1.1 Biodiversity (p. 8 - 13)

Introduction to Biology

Questions

1. What is Biology?
2. What are the Seven Characteristics of Life?

Biodiversity

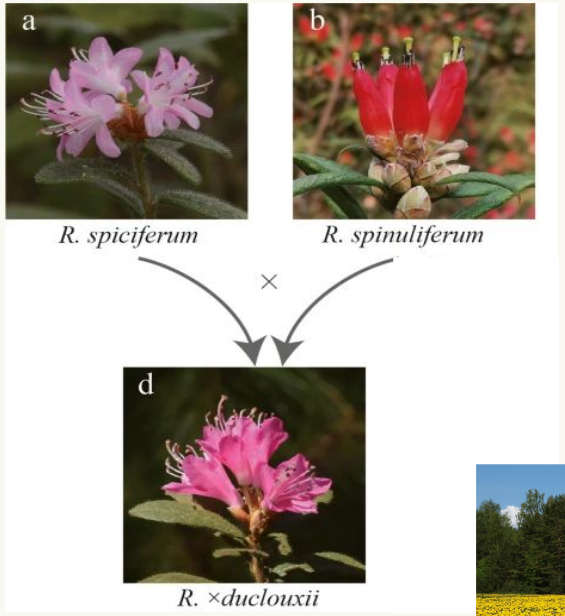
Biodiversity: the number and variety of **species** and **ecosystems** on Earth

- Over 1.2 million species of living things had been identified and described by scientists
- Scientist use **‘species’** as the fundamental unit to quantify life forms!

What is a species?

Species: Organisms that are capable of breeding freely with each other under natural conditions. The definition is referred to as the **biological species concept**.

Exceptions to the Rule



Exceptions to the rule...

➔ Some different species of plants can **hybridize** (cross breed) together to form a new species

More on this in genetics!

➔ Some organisms reproduce asexually (e.g. dandelions) so are defined as species by their **morphology** (physical characteristics) instead

Individual Variability

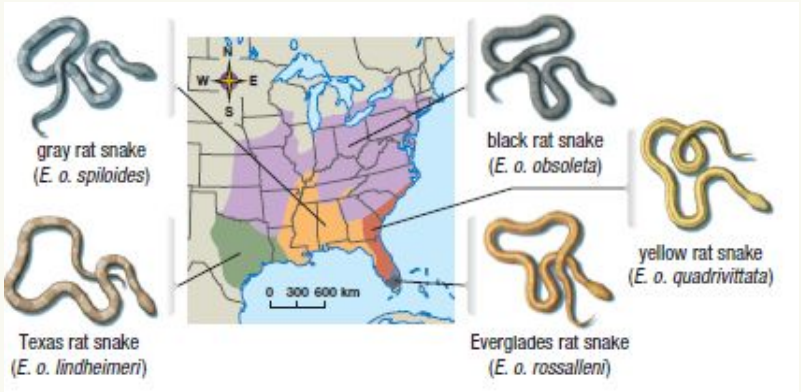
Individual variability:
A species is composed of **individuals** with **different traits** due to their unique **genetics**

Although subtle differences exist, the individuals within a species can **breed**

Variation over Time and Space

Species can evolve or change over **many generations** and **across continents**

- **Evolutionary change:** a change that occurs in an **entire** population; it usually occurs over a **long** period of time



Rat snakes are members of the **same species**. They exhibit different colours depending on their **geographic location**.

Biodiversity

Biodiversity

Refers to the variety of species in an ecosystem but also includes **structural diversity** within ecosystems and **individual variability** within species.

Genetic Diversity

Genetic variability among organisms; usually referring to individuals of the **same species**.

Diversity in Ecosystems

Ecosystems are made up of many different species and their physical environment. All these species depend on other species in some way for their own survival.

- ➔ **Heterotrophs** rely on other organisms, including autotrophs, for nutrients
- ➔ Although **autotrophs** make their own nutrients using energy from the sun, they still rely on other organisms. E.g. insects for pollination and microorganisms to recycle nitrogen

Heterotrophs

Autotrophs

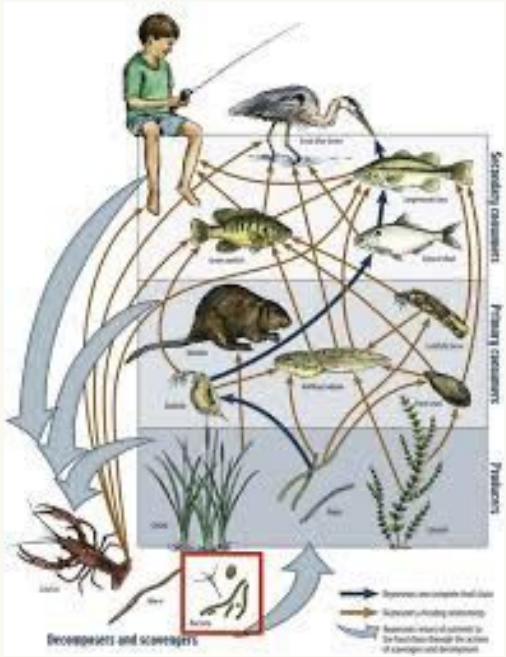
A mature forest with a herb layer, understory layer and canopy layer can support many different types of species

