

B6 Reproduction, DNA and evolution

Separate Biology Paper 2 extras | AQA 8461 | Core: Foundation + Higher

Supplement to shared content: revise the main topic sheets as well.

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Reproduction and the DNA code

Sexual reproduction produces genetic variation. A varied population is more likely to include individuals suited to changed conditions; selective breeding can increase useful traits.

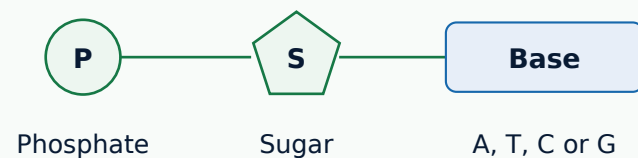
Asexual reproduction needs one parent, is rapid and energy-efficient, and can make many offspring in favourable conditions. Clones have little genetic variation, so the same change may harm many.

Some organisms use both: malaria parasites reproduce asexually in humans and sexually in mosquitoes; fungi form asexual spores but may reproduce sexually in adverse conditions; plants make seeds and may also form runners or bulbs.

DNA is a polymer of nucleotides. Each has a sugar, phosphate and base: A, T, C or G. Alternating sugars and phosphates form a backbone. Two strands form a double helix.

A sequence of **three bases** codes for a particular amino acid. Base order determines amino-acid order and therefore which protein is made.

One nucleotide



Cloning useful organisms

Tissue culture: plant cells divide by mitosis in sterile nutrient medium with hormones. Produces many clones rapidly, including rare plants or useful crop varieties.

Cuttings: take part of a parent plant, encourage roots and grow it into a genetically identical plant.

Embryo transplants: split cells from an early animal embryo before specialisation; implant the identical embryos into host mothers.

Adult-cell cloning

1. Remove the nucleus from an unfertilised egg cell.
2. Insert the nucleus from an adult body cell.
3. Stimulate division, for example with an electric shock.
4. Implant the developing embryo into a host mother.

The clone has the same nuclear genetic information as the adult nucleus donor, not the egg donor or host mother.

Evaluate: preserve useful traits or endangered genotypes, but cloning may have low success, welfare concerns and reduced variation. Identical genes do not guarantee identical outcomes in different environments.

How evolutionary ideas developed

Darwin: variation, competition and natural selection explain evolution. Wallace independently proposed natural selection; his work helped prompt Darwin to publish and advanced ideas about warning colouration.

Darwin faced opposition from religious beliefs, insufficient evidence at the time, and lack of understanding of inheritance. Genetics and other evidence later strengthened the theory.

Lamarck: proposed that acquired characteristics were inherited. This is not the accepted explanation for evolutionary change.

Speciation: populations become isolated, face different selection pressures and accumulate inherited differences. Eventually they cannot interbreed to produce fertile offspring.

Mendel: breeding pea plants led him to propose inherited units, passed from each parent. Their importance was recognised later; chromosomes were identified and genes were found to be sections of DNA.

Exam link: natural selection changes populations over generations. Individuals do not evolve because they need to.

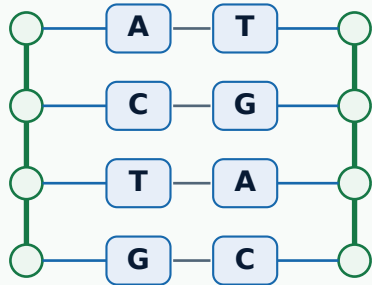
B6 From complementary bases to proteins

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Complementary base pairing



Sugar-phosphate backbones

Base pairs join the two strands

A pairs with T; C pairs with G. The sequence on one DNA strand determines the complementary sequence on the other.

DNA strand	Sequence
Given	A T G C C A T
Complement	T A C G G T A

The sugar and phosphate form the backbone. Each base attaches to a sugar. The bases of opposite strands pair in the centre.

Keep distinct: a base pair joins the two strands; a triplet is three consecutive bases along one strand.

Protein synthesis

DNA in nucleus

Base sequence is the code



mRNA copy

Leaves nucleus for a ribosome



Ribosome in cytoplasm

Amino acids joined in coded order



Protein chain folds

Shape enables a specific function

DNA stays in the nucleus. A messenger RNA (mRNA) copy carries the code to a ribosome. Carrier molecules bring specific amino acids in the order specified by the code.

Amino acids join into a chain, which folds into a specific shape. Proteins include enzymes, hormones and structural molecules such as collagen.

Detailed knowledge of mRNA, tRNA and ribosome structure is not required.

Coding and non-coding variants

A mutation changes a DNA base sequence. A **coding variant** can alter the amino-acid sequence and hence protein folding, shape and activity.

For an enzyme, a changed active site may no longer fit its substrate. For a structural protein, altered shape may change its strength or function.

Not every mutation changes the phenotype. Many are neutral: they may not alter the protein, or may not significantly affect its function.

Non-coding DNA

Not all DNA codes for proteins. Non-coding sections can regulate whether genes are switched on or off. A variant here can change how a gene is expressed, altering the amount of a protein made.

Explain the causal chain

Coding: changed base sequence - changed amino-acid order - changed folding/shape - altered protein function - possible phenotype change.

Non-coding: changed regulatory DNA - altered gene expression - altered protein production - possible phenotype change.