Biodiversity of animals

Scope

Topic	Breakdown of topic
Biodiversity of animals	The concept of a phylum. Relationship between body plan and grouping of animals in phyla. Six animal Phyla: - Porifera, - Cnidaria, - Platyhelminthes, - Annelida, - Arthropoda - Chordata Use simple diagrams to identify an example of each phylum and a comparative table to demonstrate the following in the six phyla: Key features in respect of body plans: - symmetry and cephalisation - the number of tissue layers developed from embryo - the number of openings in the gut - coelom and blood systems. The role of invertebrates in agriculture and ecosystems

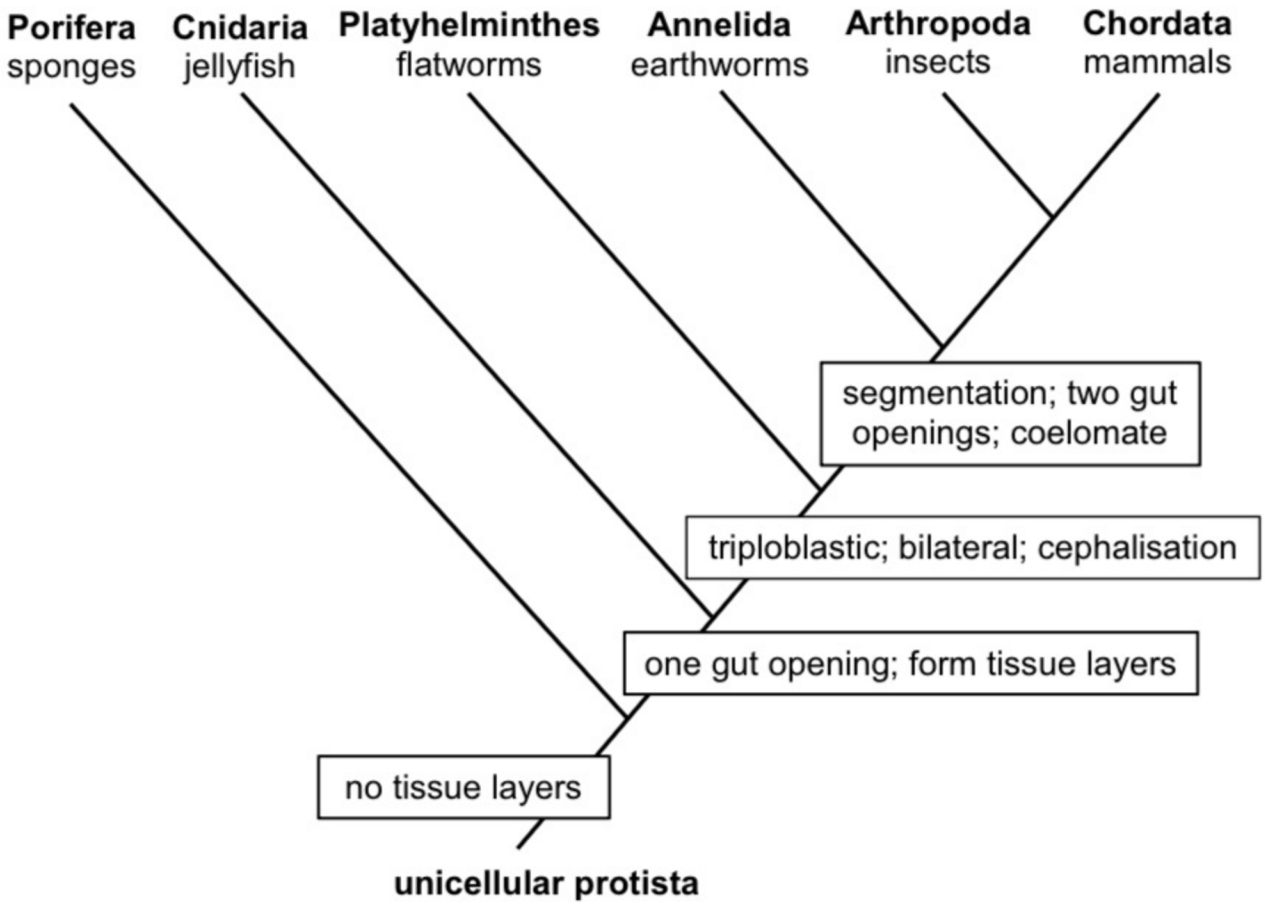
Biodiversity of animals

Notes

Biodiversity refers to the wide variety of plants, animals and micro-organisms on Earth.

