Phylum Mollusca

Phylum Mollusca

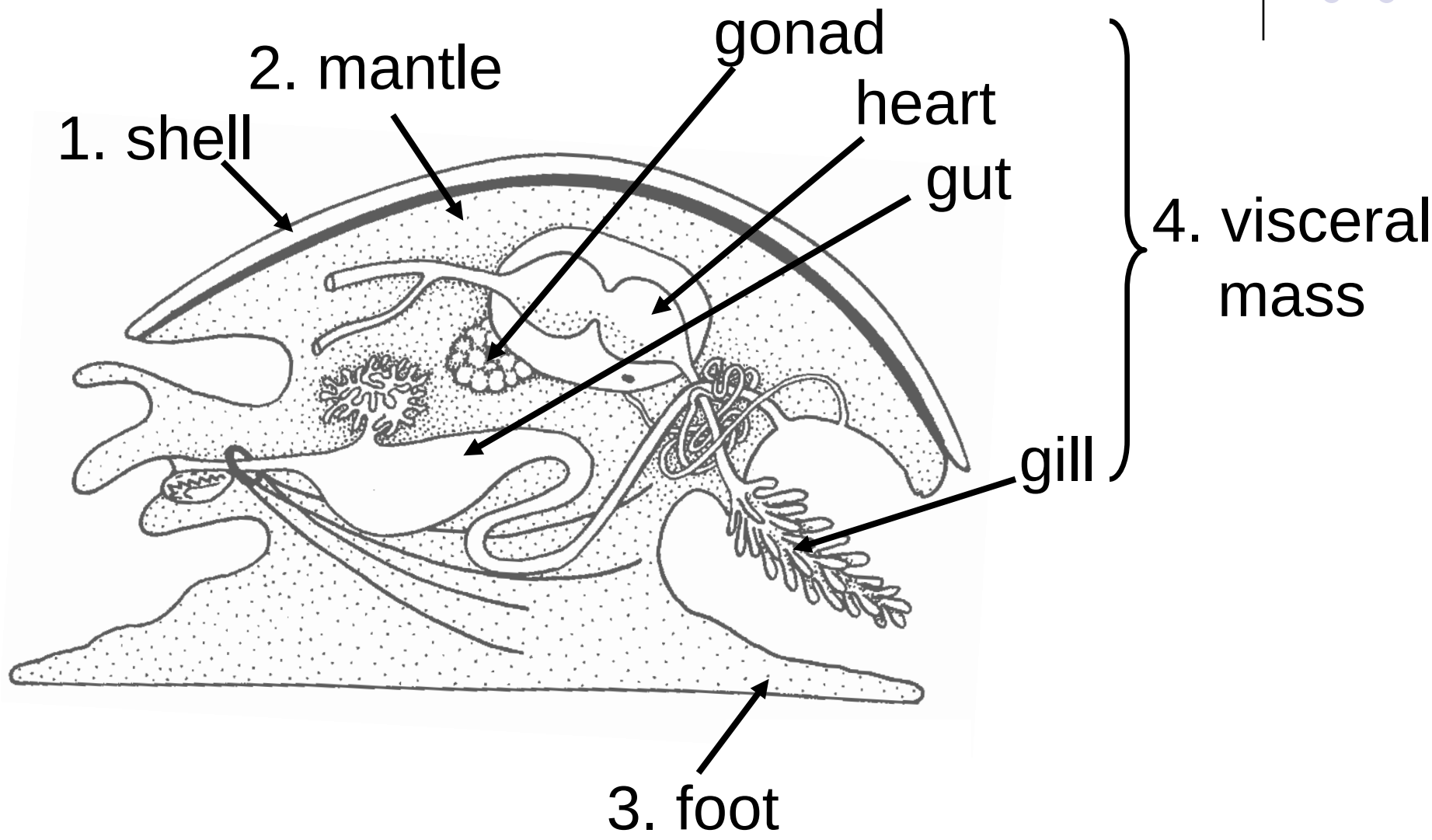
- 3 embryonic germ layers
- true coelom
- complete gut
- second largest phylum of animals, around 100,000 species
- mainly aquatic, but some terrestrial species

Basic mollusc body plan

A typical mollusc has these 4 features:

