KECUDO

PREMIUM
II
EDITION

HIGH SCHOOL BIOLOGY

Class 2

Genetics & Heredity

From DNA to traits — Mendel's peas, Punnett squares, protein synthesis and mutations, with a 25-question self-assessment

2026 EDITION · SCIENCE SERIES

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FOUNDATION

Chapter 1 · The instruction manual

DNA: the Molecule of Heredity

Every cell in your body carries the same instruction manual, written in a four-letter chemical alphabet. That manual is **DNA** — deoxyribonucleic acid — and it is passed from parents to children.

DNA is a polymer of **nucleotides**. Each nucleotide has three parts: a **phosphate**, a sugar called **deoxyribose**, and one of four **bases**: adenine (A), thymine (T), guanine (G) or cytosine (C).

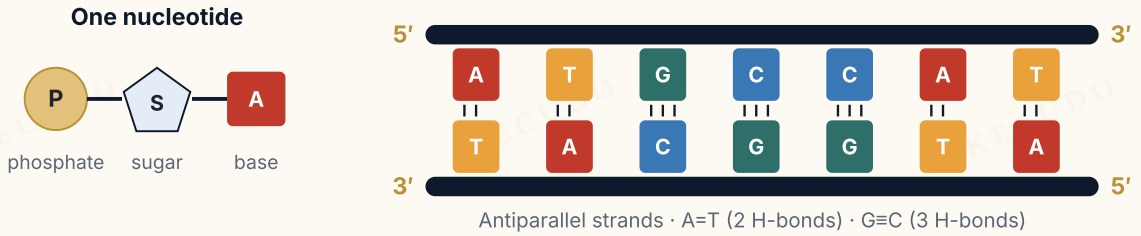


FIG 1.1 A nucleotide, and how two strands pair to form DNA

Feature	What it means
Double helix	Two strands twisted around each other like a spiral staircase
Backbone	Alternating sugar and phosphate — the “handrails”
Base pairs	A pairs with T, G pairs with C — the “steps” (recall Chargaff’s rules, Class 1)
Antiparallel	One strand runs 5′→3′, its partner 3′→5′

Purines and pyrimidines. A and G are larger, two-ring *purines*; T and C are one-ring *pyrimidines*. Every rung pairs one of each, so the helix has an even width.

How we found out DNA is the genetic material

Until the 1940s most scientists thought genes were made of protein, because proteins are far more varied. A chain of clever experiments proved otherwise.

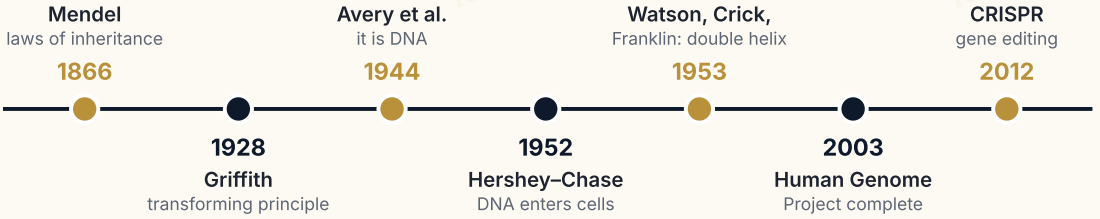


FIG 1.2 How we learned that DNA carries heredity

Experiment	What they did	What it showed
Griffith (1928)	Heat-killed deadly bacteria turned harmless bacteria deadly	A “transforming principle” can pass between cells
Avery, MacLeod & McCarty (1944)	Destroyed protein, RNA or DNA in the extract one at a time	Only destroying DNA stopped transformation
Hershey & Chase (1952)	Labelled virus DNA with radioactive P and protein with S	Only DNA entered the bacteria
Franklin; Watson & Crick (1952–53)	X-ray image (“Photo 51”) and model building	DNA is a double helix

Bio Lab · Strawberry DNA

Maya mashed strawberries with dish soap (breaks membranes) and salt (clumps DNA), filtered the mush, then layered ice-cold alcohol on top. White strands rose into the alcohol: millions of DNA molecules clumped together. Cultivated strawberries are **octoploid** — eight copies of each chromosome — which is why they give so much DNA.

FOUNDATION

Chapter 2 · How DNA is organised

Genes, Chromosomes & the Genome

If you stretched out the DNA in one of your cells it would be about 2 metres long — yet it fits in a nucleus a few micrometres wide. It is packed by winding around proteins called **histones**, then coiled again and again into **chromosomes**.

