# The understanding of genetics

4.6.3.3 · Inheritance, variation and evolution · revision notes

How our understanding of inheritance developed: Mendel's experiments on pea plants, the link between his 'units' and chromosomes, and the discovery of the structure of DNA. This is in GCSE Biology only, not in Combined Science. Questions test the order of events and why Mendel's work was not recognised in his lifetime.

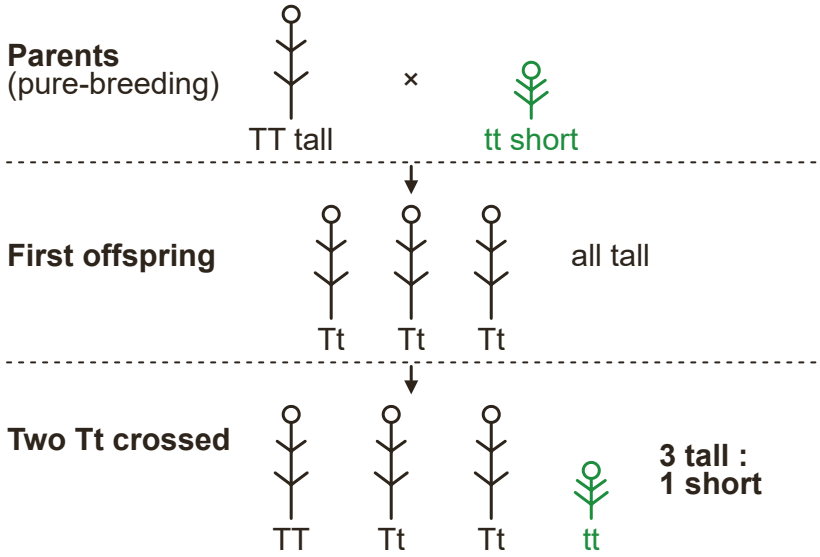
## Key facts

- Mendel: mid-19th century, breeding experiments on pea plants
- Late 19th century: behaviour of chromosomes during cell division observed
- Mid-20th century: structure of DNA determined; how genes work explained
- Mendel's 'units' (now called genes) are passed on to descendants unchanged
- Early 20th century: 'units' (genes) are located on chromosomes
- Mendel not recognised in his lifetime: no knowledge of chromosomes, genes or DNA; his work was little read

## Notes

### Mendel's experiments

- In the **mid-19th century**, **Gregor Mendel** carried out breeding experiments on **pea plants**.
- He crossed plants with different characteristics (e.g. tall and short stems) and counted the offspring with each characteristic over several generations.
- One of his observations was that the inheritance of each characteristic is determined by **'units'** that are **passed on to descendants unchanged**. We now call these units **genes**.
- Example: crossing pure-breeding tall plants with pure-breeding short plants gave all tall offspring. Crossing these offspring gave about 3 tall : 1 short. The unit for 'short' had been passed on unchanged but was hidden, because it is recessive. Grade 7+ only

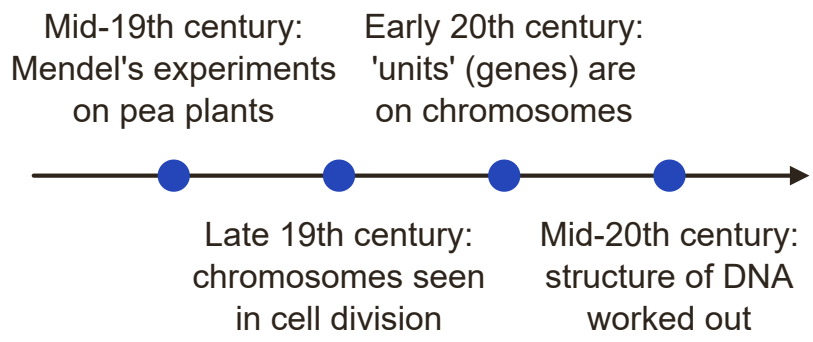



Mendel's results explained with alleles: the short allele was hidden, not lost.

Grade 7+ only

## From 'units' to gene theory

- **Late 19th century**: the behaviour of **chromosomes during cell division** was observed.
- **Early 20th century**: scientists saw that chromosomes and Mendel's 'units' behaved in similar ways. This led to the idea that the units, now called **genes**, were located on **chromosomes**.
- **Mid-20th century**: the **structure of DNA** was determined and the mechanism of gene function was worked out.
- This scientific work by **many scientists** led to the **gene theory** being developed.




