Organise, identify and name

Classification places organisms in groups. Taxonomy includes naming and classification; phylogeny describes evolutionary history and relationships. Modern groupings aim to reflect shared ancestry.

1. FOLLOW THE TAXONOMIC HIERARCHY

Rank	Human example
Domain	Eukarya
Kingdom	Animalia
Phylum	Chordata
Class	Mammalia
Order	Primates
Family	Hominidae
Genus	*Homo*
Species	*Homo sapiens*

Broad to specific: each lower group is contained within the higher groups. A taxon is a named group; a rank is its level, such as family or genus.

2. READ A BINOMIAL NAME

A species name has two parts: the genus and a specific epithet, for example *Homo sapiens*. Capitalise the genus, use lower case for the epithet, and italicise both words in print. Underline each word separately when handwriting.

The epithet alone is not the complete species name. Different common names can refer to the same organism; scientific naming helps researchers communicate consistently.

Ranks and hierarchy: OpenStax, Biology 2e 20.1.
Taxonomy and scientific naming: OpenStax, Microbiology 1.2.
Website lesson numbering; Cambridge classification scope: 18.1.1-6.
Cambridge Biology 9700 syllabus: p. 45; DNA evidence link: 17.3.2, p. 44.

What counts as a species?

Different species concepts emphasise different evidence. State which concept you are applying and why it suits the organisms or specimens being studied.

1. BIOLOGICAL SPECIES CONCEPT

A group of natural populations whose members can actually or potentially interbreed and produce viable, fertile offspring, while being reproductively isolated from other groups.

Use and limitation: Useful for many sexually reproducing organisms. Difficult to apply to fossils, asexual organisms or separated populations whose breeding cannot be assessed.

2. MORPHOLOGICAL SPECIES CONCEPT

Groups organisms by shared structural features, such as body shape and anatomical details.

Use and limitation: Useful when only preserved specimens or fossils are available. Different species may look alike; age, sex or environmental effects can also make one species look very variable.

3. ECOLOGICAL SPECIES CONCEPT

Distinguishes species by their ecological niche: the resources they use, conditions they occupy and interactions that define their role in the environment.

Use and limitation: Can be applied without testing interbreeding. Niches may overlap or change with life stage, location or conditions, making boundaries difficult to establish.

Do not decide from appearance alone. Strong identification can combine morphology, ecology, reproductive evidence and DNA data.

Biological, morphological and ecological concepts: ETSU, Chapter 24 notes.

Required species concepts: Cambridge Biology 9700, 18.1.1.

Website lesson numbering; Cambridge classification scope: 18.1.1-6.

Cambridge Biology 9700 syllabus: p. 45; DNA evidence link: 17.3.2, p. 44.

Domains and eukaryotic kingdoms

The syllabus uses three domains: Bacteria, Archaea and Eukarya. Bacteria and Archaea are prokaryotes; eukaryotic cells have a membrane-bound nucleus and membrane-bound organelles.

1. DISTINGUISH BACTERIA FROM ARCHAEA

Feature	Bacteria	Archaea
Nucleus	No membrane-bound nucleus.	No membrane-bound nucleus.
Membrane lipids	Typically unbranched fatty acids with ester links.	Branched hydrocarbon chains with ether links.
Cell wall	Usually contains peptidoglycan (murein).	No peptidoglycan; other materials may form the wall.
Ribosomal RNA	Characteristic bacterial base sequences.	Distinct rRNA sequences; molecular evidence separates this domain.

Do not identify Archaea solely by extreme habitats: many live in ordinary environments.

2. FOUR EUKARYOTIC KINGDOMS IN THIS SYLLABUS

Protoctista — Mostly unicellular; some multicellular. Nutrition varies: photosynthesis or heterotrophy. Cell walls vary.

Fungi — Usually hyphae forming a mycelium; yeasts are unicellular. Chitin walls; extracellular digestion and absorption.

Plantae — Multicellular, cellulose cell walls; most photosynthesise using chloroplasts. Typically store starch.

Animalia — Multicellular; no cell walls. Heterotrophic, generally ingesting food; specialised tissues are typical.

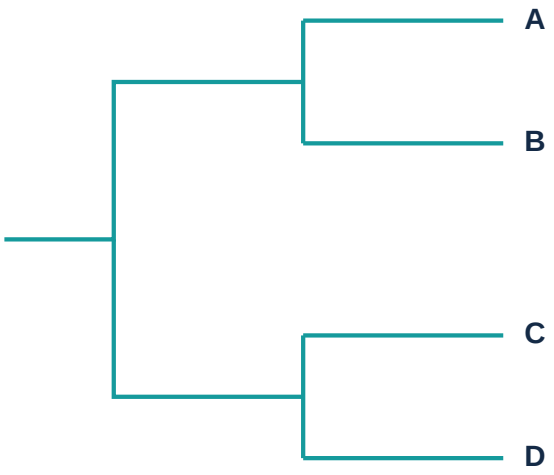
Protoctista is a syllabus grouping, not one complete branch of the modern evolutionary tree.

Prokaryotic structures: OpenStax, Microbiology 3.3.
Protists and kingdom context: OpenStax, Biology 2e 23.2.
Website lesson numbering; Cambridge classification scope: 18.1.1-6.
Cambridge Biology 9700 syllabus: p. 45; DNA evidence link: 17.3.2, p. 44.

Classify using evolutionary evidence

Compare homologous DNA regions, ribosomal RNA or corresponding protein sequences. Shared inherited features and molecular data help reconstruct ancestry and can change earlier classifications.

1. READ BRANCHING POINTS, NOT TIP ORDER



A and B share a more recent common ancestor with each other than with C or D. C and D are also sister groups.

Rotating branches around a node does not change relationships. These branch lengths are not a time scale.

2. USE MULTIPLE LINES OF EVIDENCE

Fewer sequence differences often suggest closer ancestry, but mutation rates differ and one gene may not represent the full history. Compare many appropriate sequences alongside other evidence. Similar functions can evolve independently, so visible resemblance alone can mislead.

3. VIRUSES: CLASSIFY THE GENOME

Viruses are acellular and depend on host cells for replication. They are not assigned to the three domains of cellular life. For this syllabus, distinguish:

- **Single-stranded DNA**
- **Double-stranded DNA**
- **Single-stranded RNA**
- **Double-stranded RNA**

Sequence evidence and homology: OpenStax, Biology 2e 20.2.
Viral genomes and classification: OpenStax, Biology 2e 21.1.
Website lesson numbering; Cambridge classification scope: 18.1.1-6.
Cambridge Biology 9700 syllabus: p. 45; DNA evidence link: 17.3.2, p. 44.