

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

1

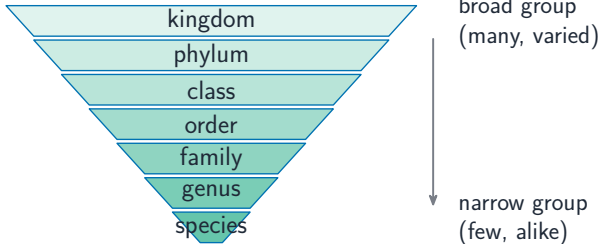
Classification

Species and the three domains

A **species** 种 is a group that can interbreed to give fertile offspring. The three **domains** 域 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 原生生物界,
Fungi 真菌界, **Plantae** 植物界,
Animalia 动物界.

2

Biodiversity

Biodiversity



Biodiversity 生物多样性 is measured at three levels:

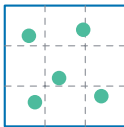
- the range of **ecosystems** 生态系统 & **habitats** 栖息地
- the number of species & their **abundance** 丰度
- the genetic variation within a species

Sampling an area

Random sampling 随机取样 avoids bias:

- **quadrats** 样方 & **transects** 样带 – fixed plants
- **mark-release-recapture** 标志重捕法 – moving animals

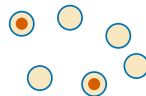
Simpson's index 辛普森多样性指数 gives diversity as one number. Link a species' spread to **biotic** 生物因素 or **abiotic factors** 非生物因素 with a **correlation** 相关性 test – Spearman's rank or Pearson's.



quadrat
count species
in a square



transect
record along
a line



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

3

Conservation

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** 灭绝 from climate change, hunting & habitat loss.

- **in-situ** 就地保护 – national & marine parks
- **ex-situ** 迁地保护 – zoos, seed banks 种子库

IUCN 世界自然保护联盟 lists threat; **CITES** 濒危物种贸易公约 controls trade.

Ways to conserve a species

in situ	protect the habitat – reserves, national parks, and legal protection for endangered species 濒危物种
ex situ	zoos, botanic gardens, and seed banks for plants
assisted reproduction	for rare mammals: in vitro fertilisation 体外受精, embryo transfer 胚胎移植, 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 入侵物种	they out-compete natives, so removing them is itself conservation
the limit	ex-situ populations lose genetic diversity and behaviours, so in situ is preferred wherever possible

Conservation protects **genetic diversity** and each species' **niche** 生态位, not only numbers.

Worked example – the Lincoln index

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

n_1 marked first, n_2 second catch, m
marked in it:

$$N = \frac{n_1 \times n_2}{m}$$

$$N = \frac{60 \times 80}{15} = \mathbf{320}$$

The estimate is only as good as its
assumptions:

- ✓ no **births, deaths or migration** between catches
- ✓ marks **stay on** and do not harm
- ✓ marked animals **mix back in** 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 就地保护

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

ex situ 迁地保护

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

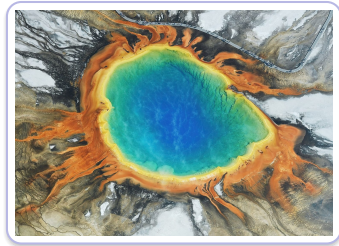
Viruses are not placed in any kingdom. They are classified instead by their **nucleic acid** 核酸:

DNA or RNA

**single-stranded 单链
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

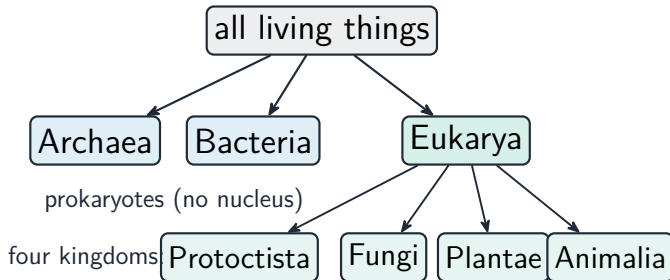
Bacteria, Archaea and Eukarya: archaea are prokaryotes, but their membrane lipids differ, their walls lack peptidoglycan and their rRNA is closer to eukaryotes'.

Biodiversity at three levels



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

Three domains and their kingdoms



Archaea and Bacteria are prokaryotes; the Eukarya split into four kingdoms – **Protocista** 原生生物界 (mostly single-celled, like *Amoeba*), **Fungi** 真菌界 (absorb their food, chitin cell walls), **Plantae** 植物界 (photosynthesise) and **Animalia** 动物界 (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** 物种 can be defined in more than one way:

Biological species concept

members can **interbreed** to produce **fertile offspring**

Morphological species concept

members **look alike** (shared structure)

Ecological species concept

members fill the **same role** (niche) in their surroundings

The biological concept fails for **fossils** and **asexual** organisms – so the others are still needed.

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Recap

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** 均匀度.
- $D = 1 - \sum (n/N)^2$, 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