1. shell = a protective covering for the body, protein hardened by calcium carbonate
2. mantle = tissue layer surrounding the body, makes the shell and forms a cavity
3. foot = a muscular organ adapted for crawling, burrowing, or holding prey
4. visceral mass = the internal organs

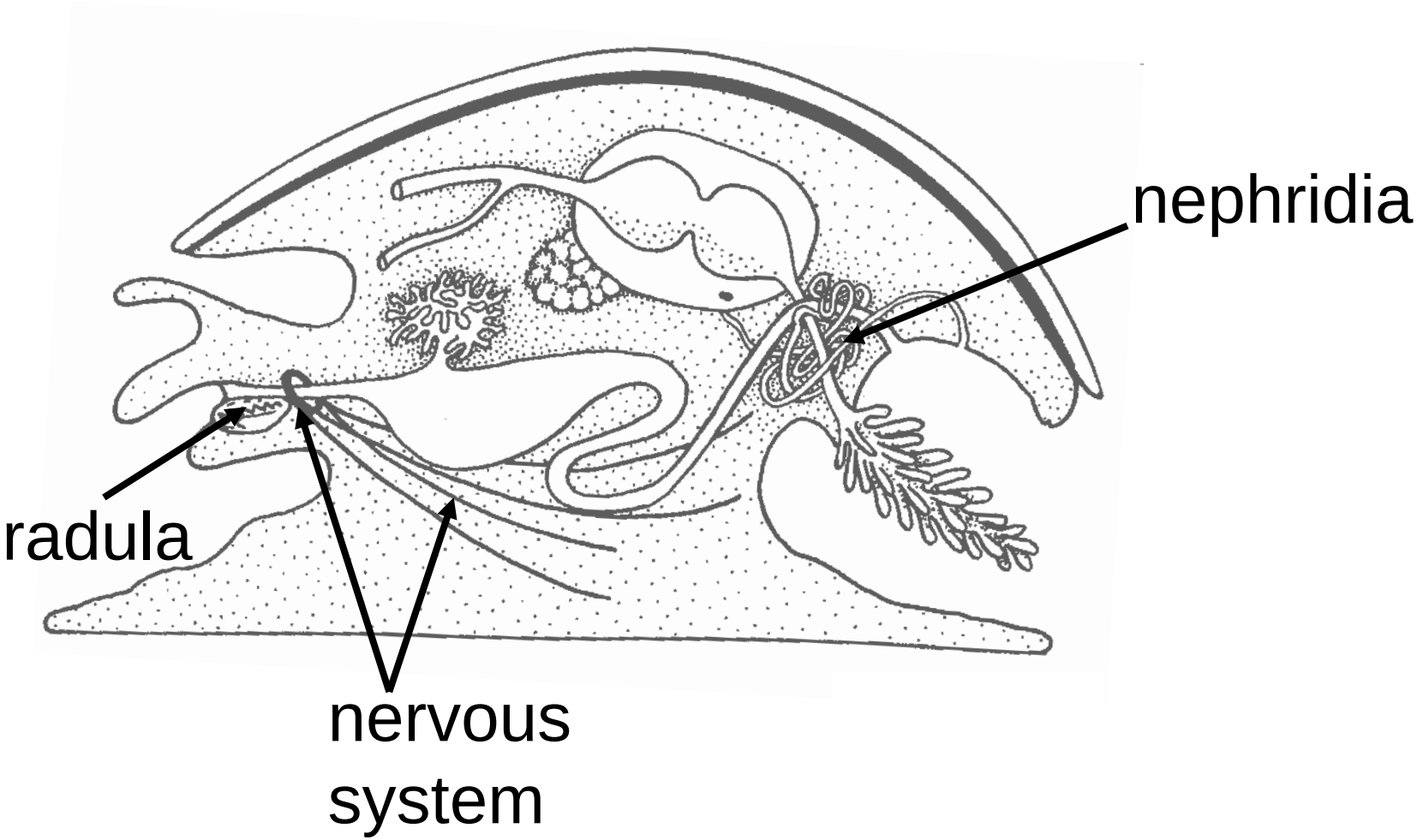
Basic mollusc body plan



Organ systems

- many molluscs have a toothed tongue-like organ called the radula, used for feeding
- coelom is small, surrounds the heart and gonads
- a pair of nephridia collect waste from the coelom and release it into the mantle cavity
- simple brain and two paired ventral nerve cords: one for the visceral mass and one for the foot

