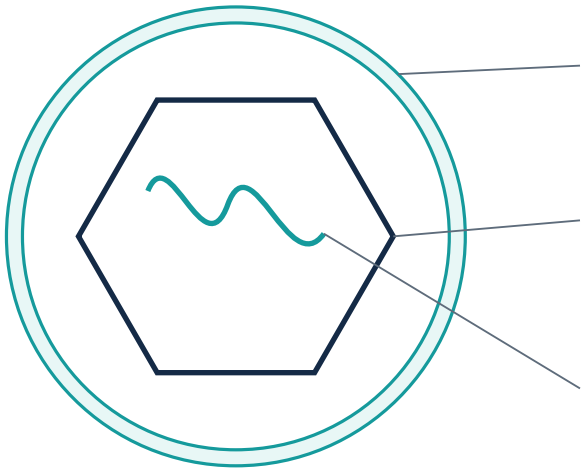
A genome in a protein coat

Core syllabus model: viruses are non-cellular structures with a DNA or RNA genome enclosed by a protein capsid. Some also have an outer phospholipid envelope.

AN ENVELOPED VIRUS: SCHEMATIC CROSS-SECTION



ENVELOPE

Phospholipid bilayer; optional.

CAPSID

Protein coat around the genome.

NUCLEIC ACID

DNA or RNA: genetic information.

Not to scale. The teal line represents a genome, not its molecular detail. Attachment proteins are omitted. Viral shapes vary.

1. NUCLEIC ACID: DNA OR RNA

The genome carries information used to produce new virus particles. Different viruses use different genome types. Do not state that every virus contains DNA, or that a viral genome must contain both DNA and RNA.

2. CAPSID: PROTEIN, NOT A CELL WALL

The capsid packages and protects the genome and contributes to particle shape. It is not a nucleus, a bacterial peptidoglycan wall or a plant cellulose wall. A complete virus particle is called a virion.

3. ENVELOPE: PRESENT IN SOME VIRUSES

An envelope surrounds the capsid in some viruses and is derived from host-cell membranes. It contains phospholipids and viral proteins. A non-enveloped virus is complete without this layer.

Cambridge Biology 9700 syllabus: section 1.2, learning outcome 7, p. 16.

New particles need a host cell

Supporting explanation: viruses lack ribosomes and an independent cellular metabolism. They cannot make proteins or supply ATP independently and rely on a suitable host cell to produce new particles.

A GENERALISED SEQUENCE: DETAILS VARY BETWEEN VIRUSES

1. ATTACHMENT

Viral surface proteins recognise suitable host-cell receptors. This helps determine which cells can be infected; attachment alone does not guarantee successful replication.

2. ENTRY + UNCOATING

The genome gains access to the cell and becomes available for use. Depending on the virus, the whole particle may enter or only the genetic material may be delivered.

3. GENOME COPYING + PROTEIN PRODUCTION

Inside the host, the viral genome is copied and viral proteins are produced. Host ribosomes translate viral instructions; host energy and materials are required. Some viruses supply their own enzymes.

4. ASSEMBLY

New genomes and viral proteins are brought together to form new particles. This is assembly from components, not cell division by binary fission or mitosis.

5. RELEASE

New particles leave the host. Release can involve cell lysis or budding, among other routes. Budding through a host membrane can give a virus its envelope.

A phospholipid envelope is not evidence of cellular organisation: the particle still has no ribosomes or cytoplasm.

Supporting explanation: OpenStax Biology 2e, 21.2 Virus infections and hosts.

A virus is not a small bacterium

Bacteria are prokaryotic cells; viruses are acellular. Compare corresponding features and use structural evidence rather than size or shape alone.

FEATURE	VIRUS PARTICLE	TYPICAL BACTERIUM
Organisation	Non-cellular particle; no normal cellular cytoplasm.	A cell with cytoplasm and a cell surface membrane.
Genetic material	Genome made of DNA or RNA.	DNA genome; RNA also occurs in the cell and supports gene expression.
Ribosomes	Absent; viral proteins are made using host ribosomes.	70S ribosomes make proteins.
Outer structures	Protein capsid; some have a phospholipid envelope.	Cell membrane and usually a peptidoglycan wall; some have a capsule.
Metabolism	No independent cellular metabolism or ATP supply.	Own metabolic reactions; ATP is produced and used.
New individuals	Components made inside host cells and assembled.	Cells grow and divide, typically by binary fission.

DO NOT CLASSIFY FROM SIZE ALONE

Many viruses are measured in nanometres and are smaller than bacteria, but there are exceptions. An envelope does not make a particle a cell, and a protein capsid does not tell you whether its genome is DNA or RNA.

THE ESSENTIAL SUMMARY

A virus has a nucleic acid genome and a protein capsid; an envelope is optional. It is non-cellular and depends on host cells to produce new particles.

Cambridge Biology 9700 syllabus: bacterial and viral structure, section 1.2, outcomes 5-7.