

18.1 Classification

Name: _____ Class: _____ Date: _____

Total: 24 marks

KEY WORDS class • species • kingdom • taxonomic hierarchy • domain

Objective

Build the skills to answer exam questions on **classification** – the meaning of **species**, the three **domains**, the **taxonomic hierarchy**, the four **kingdoms**, and how viruses are classified.

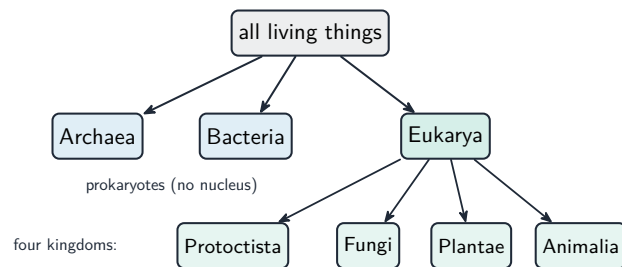
You must be able to:

- discuss the biological, morphological and ecological species concepts
- describe the three domains and the taxonomic hierarchy
- outline the four eukaryotic kingdoms and how viruses are classified

1 Key knowledge and worked examples

■ Species and domains

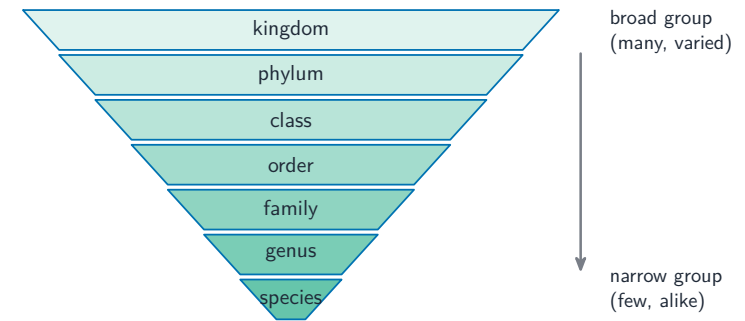
A **species** can be defined by the **biological** (can interbreed to give fertile offspring), **morphological** (look alike), or **ecological** (same niche) concept.



Three domains: *Archaea* and *Bacteria* are prokaryotes; the *Eukarya* split into four kingdoms

Archaea and **Bacteria** are prokaryotes but differ in membrane lipids, ribosomal RNA and cell-wall make-up. **Eukarya** have a nucleus.

■ The taxonomic hierarchy



Kingdom → *phylum* → *class* → *order* → *family* → *genus* → *species*

The four eukaryotic kingdoms: **Protocista** (mostly single-celled), **Fungi** (absorb food, chitin walls), **Plantae** (photosynthesise), **Animalia** (feed on others). **Viruses** are classified by their **nucleic acid** (DNA or RNA) and whether it is single- or double-stranded.

2 Practice

2.1 State the biological species concept. [1]

2.2 Put these in order from largest to smallest group: family, kingdom, genus, order. [2]

3 Exam-style questions

3.1 To which domain do organisms with a nucleus belong? [1]

☐

- A Archaea
B Bacteria
C Eukarya
D Protocista

3.2 Viruses are classified according to: [1]

☐

- A** the kingdom they belong to
- B** the type of nucleic acid and whether it is single- or double-stranded
- C** their cell wall composition
- D** the number of chromosomes

3.3 (a) State **two** features that distinguish the kingdom Fungi from the kingdom Plantae. [2]

(b) Explain why Archaea and Bacteria are placed in separate domains even though both are prokaryotes. [2]

3.4 Explain a limitation of the biological species concept. [2]

3.5 The scientific name of the domestic dog is *Canis lupus familiaris*.

(a) Name the taxonomic levels of the hierarchy from domain down to species, in order. [3]

(b) State the rules of the binomial system, using *Canis lupus* as your example. [3]

(c) Name the three domains, and give **one** feature that distinguishes each from the other two. [4]

(d) Explain why classification based on molecular evidence has changed the way organisms are grouped. [3]

Solutions

Each answer shows the steps, then the **result**.

2.1

- a group of organisms that can interbreed to produce fertile offspring

2.2

- kingdom
- order
- family
- genus

3.1 C

- Organisms with a nucleus are in the Eukarya domain

3.2 B

- Viruses are classified by nucleic acid type and strandedness

3.3

(a)

- Fungi feed by absorbing food (not photosynthesis); Fungi have chitin cell walls (Plantae have cellulose)

(b)

- they differ in their membrane lipids, ribosomal RNA and cell-wall composition, showing they are only distantly related

3.4

- it cannot be applied to organisms that reproduce asexually / to extinct/fossil species / where two groups rarely meet to test interbreeding

3.5

(a)

- Domain, kingdom, phylum, class, order, family, genus, species

(b)

- The name has two parts: the **genus** first, with a capital letter – *Canis* – and the **species** second, in lower case – *lupus*; the whole name is printed in italics, or underlined when handwritten

(c)

- **Bacteria** – prokaryotic, with peptidoglycan in the cell wall. **Archaea** – prokaryotic, but no peptidoglycan and with different membrane lipids and RNA polymerase, closer

to eukaryotes. **Eukarya** – cells have a true nucleus and membrane-bound organelles

(d)

- Molecular data – DNA and RNA sequences and amino acid sequences – measure ancestry directly, rather than inferring it from appearance; it revealed that the prokaryotes are two deeply distinct groups, which is why the three-domain system replaced the old five-kingdom one; it also separates organisms that merely look alike through convergent evolution from those that are genuinely related