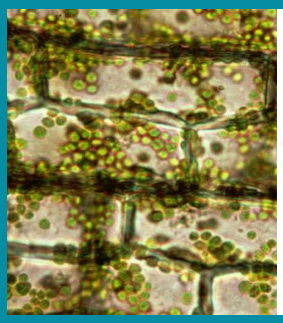
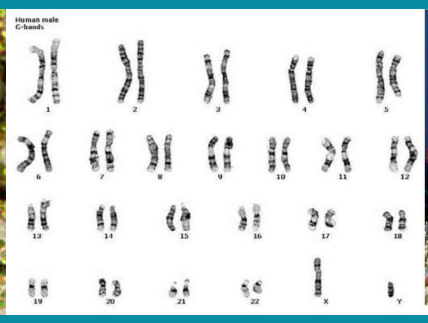
SLE 132 – Form and Function
Diversity of Animals





DEAKIN COLLEGE
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Learning Objectives

- How are the animals divided into groups according to their body plans (symmetry, tissue layers, presence or absence of body cavities)?
- Be able to identify the main characteristics of some of the main animal phyla.

Animal Diversity Table

Over the next section of slides we are going to go through the different phyla of animals and discuss the characteristics of each phyla.

As we discuss these characteristics you will gain the information you need to fill out the Animal Diversity table which you will hand in at the start of practical 1. This piece of assessment is worth 1%.

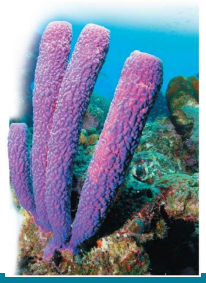
Animal Groups

- Can be classified according to different body plans.
- Phyla Classification of animals:
  - Symmetry
  - Body cavity types (based on embryology)
- Class and Order classification of animals:
  - Specific differences shared by some members, other members may have lost them overtime

Body Plans

Single Cells
No cell walls
Organelles

Multicellular

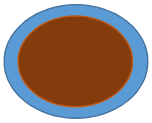


Parazoa
Cell Aggregate

Eumetazoa
Tissue

Body Plans

2 cell layers
- Ectoderm
- Endoderm

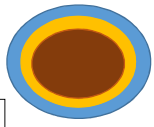


Eumetazoa
Tissue

Radial Symmetry
Bi-blastic
(Diploblastic)

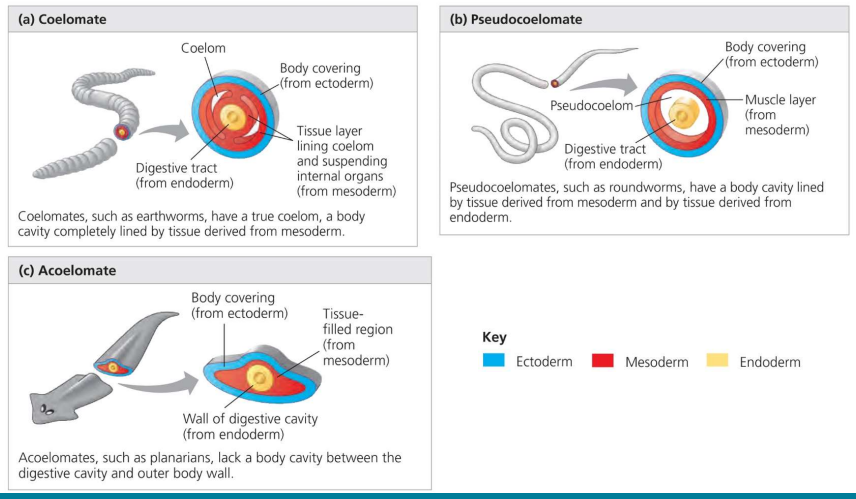
Bilateral Symmetry
Organs
Tri-blastic
(Triploblastic)

3 cell layers
- Ectoderm
- Mesoderm
- Endoderm



Body Cavities – Triploblastic animals

▼ Figure 32.9 Body cavities of triploblastic animals. The organ systems develop from the three embryonic germ layers.

