

Classification & Biodiversity

A-Level Biology ■ Topic 18

A-Level Biology



What we will cover

- 1 Species & the three domains
- 2 The taxonomic hierarchy
- 3 Biodiversity
- 4 Sampling an area
- 5 Conservation



grouped by shared features

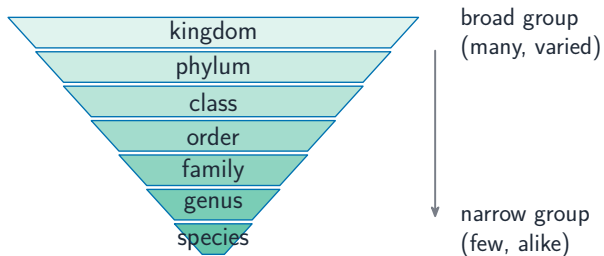


Species and the three domains

A **species** is a group that can interbreed to give fertile offspring. The three **domains** are Bacteria, Archaea and Eukarya – based on rRNA, not just cell type.

Archaea look like bacteria under the microscope but are genetically closer to eukaryotes.

The taxonomic hierarchy



Smaller, more closely related groups:

kingdom → phylum → class → ... → species

Eukarya's four kingdoms:

Protocista , **Fungi** , **Plantae** ,
Animalia .



Biodiversity



Biodiversity is measured at three levels:

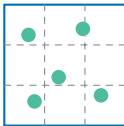
- the range of **ecosystems** & **habitats**
- the number of species & their **abundance**
- the genetic variation within a species

Sampling an area

Random sampling avoids bias:

- **quadrats & transects** – fixed plants
- **mark-release-recapture** – moving animals

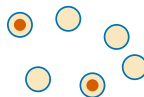
Simpson's index gives diversity as one number. Link a species' spread to **biotic** or **abiotic factors** with a **correlation** test – Spearman's rank or Pearson's.



quadrat
count species
in a square



transect
record along
a line



mark-recapture
mark some (red), release,
then re-catch



Conservation

two ways to conserve a species

in-situ (in the wild)
national parks,
marine reserves

ex-situ (away
from the wild)
zoos, botanic gardens,
seed banks,
frozen zoos

Species go **extinct** from climate change, hunting & habitat loss.

- **in-situ** – national & marine parks
- **ex-situ** – zoos, **seed banks**

IUCN lists threat; **CITES** controls trade.

Ways to conserve a species

in situ	protect the habitat – reserves, national parks, and legal protection for endangered species
ex situ	zoos, botanic gardens, and seed banks for plants
assisted reproduction	for rare mammals: in vitro fertilisation , embryo transfer , and surrogacy
why it helps	it raises numbers faster than natural breeding, and widens the gene pool by moving gametes rather than animals
invasive species	brought in from elsewhere, they out-compete natives – so control or removal is itself conservation
the limit	ex-situ populations lose genetic diversity and behaviours, so in situ is preferred wherever possible

A **coral reef** is the standard example of high biodiversity: very many species sharing one small area, each in its own **niche** .

Worked example – the Lincoln index

**60 snails marked; later 80 caught,
15 marked**

$$N = \frac{\text{first} \times \text{second}}{\text{marked in the second}} = \frac{60 \times 80}{15} = 320$$

The estimate is only as good as its **assumptions**, so state them:

- no births, deaths or migration between the two catches
- the marks stay on and do not harm the animal
- marked animals mix back in fully and are no easier to catch

Why conserve at all, and how

Other species give us food, medicines and materials, help keep ecosystems stable, and have value in themselves.

in situ

protect them where they live: national parks, marine reserves, protected habitat

ex situ

move them somewhere safe: zoos, botanic gardens, seed banks, captive breeding

In situ keeps the species doing its job in the ecosystem; *ex situ* is the fallback when the habitat itself is gone.

Viruses sit outside the scheme

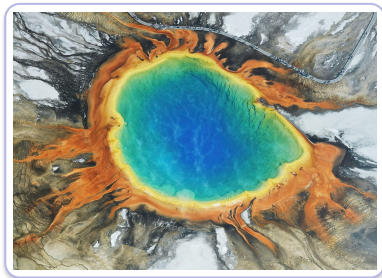
Viruses are not placed in any kingdom. They are classified instead by their **nucleic acid** :

DNA or RNA

**single-stranded or
double-stranded**

They have no cells and cannot reproduce alone, so the usual test – can these two breed?
– has nothing to work on.

The three domains



Each coloured ring around this scalding spring is a different community of microbes living at a different temperature. Archaea like these – thriving where almost nothing else can – were the clue that they form a domain of their own, separate from ordinary bacteria

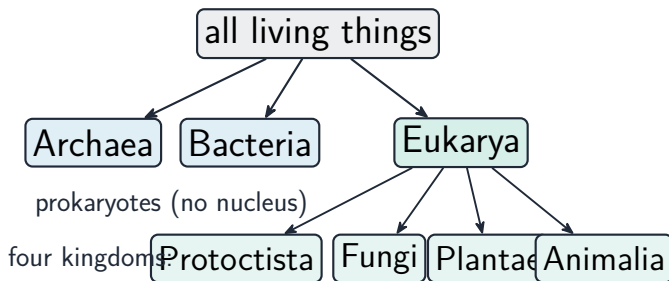
The three domains

Biodiversity, continued



Biodiversity is measured at three levels: the range of ecosystems, the number of species, and the genetic variation within a species

The taxonomic hierarchy, continued



Archaea and Bacteria are prokaryotes; the Eukarya split into four kingdoms – **Protocista** (mostly single-celled, like *Amoeba*), **Fungi** (absorb their food, chitin cell walls), **Plantae** (photosynthesise) and **Animalia** (feed on other organisms).

Exam tips

- Learn the **taxonomic hierarchy** (domain → kingdom → ... → species) and the three domains; a species interbreeds to give **fertile** offspring.
- Measure biodiversity with **Simpson's index** (a higher value = more diverse) and explain why high biodiversity aids stability.
- Give **in-situ vs ex-situ** conservation methods with the advantage of each.

Classifying living things

A **species** can be defined in more than one way:

- the **biological** species concept – a group whose members can breed together to produce fertile offspring.
- the **morphological** species concept – a group whose members look alike.
- the **ecological** species concept – a group that fills the same role in its surroundings.



Worked example – measuring biodiversity

Why can two woods with the same number of species have very different biodiversity?

- Species **richness** counts species but ignores how many of each there are.
- A wood where one species dominates is **less** diverse than one with even numbers.
- Simpson's index uses **both** richness and **evenness**.
- $D = 1 - \sum (n/N)^2$, so **higher D = more diverse**.

Richness alone is not biodiversity – **evenness** matters too. Random sampling with quadrats avoids bias; a large N makes the estimate reliable.

Topic 18 – key takeaways

1

Domains

Archaea, Bacteria, Eukarya

2

Hierarchy

kingdom → phylum → ... →
species

3

Biodiversity

ecosystems, species, genetic
variation

4

Conservation

in-situ vs ex-situ; IUCN & CITES

Check yourself

- 1 Name the three domains.
- 2 Which taxonomic level is the smallest?
- 3 Which method samples moving animals?
- 4 What does “in-situ” conservation mean?



Answers 1. Archaea, Bacteria, Eukarya 2. species 3. mark-release-recapture
4. protecting species in their own habitat