Basic mollusc body plan



Circulatory system

- primitive molluscs have an open circulatory system: blood is pumped into spaces inside the body and makes its way back to the heart
- advanced molluscs are more active and have a closed circulatory system
- blood passes through a gill in the mantle cavity for respiration

Life cycle of molluscs

- most go through a series of larval stages that look very different from the adult
- molluscs are related to annelids: they share a larval stage called the trochophore:

trochophore larva = larval stage of molluscs and annelids with several bands of cilia and a tuft of flagella


trochophore

Molluscan diversity

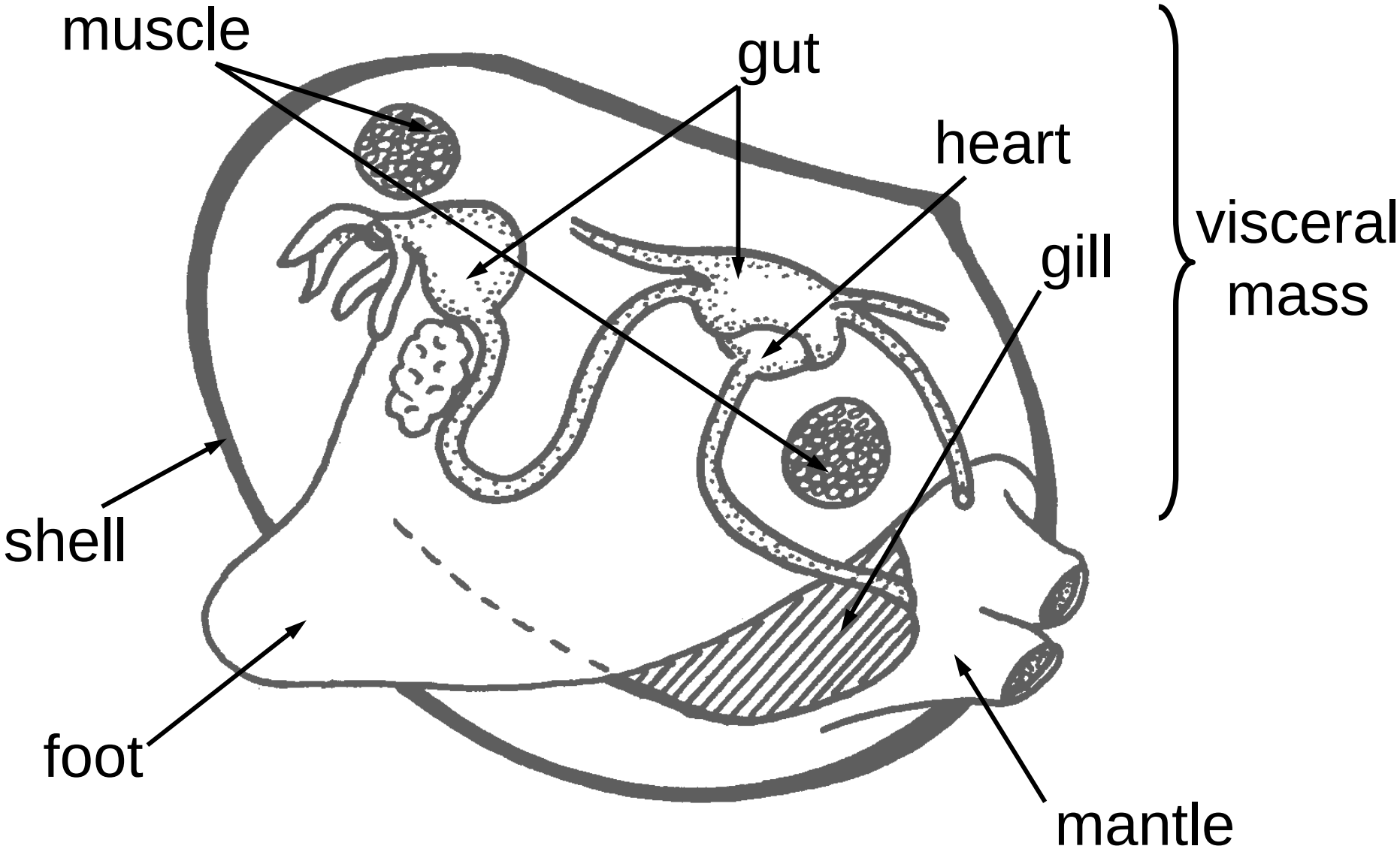
Molluscan diversity

There are 3 main groups of living molluscs:

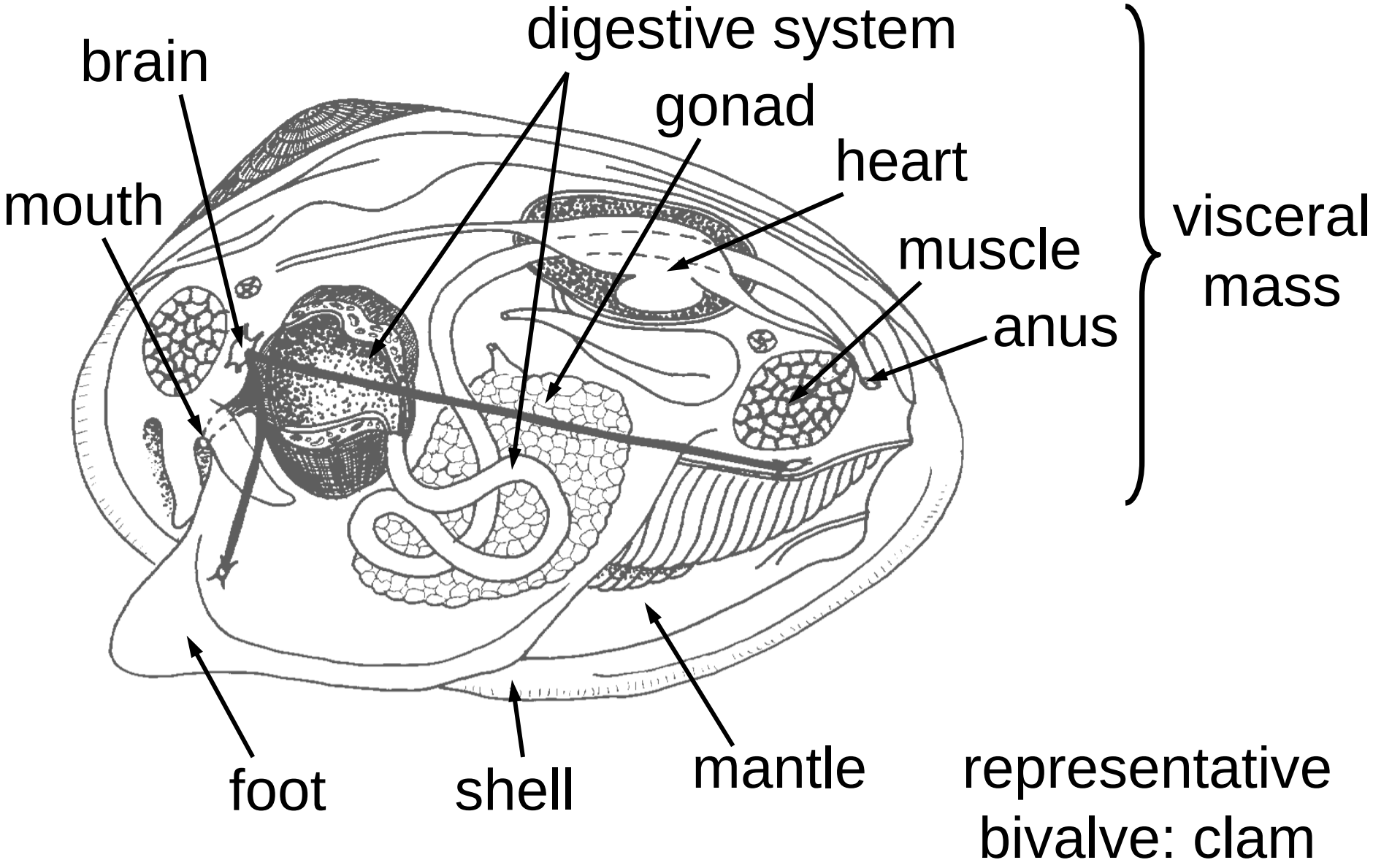
1. Class Bivalvia – clams
2. Class Gastropoda – snails, slugs
3. Class Cephalopoda – squid, cuttlefish, octopus

