexual reproduction creates variations in each generation. Over thousands of generations, these variations accumulate. If a variation gives a survival advantage in a particular environment, organisms with that variation reproduce more — this is **natural selection** (proposed by Charles Darwin).

Speciation

When populations of a species become **geographically isolated** (separated by a mountain, river, etc.), they cannot interbreed. Over time, they accumulate different variations and eventually become so different that they form new species — this is called **speciation**.

Evolution vs Progress

Evolution is NOT progress from “lower” to “higher” organisms. It is simply the accumulation of changes that help organisms survive in their specific environment. Bacteria are not “less evolved” than humans — they are perfectly adapted to their niche.

Important Definitions

Term	Definition
Heredity	Transmission of traits from parents to offspring
Variation	Differences in traits among individuals of the same species
Gene	Unit of inheritance; segment of DNA coding for a protein/trait
Allele	Alternative forms of the same gene (e.g., T and t)
Dominant trait	Trait that appears in heterozygous condition
Recessive trait	Trait that is masked in heterozygous condition; appears only in homozygous state
Genotype	Genetic constitution of an organism (e.g., Tt)
Phenotype	Observable characteristic/physical appearance (e.g., tall)
Homozygous	Having two identical alleles for a trait (TT or tt)
Heterozygous	Having two different alleles for a trait (Tt)
Monohybrid cross	Cross between organisms considering only one contrasting trait
Dihybrid cross	Cross between organisms considering two contrasting traits simultaneously
Sex chromosomes	Chromosomes that determine the sex of an individual (X and Y in humans)
Natural selection	Process where organisms with advantageous traits survive and reproduce more
Speciation	Formation of new species due to geographical isolation and accumulated variations

Solved Examples (NCERT-Based)

Example 1

A man with blood group A marries a woman with blood group O. Can they have a child with blood group O?

Answer: Yes, it is possible. Blood group A can be genotype $I^A I^A$ (homozygous) or $I^A i$ (heterozygous). Blood group O is always ii . If the father is $I^A i$ (heterozygous A), then the cross $I^A i \times ii$ gives: $I^A i$ (blood group A) and ii (blood group O) in a 1:1 ratio. So yes, they can have a child with blood group O if the father is heterozygous.

Example 2

In a monohybrid cross between tall (Tt) and dwarf (tt) pea plants, what will be the phenotypic ratio of the offspring?

Answer: Cross: $Tt \times tt$. Using a Punnett square: $Tt, Tt, tt, tt \rightarrow 2 \text{ Tall } (Tt) : 2 \text{ Dwarf } (tt) \rightarrow \mathbf{1:1 \text{ ratio}}$. This is a test cross — used to determine if a tall plant is TT or Tt .

Example 3

How is the sex of the child determined in humans? Is it correct to blame the mother for giving birth to a girl?

Answer: No, it is absolutely incorrect to blame the mother. The sex of a child depends entirely on which type of sperm (from the father) fertilises the egg. The mother always contributes an X chromosome. If the father's sperm carrying an X chromosome fertilises the egg, the child is XX (girl). If the Y-bearing sperm fertilises the egg, the child is XY (boy). The probability is 50:50, and the mother has no role in determining sex.

Example 4

If a round, yellow-seeded pea plant ($RrYy$) is crossed with a wrinkled, green-seeded pea plant ($rryy$), what will be the ratio of offspring phenotypes?

Answer: The gametes of $RrYy$ are: RY, Ry, rY, ry . The gametes of $rryy$ are: ry only. The offspring will be: $RrYy$ (round yellow), $Rryy$ (round green), $rrYy$ (wrinkled yellow), $rryy$ (wrinkled green) — in equal proportions. **Phenotypic ratio: 1:1:1:1.**

Important Questions for Board Exams

1-Mark Questions

1. What are genes?
2. Name the plant Mendel used for his experiments.
3. What is the phenotypic ratio of a monohybrid cross in F_2 generation?
4. Who determines the sex of a child — the father or the mother?
5. What is an allele?

2-Mark Questions

1. Distinguish between dominant and recessive traits with an example.
2. What is the difference between genotype and phenotype?
3. Why did Mendel choose pea plants for his experiments? Give two reasons.
4. What are inherited traits? Give two examples.
5. Differentiate between homozygous and heterozygous organisms.

3-Mark Questions

1. Explain Mendel's monohybrid cross with the help of a Punnett square. State the phenotypic and genotypic ratios in the F_2 generation.
2. How is sex determined in human beings? Explain with a diagram.
3. Explain the Law of Independent Assortment using a dihybrid cross.
4. Distinguish between acquired traits and inherited traits. Why are acquired traits not passed to the next generation?
5. How do traits get expressed from genes? Explain the pathway.

5-Mark Questions

1. Describe Mendel's dihybrid cross experiment. Show the F_2 generation results with a checkerboard (Punnett square). What law did Mendel deduce from this experiment?
 2. What is heredity? Explain with the help of Mendel's monohybrid cross how traits are inherited from one generation to the next.
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Quick Revision Points

- Heredity = passing traits from parents to offspring; coded in genes (DNA segments)
 - Acquired traits (scars, muscles from exercise) cannot be inherited — only DNA changes in germ cells are inheritable
 - Mendel used pea plants; studied 7 contrasting traits
 - Monohybrid cross F_2 ratio: 3:1 (phenotypic), 1:2:1 (genotypic)
 - Dominant trait masks recessive in heterozygous condition (Tt appears tall)
 - Dihybrid cross F_2 ratio: 9:3:3:1 → Law of Independent Assortment
 - Gene → Protein → Biochemical process → Trait (expression pathway)
 - Sex determination: XX = Female, XY = Male; father's sperm decides sex (X or Y)
 - 50:50 chance of boy or girl — mother is NOT responsible for child's sex
 - Humans: 23 pairs chromosomes (22 autosomes + 1 pair sex chromosomes)
 - Evolution = accumulation of variations + natural selection; NOT "lower" to "higher"
 - Speciation = new species from geographically isolated populations
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Previous Chapter: Chapter 7 — How do Organisms Reproduce?

Next Chapter: Chapter 9 — Light: Reflection and Refraction



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