A tree plantation, established after a clear-cut, exhibits almost no structural diversity

Diversity in Habitats

An ecosystem with **greater structural diversity** can support a greater **diversity of species** since it creates more **microhabitats**

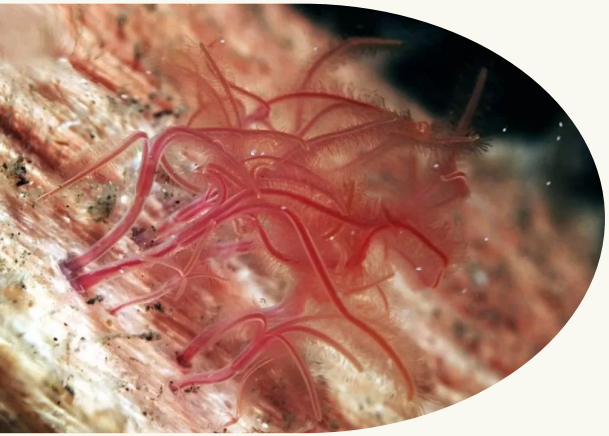
➔ **Structural diversity:** the range of physical shapes and sizes within a habitat or ecosystem



Diversity in Interactions

Species support one another. **The more species** in an ecosystem, the more productive and stable it is.

Species diversity takes into account both the **number of species** present in an ecosystem as well as the **number of individuals** within the species



Relationships: Feeding Relationships

1. **Bone worms** feed exclusively on bones of dead whales found at the bottom of the ocean.

2. **Photosynthetic microorganisms** live in the bodies of giant clams and corals

    - The microorganisms perform photosynthesis and supply the coral and clams food.

Relationships:
Protection

1. **Hermit crabs** use the shells of dead snails for a home

2. **Ants** protect the Cecropia tree, which provides shelter

Relationships:
Transportation

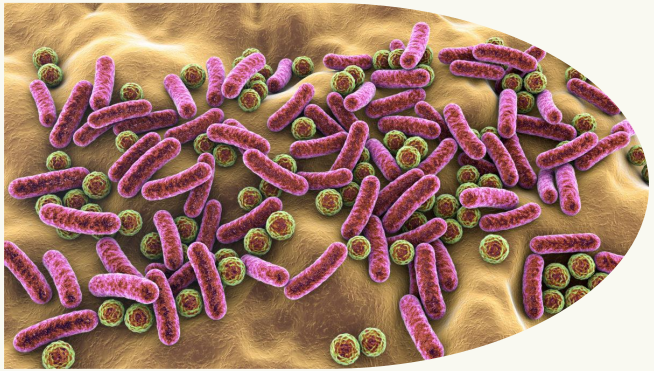
1. **Flower mites** climb into bills of hummingbirds moving from flower to flower to collect nectar

2. **Seeds** have hooks to allow them to stick to passing animals. This allows the seed to disperse to other areas.

Relationships:
Reproduction

1. **Trilliums** produce seeds with fleshy tissues that attract ants.
   - If ants do not feed on outer tissues, they cannot germinate

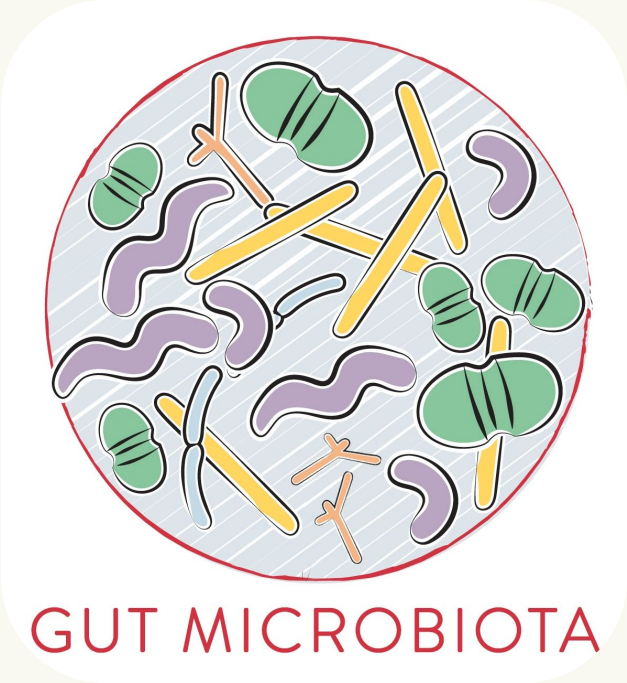
2. **Birds** inhabit tree cavities for building nests