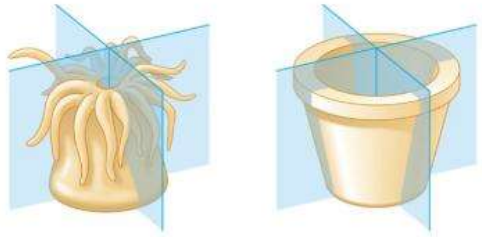


Symmetry

- Animals can be categorised according to the symmetry of their bodies, or lack of it
- Some animals have **radial** symmetry
- Others are **bilateral**
- Those that have no symmetry are said to be **asymmetrical**

Radial Symmetry

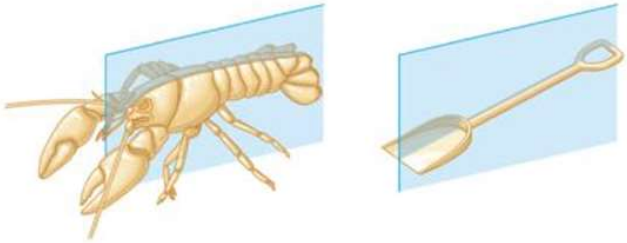
- Cut in half along any plane to give a mirror image
- Good for sessile animals
- All sides have equal change of catching prey
- No front (anterior) or back (posterior), no left and right



(a) Radial symmetry. A radial animal, such as a sea anemone (phylum Cnidaria), does not have a left side and a right side. Any imaginary slice through the central axis divides the animal into mirror images.

Bilateral Symmetry

- Only cut along one plane to give mirror image
- Anterior and posterior axis, and dorsal/ventral axis, contain left and right side
- Cephalization



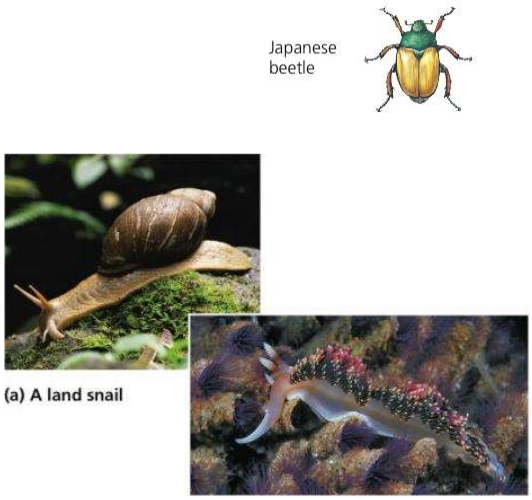
(b) Bilateral symmetry. A bilateral animal, such as a lobster (phylum Arthropoda), has a left side and a right side. Only one imaginary cut divides the animal into mirror-image halves.

▲ **Figure 32.7 Body symmetry.** The flowerpot and shovel are included to help you remember the radial-bilateral distinction.

Cephalisation

Many animals that have bilateral symmetry also have **sensory equipment** concentrated at their anterior (head) end, including a central nervous system ('brain') in the head.

This is called cephalization.



(a) A land snail

(b) **A sea slug.** Nudibranchs, or sea slugs, lost their shell during their evolution.

Skeletons

- **Hydrostatic Skeleton** – A skeletal system composed of fluid held under pressure in a closed body compartment
- **Exoskeleton** – A hard encasement on the surface of an animal
- **Endoskeleton** – internal skeleton/support structures
- **Notocord** – a longitudinal, flexible rod made of tightly packed mesodermal cells that runs anterior to posterior (in humans the spinal column)

Segmentation

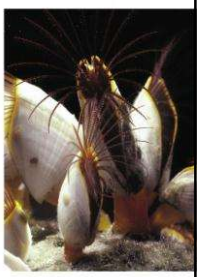
- **Serial Segmentation** – the animal body is characterised by the repetition of similar segments.
- **Segmentation** – characterised by non repeating segments (Think of the segments of an ant or spider.)

Appendages

- Any peripheral extension especially the limbs of an animal
- Arms, legs, claws, etc.

(a) Ghost crabs live on sandy ocean beaches worldwide. Primarily nocturnal, they take shelter in burrows during the day.

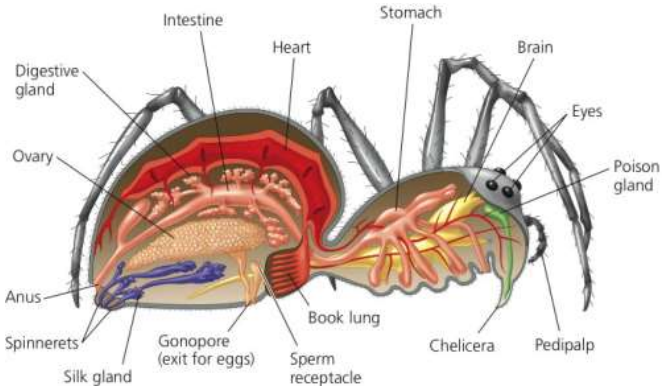
(b) Mountain shrimp, living fossils from the Triassic period represent one of Australia's threatened freshwater shrimp species.



