Reproduction

International Baccalaureate · IB Diploma · Biology · HL

Scope and prerequisites

This handout covers selected HL topics for the course first assessed in 2025; it is not the whole syllabus.

Prerequisites: read the stated quantities and units, and use arithmetic and the model conditions below.

The examples are original and fictional: they are not real measurements or real student investigations.

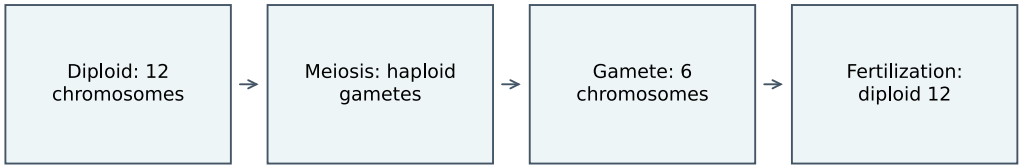
Sexual reproduction: meiosis and fertilization have different roles

What would explain this observation?

- Gametes normally contain one set of chromosomes, while **fertilization** joins two sets. Maintaining chromosome number across generations requires both processes.

Build the model

- Meiosis reduces chromosome number when producing **haploid** cells from a diploid starting cell.
- Homologous chromosomes separate in meiosis I, while sister chromatids separate in meiosis II.
- Fertilization combines haploid gamete nuclei to form a diploid zygote.
- Sexual reproduction can create new combinations of existing alleles.
- haploid: Having one chromosome set in the stated life cycle.
- fertilization: Fusion of gamete nuclei to form a zygote.



Meiosis halves the chromosome number and fertilization restores it: 12 → 6 → 12

Choose evidence that can test it

- Distinguish homologous chromosomes from sister chromatids, and chromosome number from DNA quantity.
- Replication before meiosis copies DNA without doubling the number of chromosome sets.
- Crossing over and independent assortment contribute to genetic variation, while random fertilization further changes combinations.
- These processes do not make every offspring genetically distinct under every conceivable condition.

In the lab: Use a labelled model organism with a stated chromosome number. Track chromosome sets through replication, meiosis I, meiosis II and fertilization. Use anonymous model data rather than personal family or reproductive-health information. Compare organism life cycles carefully; flowering-plant and animal reproductive structures require their own additional teaching.

Work from known quantities

- Known: a model organism has diploid chromosome number 2n=12.
- A gamete has n=6.
- After fertilization, the zygote has 12 chromosomes.
- With six independently assorting chromosome pairs and ignoring crossing over, there are 2^6=64 possible maternal/paternal chromosome combinations in a gamete.
- This is a model count, not a probability of an individual phenotype.

Your turn: A model organism has diploid chromosome number 20. How many chromosomes are normally in a gamete?

■ Check the conclusion and its limits

- A gamete is not made by halving the size of an ordinary cell.
- Independent assortment counts assume distinct homologous alternatives and do not include crossing-over outcomes.
- Human and plant reproduction cannot be fully replaced by a monohybrid Punnett grid.

Not true: DNA replication alone changes a diploid cell into a tetraploid cell. Replication doubles the DNA content but the chromosomes still count as one each (two sister chromatids); the cell remains diploid. Tetraploidy needs a failure of division, not replication.

Key:

- Meiosis reduces chromosome number when producing haploid cells from a diploid starting cell.
- Distinguish homologous chromosomes from sister chromatids, and chromosome number from DNA quantity.
- Watch for: A gamete is not made by halving the size of an ordinary cell.

■ Write from a gamete of 4 chromosomes

- A model organism has diploid number 8.
- Find the gamete chromosome number. With 4 pairs and no crossing over, how many maternal-paternal combinations are there?