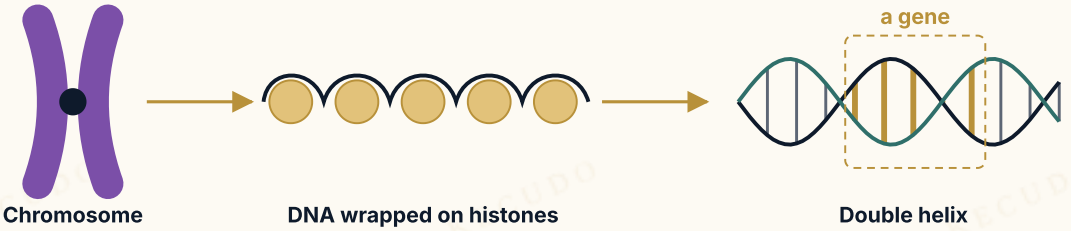


FIG 2.1 Zooming in: a chromosome is one long DNA molecule; a gene is one stretch of it

Term	Meaning	Example
Gene	A stretch of DNA that codes for a protein (or RNA)	The gene for haemoglobin
Allele	One version of a gene	Allele for purple or white flowers
Locus	A gene's position on a chromosome	"Address" of the gene
Homologous pair	Two matching chromosomes, one from each parent	Your two copies of chromosome 7
Diploid (2n)	Two sets of chromosomes	Human body cells: 2n = 46
Haploid (n)	One set	Human egg or sperm: n = 23

Humans have 22 pairs of **autosomes** plus one pair of **sex chromosomes** (XX or XY). A photo of all of them, sorted by size, is a **karyotype**.

FOUNDATION

Chapter 3 · Copying the code

DNA Replication

Before a cell divides it must copy all 6 billion base pairs of its DNA — in a few hours, with almost no mistakes. Watson and Crick saw the trick at once: because A always pairs with T and G with C, each strand carries the information to rebuild the other.

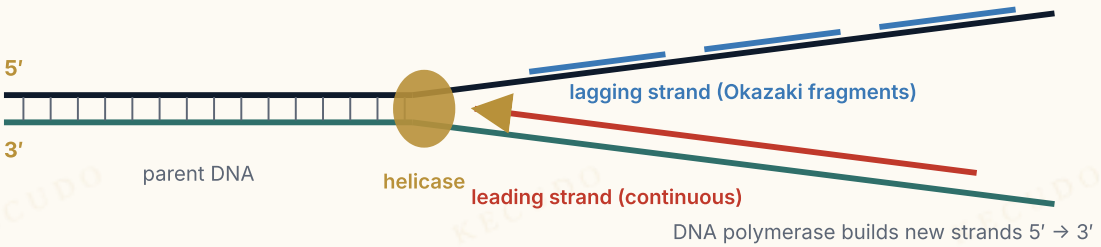


FIG 3.1 The replication fork: each parent strand is a template for a new one

Enzyme	Job
Helicase	Unzips the helix by breaking the hydrogen bonds between bases
Primase	Lays down a short RNA primer so copying can start
DNA polymerase	Adds matching nucleotides, always in the 5′→3′ direction, and proofreads
Ligase	Seals the gaps between Okazaki fragments

Because polymerase only builds 5′→3′, one new strand (the **leading strand**) grows smoothly toward the fork, while the other (the **lagging strand**) is made backwards in short pieces called **Okazaki fragments**.

> **Accuracy.** With proofreading and repair, the error rate is roughly one mistake per billion bases copied.

Self-Assessment

PART A · BASICS

Choose one answer per question. Answers lock once chosen. Your running score is shown at the top of the screen.

1. Which base pairs with guanine in DNA?

- A Adenine
- B Thymine
- C Cytosine
- D Uracil

2. How many chromosomes are in a typical human body cell?

- A 46
- B 23
- C 92
- D 48

3. Gametes (eggs and sperm) are...

- A diploid
- B haploid
- C identical to body cells
- D made by mitosis

4. An organism's observable trait, like purple flowers, is its...

- A genotype
- B allele
- C locus
- D phenotype

5. RNA uses which base in place of thymine?

- A Uracil
- B Adenine
- C Guanine
- D Cytosine

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Thank you for learning with Kecudo.

NEXT IN THE SERIES

Class 3 · Evolution & Biodiversity

Natural selection, evidence for evolution, speciation and the tree of life — with real data from Darwin's finches.