(c) The jointed appendages projecting from the shells of these barnacles capture organisms and organic particles suspended in the water.

Mouth and Anus

Being able to tell if an animal has a mouth and an anus sounds easy, but can be tricky. Some animals only have one opening, some have two!



Mouth and Anus/ Digestive System

- More advanced animals generally have both a mouth and an anus
- Enables a much more efficient **one-way digestive system**
- Allows harvesting of more energy to supply the more complex animal structure

<u>Note regarding Animal Diversity Table</u>:

Yes = mouth and anus

No = one opening for both functions

Identifying Phyla

- As we go through each Phyla, we will see the **fundamental differences in body plan** that animals in each group possess.
- Certain cells and structures will only be found within certain phyletic groups.
- Knowing the characteristic cells/structures of each phyla will allow you to classify and identify unknown animals (Prac 1)

Invertebrates

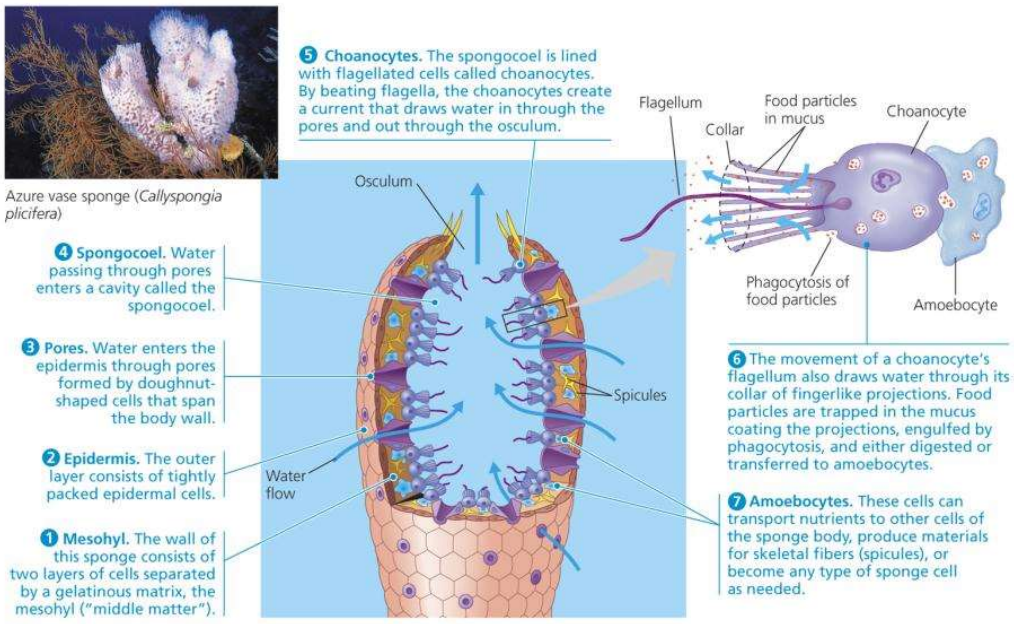
- Invertebrates are animals that lack a backbone
- They account for 95% of known animal species
- They include the following Phyla:
  - Calcerea and Silicea
  - Cnidarians
  - Platyhelminthes
  - Molluscs
  - Annelids
  - Arthropods
  - Echinodermata

Phylum Calcarea and Silicea: The sponges
(Calcera – Of Calcium, Silicea – of Silicon)

- Used to be called Phylum Porifera
- Internal skeletons of spongin and/or spicules of calcium carbonate or silicon dioxide.
- Sponges are sedentary animals.
- They live in both fresh and marine waters
- **Lack true tissues and organs**.
- Sponges are suspension feeders, capturing food particles suspended in the water that pass through their body.

Phylum Calcarea and Silicea: The sponges

- **Choanocytes**, flagellated collar cells, generate a water current through the sponge and ingest suspended food
- Water is drawn through pores into a cavity called the spongocoel, and out through an opening called the osculum (filter-feeders)
- Most sponges are hermaphrodites: each individual functions as both male and female
- Have no observable symmetry