Class Bivalvia

- shell is a pair of identical halves that fit tightly together; muscles run between the shells and hold them closed
- foot is short and muscular, used for digging into soft sediments
- filter feeders that pump water into their burrows and trap food in their gills

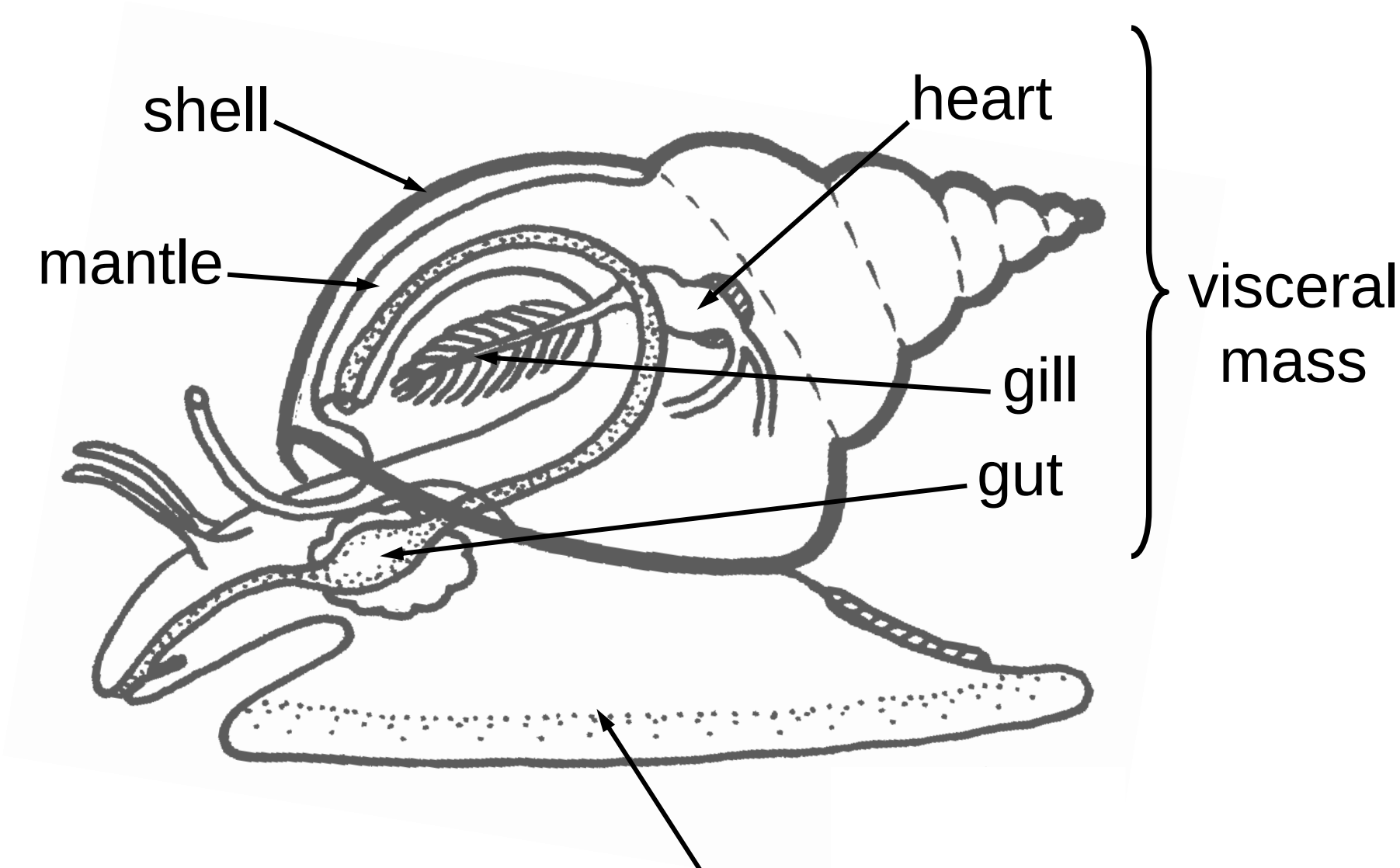


representative bivalve: clam


digestive system
brain
gonad
heart
mouth
muscle
visceral mass
anus
foot
shell
mantle
representative bivalve: clam