There are approximately 1,5 million recorded animal species on Earth. Animals are sorted according to their similarities and differences. All animals belong to the Kingdom Animalia. This kingdom is further divided into phyla (singular: phylum) which are based on differences in their basic body plan.

A cladogram illustrating the relationship between these phyla is illustrated



Biodiversity of animals Notes

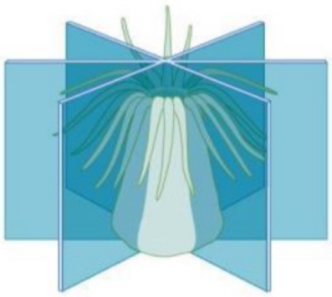
A **body plan** is structural characteristics of an organism that separates it from other organisms or groups of organisms. Important features of body plans include:

- body symmetry and cephalisation
- tissue layers
- number of gut openings
- the presence of a body cavity

Symmetry and cephalisation

An organism is symmetrical when it can be cut into two equal and identical halves through one or more plane.

Multicellular organisms can be **asymmetrical**, **radially symmetrical** or **bilaterally symmetrical**. **Cephalisation** is when most of the sense organs, feeding appen-dages and the brain are near the anterior part of the body

Type of symmetry	Description	Example
asymmetry e.g.: amoeba, sponges	• no symmetry, i.e. they cannot be divided into two equal halves (Figure 2)	 Figure 2: asymmetrical – sponge
radial symmetry e.g.: Cnidaria	• body plan can be cut through more than one plane to obtain two equal halves (Figure 3) • usually **sessile** or are able to move around only a little	 Figure 3: a radially symmetrical animal – sea anemone
bilateral symmetry e.g. all other phyla except Porifera and Cnidaria	• body plan can be divided into two equal halves in only one plane. i.e. they have a left side and a right side that are identical • cannot be divided into an equal anterior (front) and posterior (back) end, as shown in Figure 4.	 posterior (back) Figure 4: a bilaterally symmetrical animal – goat

Biodiversity of animals

Tissue layers

Notes

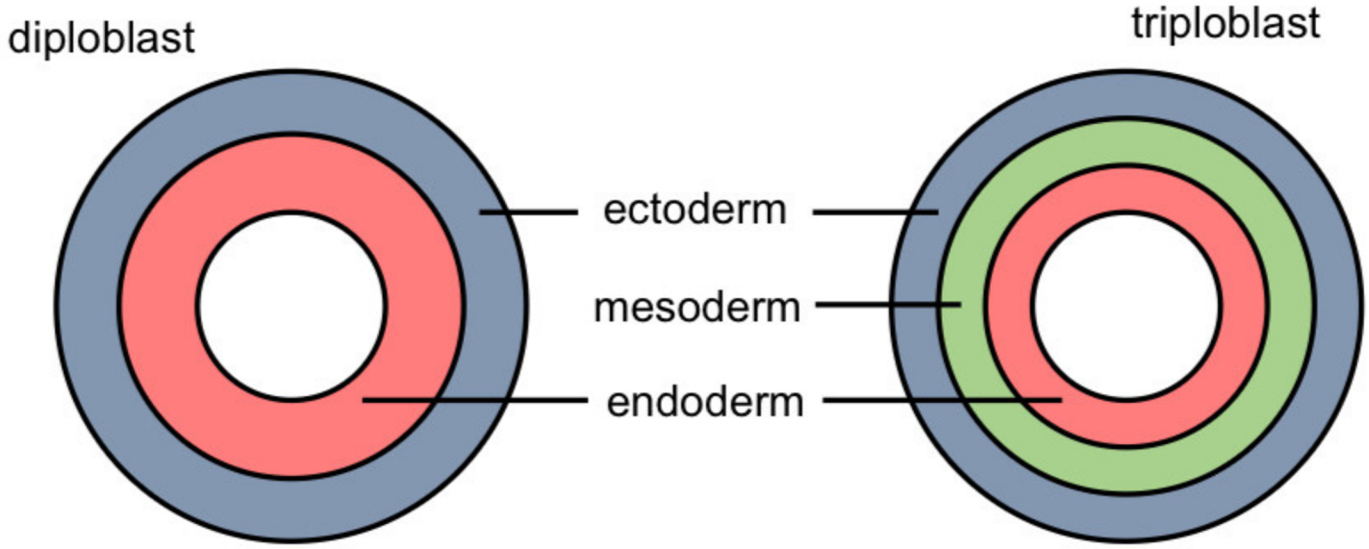
The first tissue layers formed in the embryo are called **germ layers**. The germ layers differentiate into different organs.