▲ **Figure 33.4 Anatomy of a sponge.**

Phylum Cnidaria

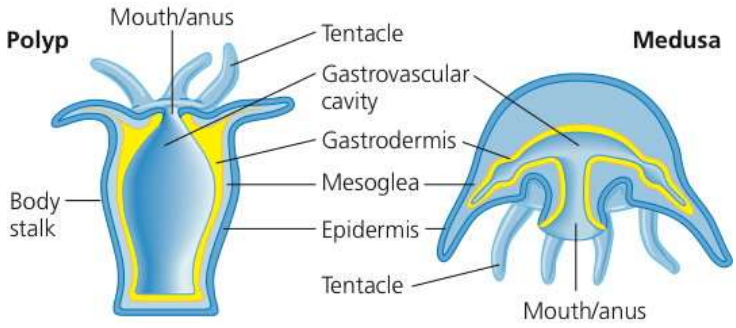
(*Knidē* – nettle, stinging cells)

Includes the hydras, corals and jellies ('jelly fish')

The basic body plan of a cnidarian is a sac with a central digestive compartment, the gastro- vascular cavity

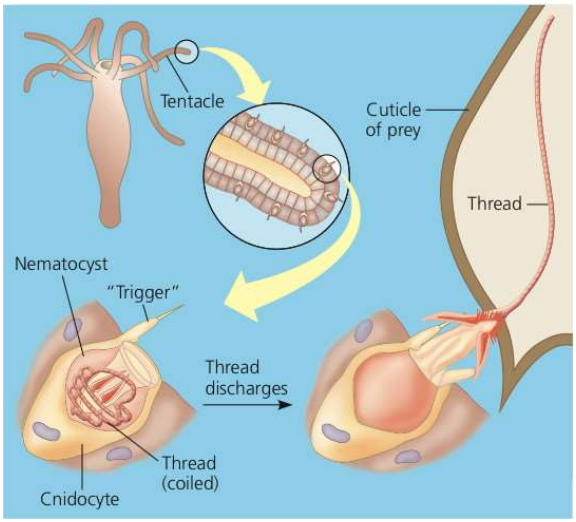
Phylum Cnidaria

- A single opening functions as mouth and anus
- There are two variations on the body plan: the sessile **polyp** and motile **medusa**



Phylum Cnidaria

- Cnidarians are all carnivores that use tentacles to capture prey
- The tentacles are armed with **Cnidocytes**, unique cells that function in defence and capture of prey
- Nematocysts are specialised organelles within cnidocytes that eject a stinging thread



Phylum Cnidarians

(a) These colonial polyps are members of class Hydrozoa.

(b) Many jellies (class Scyphozoa) are bioluminescent. Food captured by nematocyst-bearing tentacles is transferred to specialized oral arms (that lack nematocysts) for transport to the mouth.

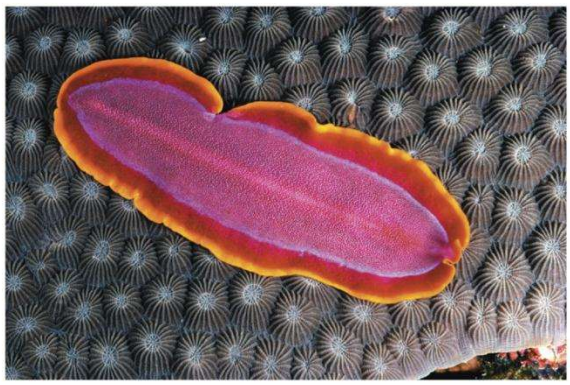
(c) The sea wasp (*Chironex fleckeri*) is a member of class Cubozoa. Its poison, which can subdue fish and other large prey, is more potent than cobra venom.

(d) Sea anemones and other members of class Anthozoa exist only as polyps.

▲ **Figure 33.7 Cnidarians.**

Phylum Platyhelminthes (Platy – flat, Helminth – worm)

- Live in marine, freshwater, and damp terrestrial habitats.
- Flattened dorsoventrally and have a simple gastrovascular cavity.
- Many flatworms are parasites



▲ **Figure 33.9 A marine flatworm (class Turbellaria).**

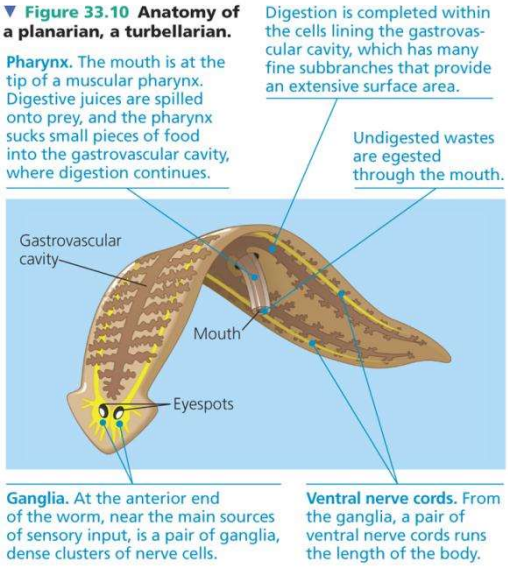
Phylum Platyhelminthes

Turbellaria
(mostly free-living flatworms)