Class Gastropoda

- shell is coiled, though this is lost in slugs
- foot is a flat creeping organ
- head and foot can be pulled into the shell when threatened
- grazers that scrape algae and other food off of surfaces with their radula

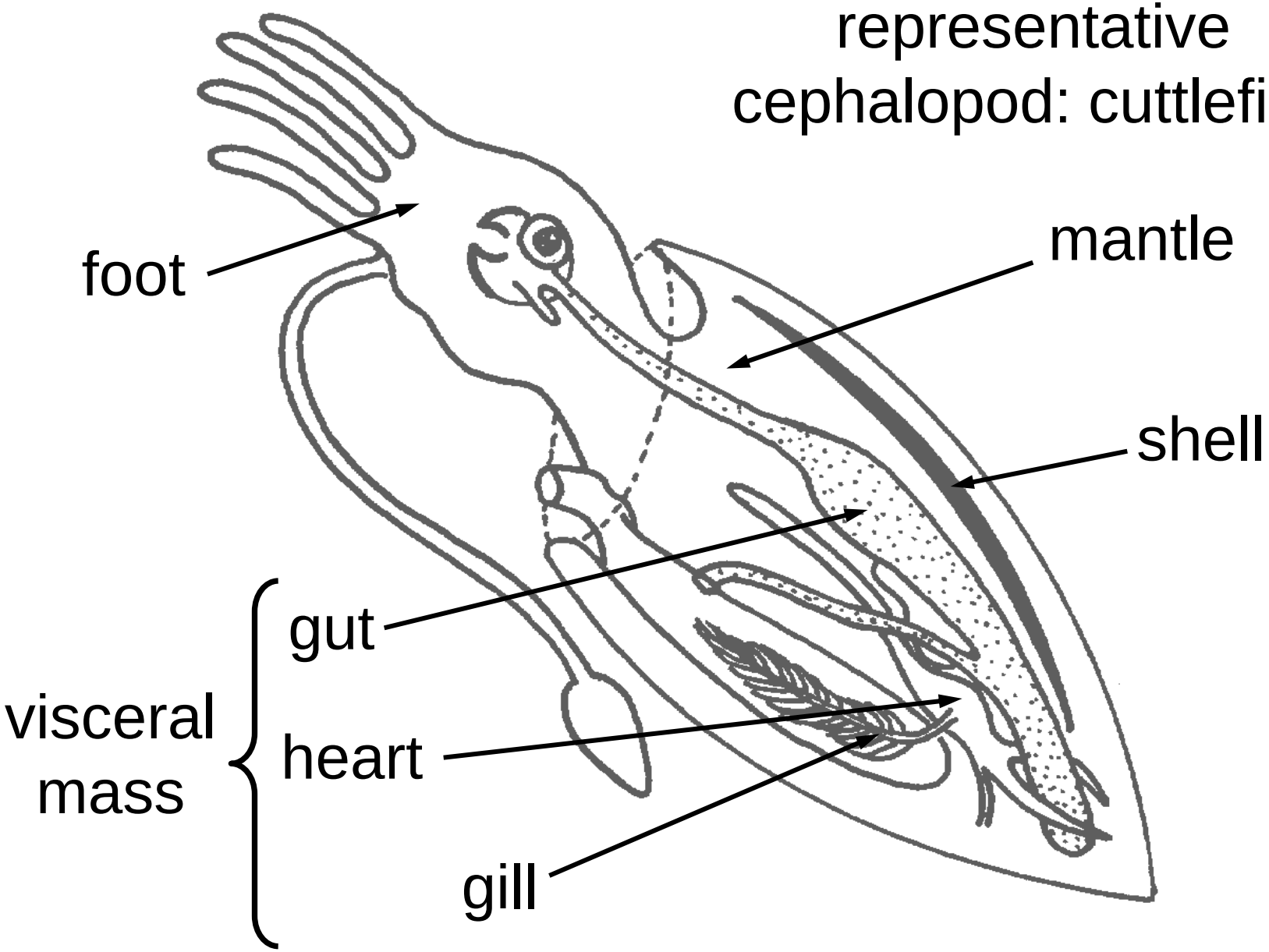


representative
gastropod: snail

Class Cephalopoda

- earliest cephalopods have a coiled shell for buoyancy, but this is gradually reduced – the octopus has no shell at all
- foot modified to form tentacles that are used for feeding
- the mantle is used to create jets of water for moving around
- active and intelligent predators