Relationships: Hygiene

1. **Coral reefs** have **cleaning stations** where large fish come to have parasites removed by small fish and shrimp

2. **Natural bacteria** on our skin help protect us from other **bacterial and fungal infections**



Relationships:
Digestion

1. Termites consume wood, but rely on bacteria in their guts to digest it

2. Bacteria living in human intestines produce vitamins that get absorbed into our circulatory system

Diversity Declining

There is a concern that the diversity of life is declining

Loss of diversity **impacts humans:**

- Threatens food supply
- Reduces sources for natural medicines
- Interferes with biogeochemical pathways (carbon and nitrogen cycles)
- Has economic impacts on tourism and forestry

(Belanger et al., 2020)

Why is Biodiversity so Important?

(Belanger et al., 2020)

1.2 The Nature of Classification

(P. 14 - 20)

Biological Classification

Biological Classification: the systematic grouping of organisms into biological categories based on **physical** and **evolutionary** relationships.

- For example, organisms can be classified according to their role such as, **producers, herbivores, carnivores and scavengers**

Producer

Herbivore

Carnivore

Scavenger

Taxonomy

Taxonomy is the science of classifying all species (living and extinct).

- Identifying species can be difficult
- Some species can be hard to tell apart (look very similar)
- Some species include members that look very different
  - males vs. females
  - young vs. mature
  - colouration (e.g. due to geographic location)

These two birds are of the same species. (A very handsome fairy wren beside a female of the same species)

At different stages of their life cycle sockeye salmon look like two different species!

Early Classification

Early names and classification systems were **highly variable** and lead to **confusion**.

- E.g. “robins” in England and “robins” in North America are actually two different species!

Biologists wanted to have **clear rules and rationale** that could be applied to all living things.

European Robin

American Robin

Carl Linneaus (1707- 1778)

Considered father of biological classification.

- Doubted the idea that species were fixed (unchanging)
- Introduced a new way of grouping species based on their **morphological** characteristics.
- Established **binomial nomenclature** whereby each species is assigned a
  1. **genus name** followed by a
  2. **specific name**

Common name:
dog-rose

Binomial name:

Rosa canina

Common name: Pebble crab

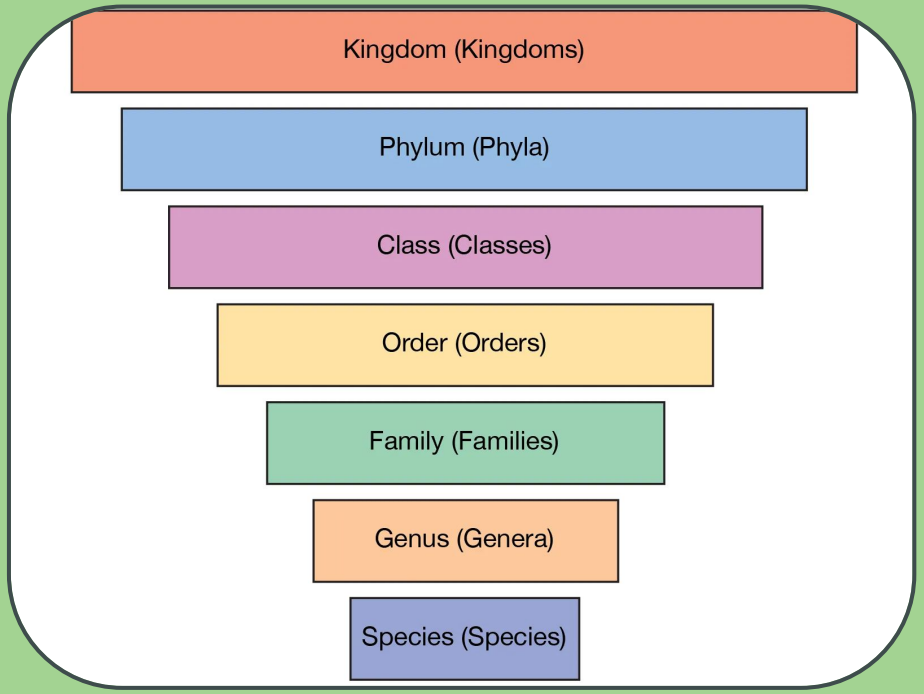
Genus Species

Scientific name: *Xanthias* *lamarckii*

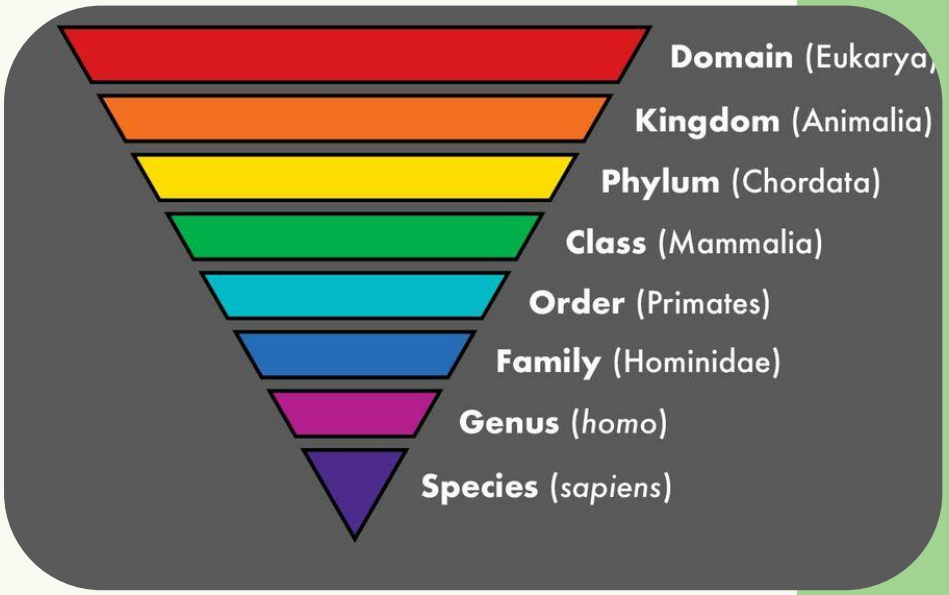
Note: the name is italicized and only the genera is capitalized

Traditional Taxonomy

- Linnaeus grouped species into **taxonomic ranks** based on their **shared characteristics**
- Each level is called a **taxon** (plural: taxa).
- There are **7** major levels:



The Linnaean System



In the Linnaean system, each taxonomic rank consists of **species** that have **similar features**.

➔ For example, all species in the **phylum Chordata** have a backbone and all members of the **class Mammalia** are warm-blooded.

Your Mnemonic Device:

K_____

P_____

C_____

O_____

F_____

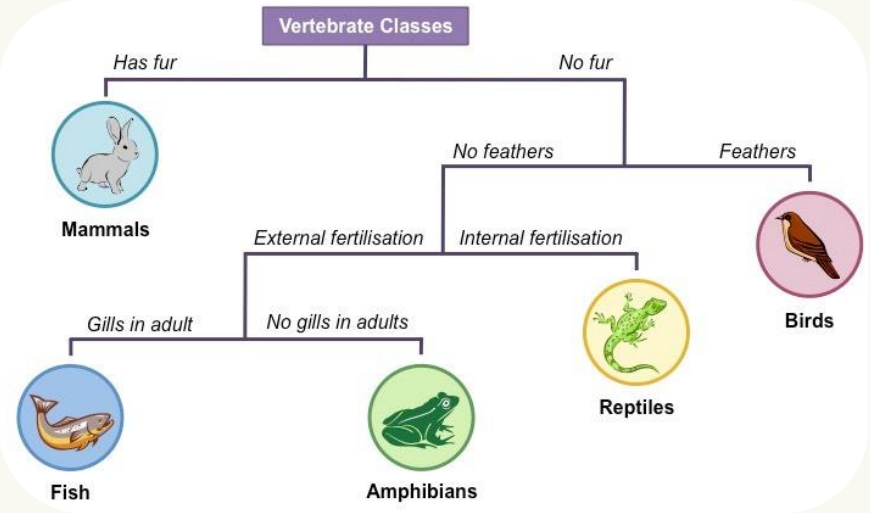
G_____

S_____

Students, write your response!

Dichotomous Keys

- Dichotomous keys are used to **identify species**.
  - The identifier works their way through a **series of choices**, each one having only two options.
  - In the end, each species can be **identified**.



Using the dichotomous key, name each creature!

i. four legs.....go to ii
six legs.....go to iii

ii. triangular body.....dreieck
round body.....bereik

iii. red in colour.....eirik
green in colour.....go to iv

iv. no spots on body.....grundle
black spots on body.....go to v

v. small wings.....flugelpunkte
no wings.....punkte