Monogenea (monogeneans)

Trematoda (trematodes, or flukes)

Cestoda (tapeworms)



Classification of Phylum Annelida

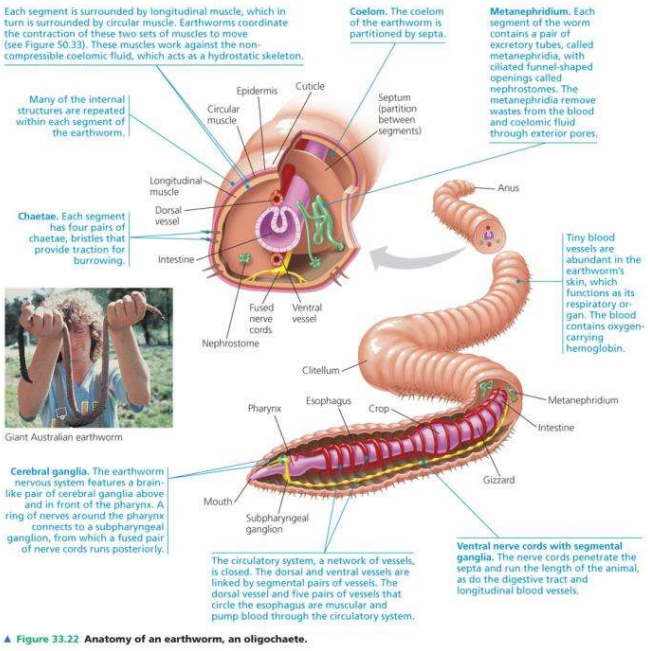
- Annelids have bodies composed of a **series of fused rings, or segments**.
- Traditionally the Annelids could be broken up into three classes:
  - **Class Polychaetes** (marine worms)
  - **Class Oligochaetes** (earthworms)
  - **Class Hirundinea** (leeches)
- However recent studies (molecular/DNA analysis) found that the oliogochaetes are a subgroup of the polychaetes and that the leeches are a sub group of the oliogochaetes

Classification of Phylum Annelidia

- Thus this group is now split into Class Errantia and Class Sedentarians

- **Class Errantia**
  - Marine
  - Mobile species
  - Some species have parapodia (paddle like appendages)
  - Well developed jaws and sensory organs

- **Class Sedentarians**
  - Less mobile than species of Class Errantia
  - Some burrow slowly, others live in tubes
  - Includes many species of leeches and earthworms



▲ Figure 33.22 Anatomy of an earthworm, an oligochaete.

Phylum Mollusca

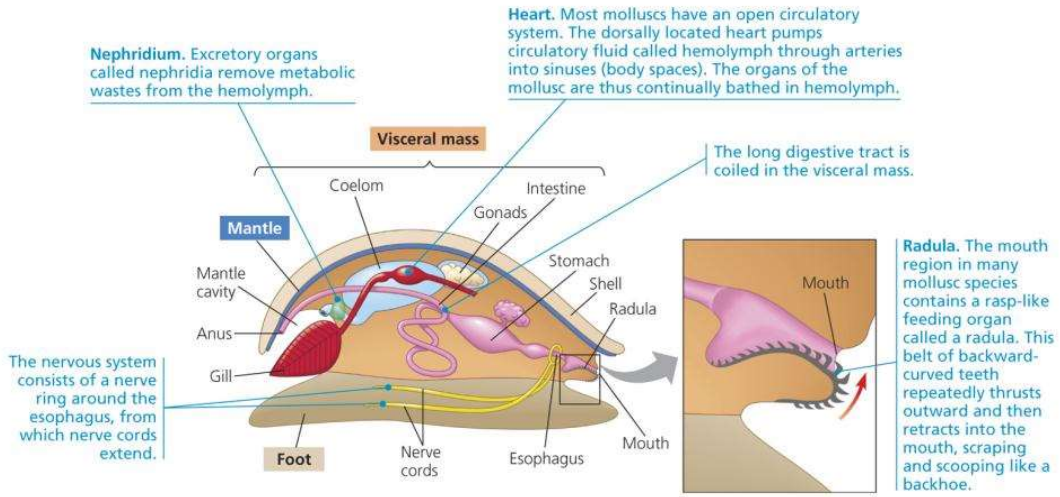
(Soft bodied, Mollis – soft)