representative
cephalopod: cuttlefish

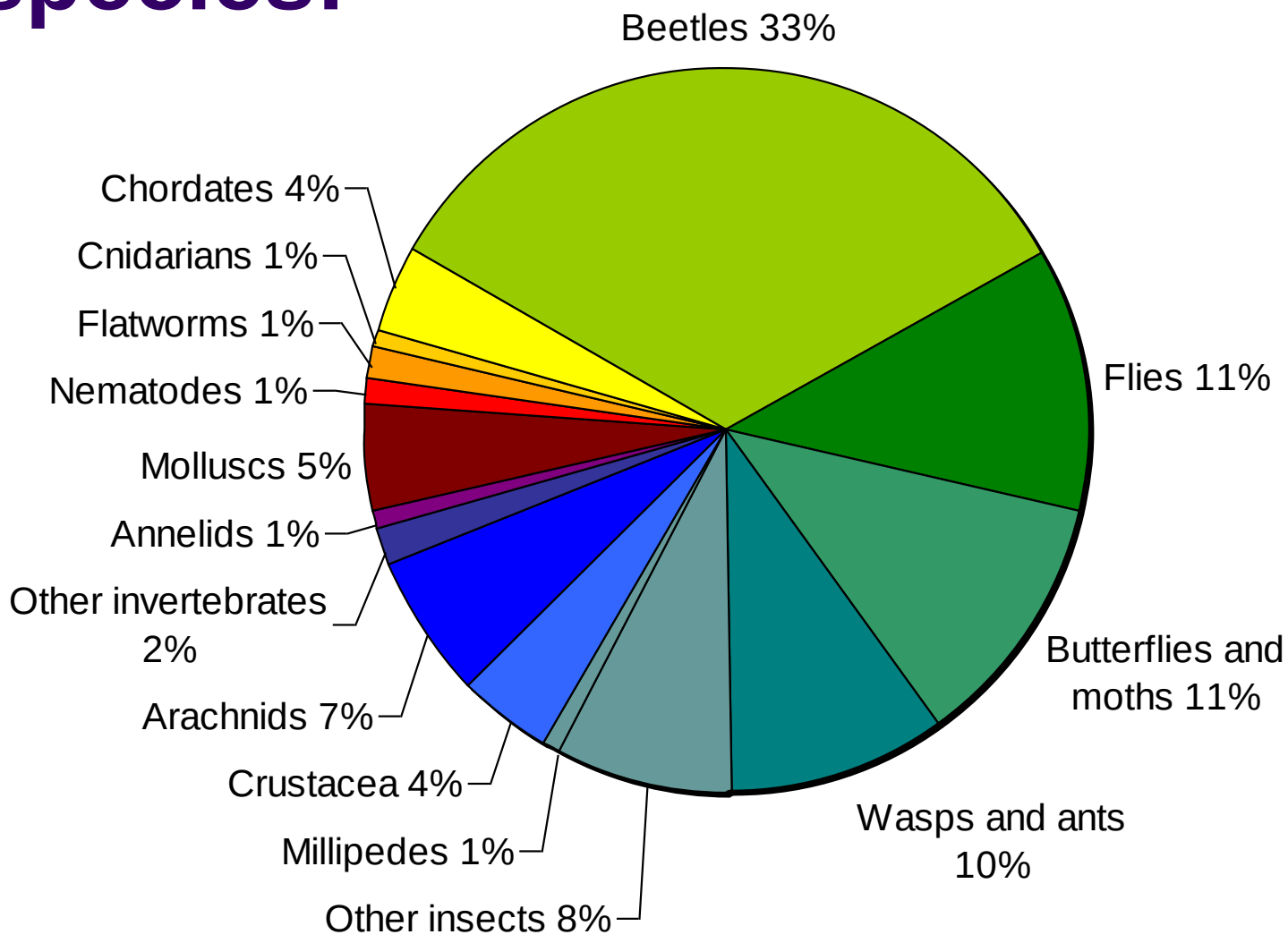


Phylum Arthropoda

Phylum Arthropoda

- 3 embryonic germ layers
- true coelom
- complete gut
- segmented
- have an external skeleton, or exoskeleton
- most successful animals on Earth – around 1 million species!