The primary germ layer consists of the **ectoderm** (outer layer) and the **endoderm** (inner layer).

- The ectoderm will develop into the skin or epithelium and the nervous system of the animal.
- The endoderm will form the digestive system.
- Animals that only have two germ layers (ecto- and endoderm) are called **diploblastic** animals
- Diploblastic animals do not form complex organs and are more primitive animals.

The **mesoderm** is a secondary germ layer which develops between the endoderm and the ectoderm.

- Animals that have three tissue layers (i.e. ecto-, endo- and mesoderm) are called **triploblastic** animals.
- The mesoderm develops into connective tissue, bone, blood, reproductive organs, cartilage, blood and the lymphatic systems.

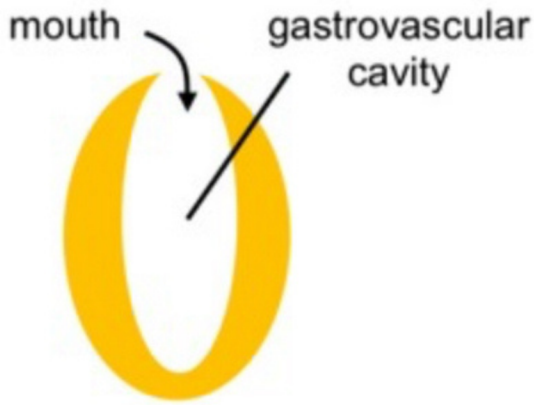


Biodiversity of animals

Openings to the gut

Notes

Animals have either one or two openings to the gut / digestive system.

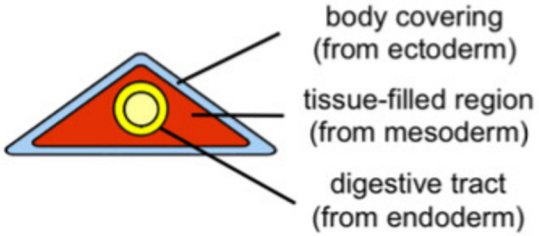
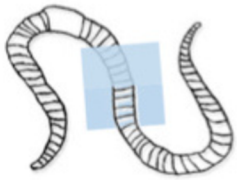
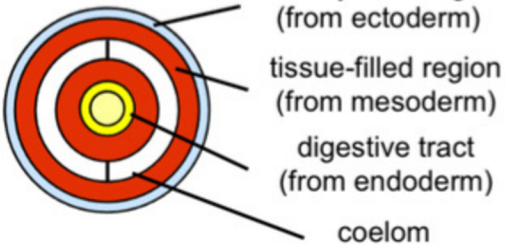
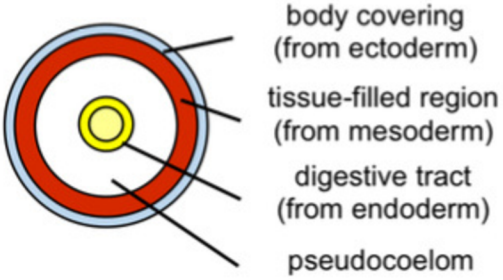
Openings	Description
One	Animals with only one opening to the gut will consume food through the opening (mouth) and excrete waste through the same opening. There is only one opening for both the mouth and the anus  • A one-opening to the gut is also called a **blind-ending gut**. • This limits the amount of food that these animals can consume –they must excrete the waste from their digestive system before they can consume more food.
Two	Animals with two openings to the gut can consume food through a mouth opening and excrete waste through another opening called the anus. This type of gut is also called a **through-gut.**  • A through-gut is an advantage because food can be consumed continuously because it moves through the digestive system. • Sections of the digestive system can also specialize (e.g. stomach) to improve the efficiency of the digestive process.