- Phylum Mollusca includes snails and slugs, oysters and clams, and octopuses and squids
- Most molluscs are marine, though some inhabit fresh water and some are terrestrial
- Molluscs are soft-bodied animals, but most are protected by a hard shell

Phylum Mollusca

- All molluscs have a similar body plan with three main parts:
  - **Muscular foot**
  - **Visceral mass**
  - **Mantle** (secretes the shell)
  - **Mantle cavity** (for breathing and excretion)
- Many molluscs also feed using a rasp like **radula**

Phylum Mollusca - a generalised body plan



▲ **Figure 33.15** **The basic body plan of a mollusc.**

Phylum Mollusca

- There are four major classes of molluscs:
  - **Polyplacophora** (chitons)
  - **Gastropoda** (snails and slugs)
  - **Bivalvia** (clams, oysters, and other bivalves)
  - **Cephalopoda** (squids, octopuses, cuttlefish, and nautiluses)

▲ **Figure 33.16 A chiton.** Note the eight-plate shell characteristic of molluscs in the class Polyplacophora.

▲ **Figure 33.19 A bivalve.** This scallop has many eyes (dark blue spots) peering out from each half of its hinged shell.

(a) A land snail

(b) A sea slug. Nudibranchs, or sea slugs, lost their shell during their evolution.

▶ Octopuses are considered among the most intelligent invertebrates.

▼ Squids are speedy carnivores with beak-like jaws and well-developed eyes.

◀ Chambered nautiluses are the only living cephalopods with an external shell.

▲ **Figure 33.21 Cephalopods.**

Phylum Arthropoda

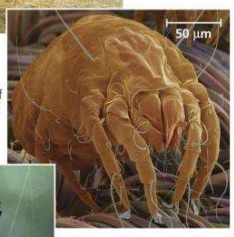
(Arthro – jointed, Poda – foot)

- Two out of every three known species of animals are arthropods!
- The largest and most diverse Phyla
- Members of the phylum Arthropoda are found in nearly all habitats of the biosphere
- The arthropod body plan consists of a **segmented body, hard exoskeleton, and jointed appendages**.

Phylum Arthropoda

- Includes Insects, Crustaceans and Spiders
- The body of an arthropod is completely covered by the cuticle, an exoskeleton made of layers of protein and the polysaccharide Chitin
- When an arthropod grows, it must shed or moult its exoskeleton

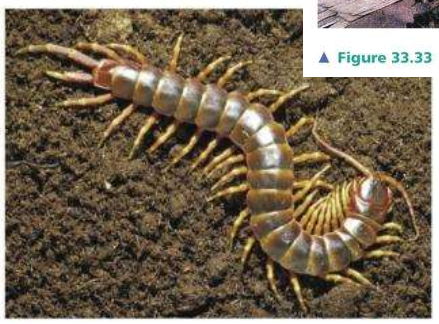
▲ Scorpions have pedipalps that are pincers specialized for defense and the capture of food. The tip of the tail bears a poisonous stinger.



▲ Dust mites are ubiquitous scavengers in human dwellings but are harmless except to those people who are allergic to them (colorized SEM).

◀ Web-building spiders are generally most active during the daytime.

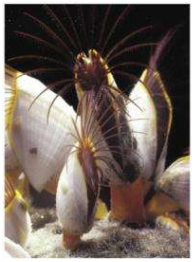
▲ **Figure 33.33** **A millipede.**



▲ **Figure 33.34** **A centipede.**

(a) Ghost crabs live on sandy ocean beaches worldwide. Primarily nocturnal, they take shelter in burrows during the day.

(b) Mountain shrimp, living fossils from the Triassic period represent one of Australia's threatened freshwater shrimp species.



(c) The jointed appendages projecting from the shells of these barnacles capture organisms and organic particles suspended in the water.