From Mendel's 'units' to gene theory.

## Why Mendel's work was not recognised

- The importance of Mendel's discovery was not recognised until after his death.
- Chromosomes, genes and DNA were unknown, so there was no mechanism to explain his 'units'.
- His work was published in a little-known journal, and he was not a well-known scientist, so few people read it or saw its importance.
- Most scientists then accepted the idea of blending inheritance, so his separate 'units' did not fit the ideas of the time.

## How to answer each type of question

**Put the discoveries in order** 2 marks **Grade 5**

1. Mendel's breeding experiments came first (mid-19th century).
2. Then chromosomes were seen during cell division (late 19th century).
3. Then genes were linked to chromosomes (early 20th century).
4. The structure of DNA came last (mid-20th century).

**Example.** Put these events in order, starting with the earliest.
A The structure of DNA was worked out.
B Mendel carried out breeding experiments on pea plants.
C Scientists suggested that Mendel's 'units' are located on chromosomes.
D The behaviour of chromosomes during cell division was observed. [2 marks]

---

**Model answer.** B, D, C, A. All four in the correct order (2); two in the correct positions (1).

**Explain why Mendel's work was not recognised** 2 marks Grade 5

1. Chromosomes, genes and DNA were unknown, so his 'units' could not be explained.
2. His work was published in a little-known journal and he was not well known, so few scientists read it.

**Example.** Mendel published his results in 1866, but their importance was not recognised until after his death.
Suggest two reasons why. [2 marks]

---

**Model answer.** Scientists at the time did not know about chromosomes, genes or DNA, so they could not explain his 'units' (1). His work was published in a journal that few scientists read / he was not a well-known scientist (1).

**Explain Mendel's results using genetics** 3 marks Grade 7

1. Give the alleles: a capital letter for dominant, lower case for recessive.
2. Show the cross between the offspring (Tt × Tt).
3. Link it to the ratio: 3 dominant : 1 recessive.

**Example.** Mendel crossed pure-breeding tall pea plants (TT) with pure-breeding short pea plants (tt). All the offspring were tall. He then crossed two of these tall offspring. About three quarters of the next generation were tall and one quarter were short.
Explain these results. [3 marks]

---

**Model answer.** All the first offspring were Tt, and tall is dominant, so they were all tall (1). Crossing Tt × Tt gives TT, Tt, Tt and tt (1). Only the tt plants are short, so the ratio is 3 tall : 1 short (1).

## Don’t lose marks

- Saying Mendel discovered genes, chromosomes or DNA. He described 'units' of inheritance; the word 'gene' came later.
- Putting the structure of DNA before the link between genes and chromosomes.
- Saying Mendel's work was ignored because it was wrong. His results were correct, but they could not be explained at the time.

## More tips

### Memory tricks

- One step per period: mid-1800s Mendel's units → late 1800s chromosomes seen → early 1900s genes on chromosomes → mid-1900s DNA structure.
- Mendel = peas and 'units' (units = genes).
- Why not recognised? Nobody knew the mechanism, and few people read his work.

### Exam technique

- Learn the order of events by period; ordering questions are common.
- When asked why an idea was not accepted, think: no mechanism, not enough evidence, not widely known.
- Link this topic to how science works: theories develop as many scientists find new evidence.

## What each grade needs

What you need to be able to do, from the first marks up to the top grade.

**Grade 3**

**Name Mendel and the plants he used**

Gregor Mendel carried out breeding experiments on pea plants in the mid-19th century.

**Grade 4**

**State Mendel's key observation**

The inheritance of each characteristic is determined by 'units' that are passed on to descendants unchanged.

**Grade 5**

**Put the development of gene theory in order**

Mendel's units, chromosomes seen in cell division, units linked to chromosomes, then the structure of DNA.

**Grade 5**

**Explain why Mendel's work was not recognised**

Nobody knew about chromosomes, genes or DNA, so his results could not be explained, and few scientists read his work.

**Grade 7**

**Explain Mendel's results using alleles**

Use dominant and recessive alleles to explain why a characteristic disappears and then reappears in a 3 : 1 ratio.

**Grade 8**

**Explain how scientific theories develop over time**

New evidence and methods from many scientists built up the gene theory step by step.

Free notes, Full packs, practice papers and mock exams at chhetriacademy.com. Written for this site; not taken from past papers. Stuck? 1-to-1 tutoring with a free 30-minute trial lesson.