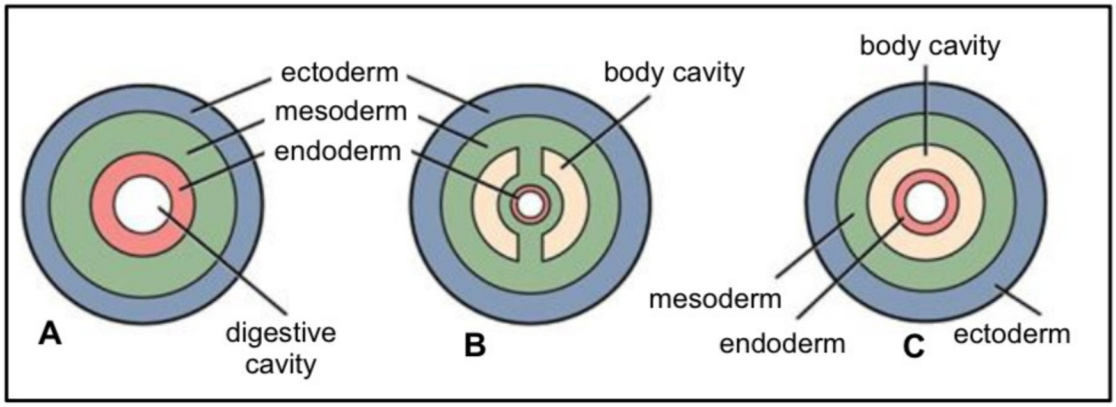
Biodiversity of animals

Coelom

Notes

A coelom is a body cavity that develops inside the mesoderm tissue layer in more advanced animals

Acoelomate  flatworm	An **acoelomate** animal does not have a body cavity or coelom. Acoelomate animals may be either **diploblastic** or **triploblastic**. Acoelomate animals are usually smaller and are less mobile that coelomates.	
Coelomate  annelid	**Coelomate** animals have a body cavity or coelom in their **mesodermal** tissue layer. Usually larger and mobile	
Pseudocoelomate  nematode	A body cavity that is **not** surrounded by mesoderm.	



Biodiversity of animals

The 6 phyla

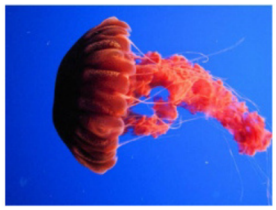
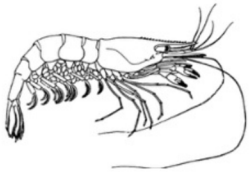
Notes

Six phyla are studied, including:

- Phylum **Porifera** e.g. sponges
- Phylum **Cnidaria** e.g. blue bottles, jelly fish, sea anemones
- Phylum **Platyhelminthes** e.g. flukes, tapeworms, free-living planarians
- Phylum **Annelida** e.g. leeches, earthworms and polychaetes
- Phylum **Arthropoda** e.g. crab, spider, locust, millipede, centipede, fly
- Phylum **Chordata** e.g. fish, mammals, birds, reptiles, amphibians

	Phylum					
	simplest → more advanced					
Characteristics	**Porifera**	**Cnidaria**	**Platyhelminthes**	**Annelida**	**Arthropoda**	**Chordata**
Example	sponges	jellyfish, bluebottle, sea anemone	flatworm, planarian, tapeworm	polychaete worm, earthworm, leeches	spider, millipede, crab, insect	shark, fish, frog, snake, bird, mammal
Body symmetry	asymmet-rical	radial	bilateral, dorso-ventrally flattened	bilateral	bilateral	bilateral
Cephalisation	none	none	yes	yes	yes	yes
Gut openings	no gut	one	one	two	two	two
Tissue layers	no true tissue	diploblastic	triploblastic	triploblastic	triploblastic	triploblastic
coelom	acoelomate	acoelomate	acoelomate	coelomate	coelomate	coelomate
Mode of living	aquatic, sessile	aquatic, sessile, free-floating, dimorphic lifecycle	most are internal parasites, some aquatic, free-living	aquatic or terrestrial, moist environments, highly mobile	aquatic or terrestrial, can survive in dry habitats	aquatic or terrestrial, can survive in dry and extreme habitats