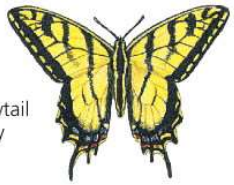
▲ **Figure 33.38** **Crustaceans.**

German cockroach

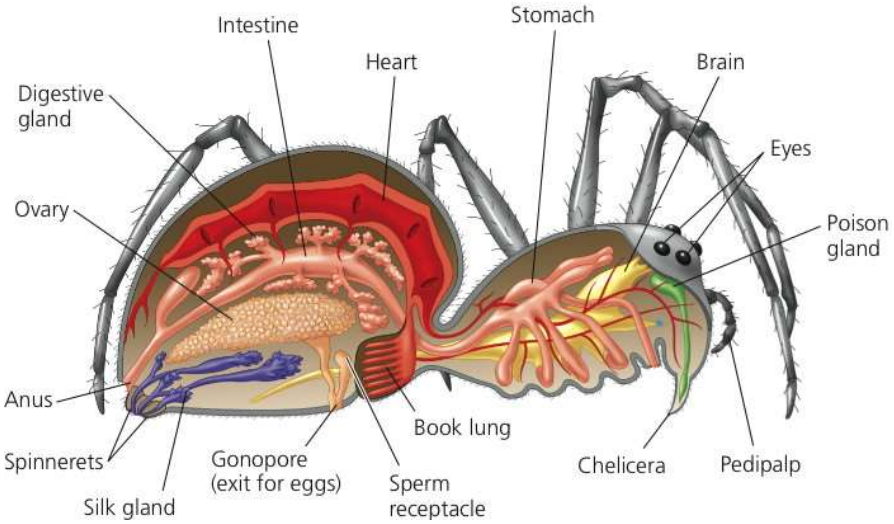
Japanese beetle

Horsefly

Swallowtail butterfly



Phylum Arthropoda



Phylum Echinodermata

(Echino – spiny, Dermis – skin)

- Sea stars and most other echinoderms are slow-moving or sessile marine animals
- A thin epidermis covers an **endoskeleton of hard calcareous plates.**
- Echinoderms have a unique **water vascular system**, a network of hydraulic canals branching into tube feet that function in locomotion, feeding, and gas exchange
- Males and females are usually separate, and sexual reproduction is external

Phylum Echinodermata

- Living echinoderms are divided into six classes:

a) **Asteroidia** (sea stars)

b) **Ophiuroidea** (brittle stars)

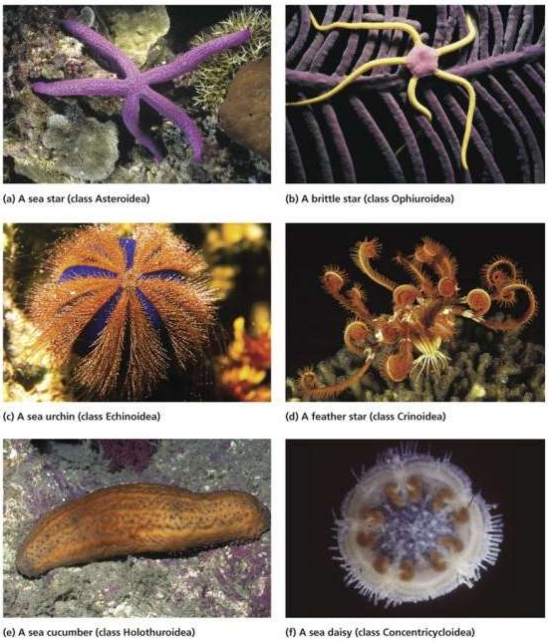
c) **Echinoidea** (sea urchins and sand dollars)

d) **Crinoidea** (sea lilies and feather stars)

e) **Holothuroidea** (sea cucumbers)

f) **Concentricycloidea** (sea daisies)

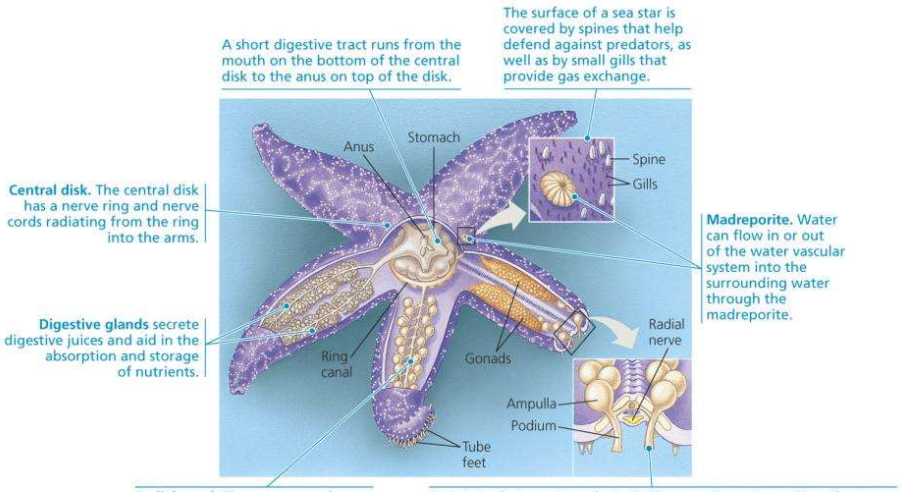
will be investigated in practical 1



(a) A sea star (class Asteroidea) (b) A brittle star (class Ophiuroidea)