The six phyla Notes

Porifera 	• aquatic (live in water) • asymmetrical with no cephalisation • acoelomate • no openings to the gut • **sessile** organisms that feed by filtering out floating particles from the water column
Cnidaria 	• radially symmetrical with no cephalisation • diploblastic which means they have a cellular ectoderm and a cellular endoderm. • acoelomate • one opening to the gut that acts as the mouth and the anus. • Cnidarians occur in two different body forms: o a **sessile** polyp phase o a free-swimming medusa
Platyhelminthes 	• bilaterally symmetrical with cephalization – a definite anterior, posterior, dorsal and ventral side • triploblastic which allows them to develop tissues and organs • acoelomate and therefore no circulatory system • one opening to the gut – **blind gut**
Annelida 	• bilaterally symmetrical with cephalisation • triploblastic • coelomate - coelom is a fluid-filled cavity that is used as a hydrostatic skeleton for movement • **segmented** which means their bodies consist of repeating segments, called metameres
Arthropoda 	• bilaterally symmetrical with cephalisation • triploblastic • coelomate – the coelom is filled with a fluid, which acts like blood, called a haemocoel. Arthropods therefore have an open circulatory system • all arthropods have jointed appendages that are used for movement andfeeding • two openings to the gut (a through-gut)
Chordata 	• bilaterally symmetrical with cephalisation • triploblastic • coelomate • segmented body • two openings to the gut (**through-gut**) • all vertebrates have a rod-like support named a notochord which may develop into the vertebral column

Biodiversity of animals

The role of invertebrates in agriculture and eco-systems

Pollination

Pollination is the transfer of pollen from the male parts of a flower to the female parts of a flower of the same species by a pollinator

Pollination results in fertilisation for the production of fruits and seeds.

- Bees are the most important pollinators because they spend their entire life collecting pollen and nectar for their developing young.
- There are many other invertebrates that pollinate flowers (examples include: ants, moths, butterflies).

Decomposition

Decomposition is the process that decays or breaks down organic molecules from dead organisms into simpler organic molecules that are released into the environment and reused in nutrient cycles.

Invertebrates (worms, beetles etc.) break down complex organic molecules (detritus), such as leaf litter, into simpler molecules.

- Microscopic decomposers (i.e. bacteria and fungi) can further break down the organic matter into humus.
- Humus is the organic part of soils which greatly improves the quality of soils for plants.

Soil aeration

Invertebrates like earthworms, burrow in the soil and make tunnels through the soil. These tunnels allow gases to move through and aerate the soil.

- Their tunnels accelerate the decomposition of nutrients to be reused for plant growth
- The community structure of the habitat is dependent on soil nutrients and plant growth
- Their tunnels improve drainage of the soil
- The earthworms act as pumps when they move through the tunnels by pushing and pulling air around their tunnels
- Their tunnels loosen the soil and allow plant roots to penetrate deeper into the soil

Animal diversity

Terminology

Key terminology

cephalisation	the presence of a definite head that contains sense organs in animals; first seen in the phylum Platyhelminthes
sessile	organisms that are immobile and attached to one place for life, e.g. sponges and barnacles
gut	portions of the alimentary canal
diploblastic	having a body wall that is composed of two layers: the endoderm and ectoderm
triploblastic	any organism that develops from a three-layered embryo; ectoderm, mesoderm and endoderm
coelom	a fluid-filled cavity that lies between the ectoderm and endoderm and is found in triploblastic organisms
hydrostatic force	a force exerted by a liquid, usually water, increased with constriction and gravity
peristalsis	an automatic wave of muscle contraction and relaxation that moves food in one direction through the digestive tract
invertebrates	organisms without a backbone
vertebrates	animals that have a backbone or spinal column
spicule	a minute (very small) sharp-pointed object or structure that is typically present in large numbers, found in sponges
nematocyst	a specialized cell in the tentacles of a jellyfish or other coelenterate, containing a barbed or venomous coiled thread that can be projected in self-defense or to capture prey
mesoglea	the tissue in jellyfish that functions as a hydro-static skeleton
acellular	not consisting of, or not containing cells
haemocoel	the body cavity of most invertebrates containing circulatory fluid
exoskeleton	a thick, rigid outer covering that protects and supports bodies and provides places for muscles to attach in animals, e.g. arthropods
ecdysis (moulting)	the process of casting off the outer cuticle in arthropods
detritus	organic matter produced by the decomposition of dead organisms
humus	organic component of soil, formed by the decomposition of leaves and other plant material by soil microorganisms
aeration	the process of turning or puncturing compacted soil to allow air and water penetration