(c) A sea urchin (class Echinoidea) (d) A feather star (class Crinoidea)

(e) A sea cucumber (class Holothuroidea) (f) A sea daisy (class Concentricycloidea)

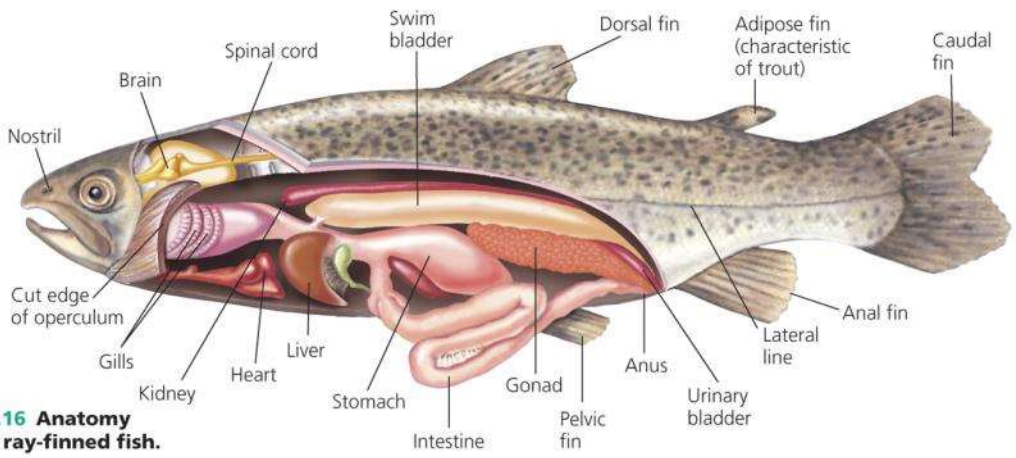


▲ Figure 33.39 **Anatomy of a sea star, an echinoderm.**

Phylum Chordata

- All chordates share a set of derived characters
- Some species have some of these traits only during embryonic development
- Four key characters of chordates:
  - **Notochord** (becomes the spine)
  - **Dorsal, hollow nerve cord**
  - **Pharyngeal slits or clefts** (become gills or jaw)
  - **Muscular, post-anal tail**

Phylum Chordata



▲ **Figure 34.16 Anatomy of a trout, a ray-finned fish.**

Practical 1 – Animal Diversity

- Pre lab quiz – complete online on Moodle
- Pre lab task – Animal diversity table
  (hand in to demonstrator at practical)
- Print out, **read** and take to Practical class the Laboratory Instructions
  (available on Moodle)
- Read Appendix 2 – Biological Drawings
  - Important component of all Practicals
  - Your record of what you observed
  - Sometimes better than photos because you can focus/highlight different features.

Dichotomous key

- Dichotomous - "divided or dividing into two parts" (from Dictionary.com)
- Dichotomous key - a tool used to identify organisms based on defining characteristics.
- At each step two options are given leading to another step with two options, until the organism is identified

For example (from prac manual)

1a Walking legs present on abdomen…go to 2
1b Walking legs absent on abdomen …go to 3

2a Antennae, two pairs; body colour red…Class Crustacea
2b Antennae, one pair; body colour other than red…go to 4

How to construct a Dichotomous Key – you will be doing this in the Practical 1

- Observe the characteristics of the organisms that you want to identify
- Make a list of the characteristics that can be used to sort the organisms
- Start with one characteristic and divide the organisms into two groups
- Continue until all organisms are identified

Example 1

Example 2

1.	a. Needle leaves	go to 2
	b. Non-needle leaves	go to 3
2.	a. Needles are clustered	Pine
	b. Needles are in singlets	Spruce
3.	a. Simple leaves (single leaf)	go to 4
	b. Compound leaves (made of "leaflets")	go to 7
4.	a. Smooth edged	go to 5
	b. Jagged edge	go to 6
5.	a. Leaf edge is smooth	Magnolia
	b. Leaf edge is lobed	White Oak
6.	a. Leaf edge is small and tooth-like	Elm
	b. Leaf edge is large and thorny	Holly
7.	a. Leaflets attached at one single point	Chestnut
	b. Leaflets attached at multiple points	Walnut