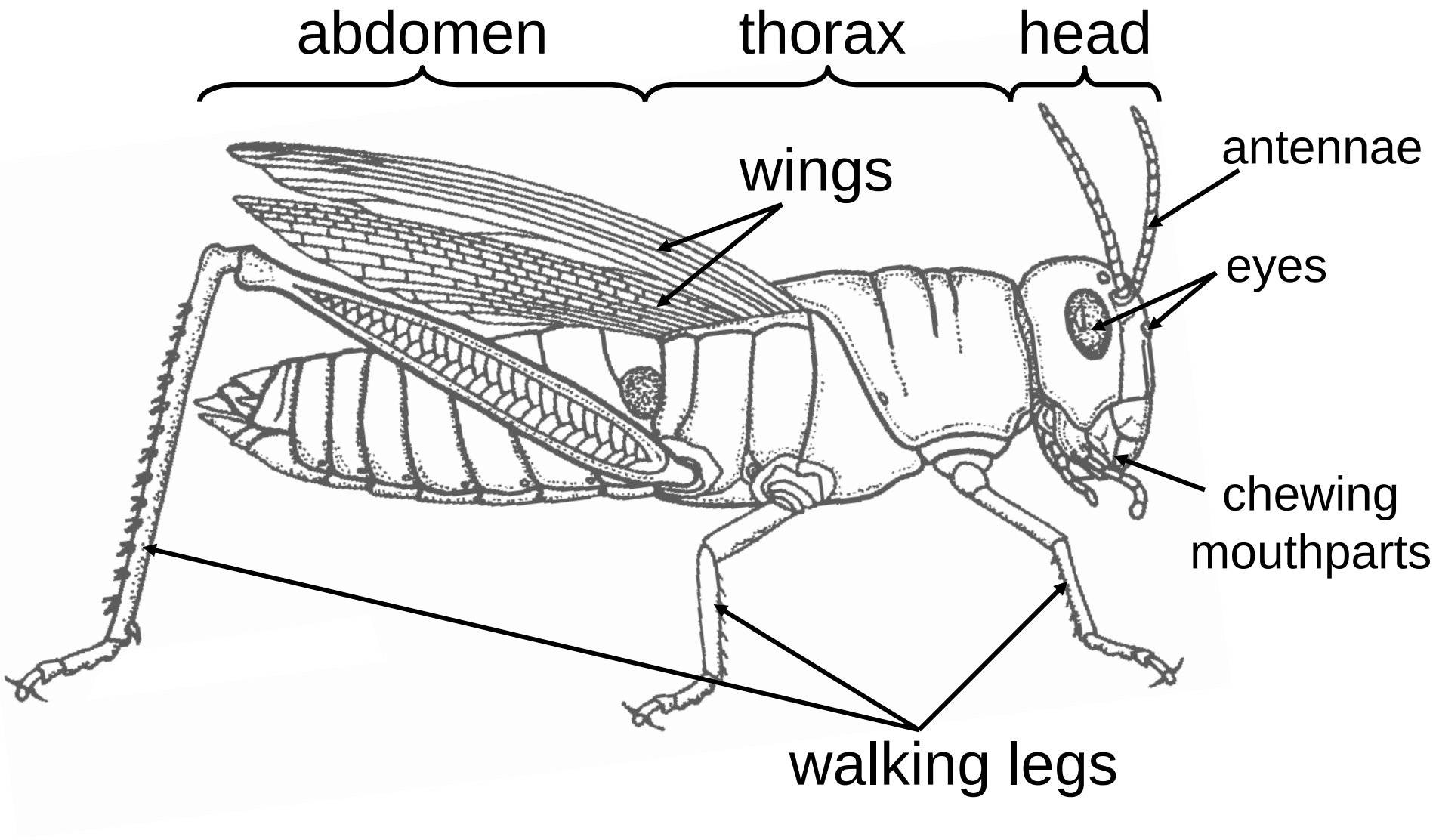
Total number of animal species:



Basic arthropod body plan

The body is made of 3 main parts:

1. head – contains the eyes, antennae, and legs modified to form chewing mouth parts
2. thorax – contains the walking legs and wings (if present)
3. abdomen – contains no legs, but most of the organs, and the tip may have a stinger, pincer, etc.



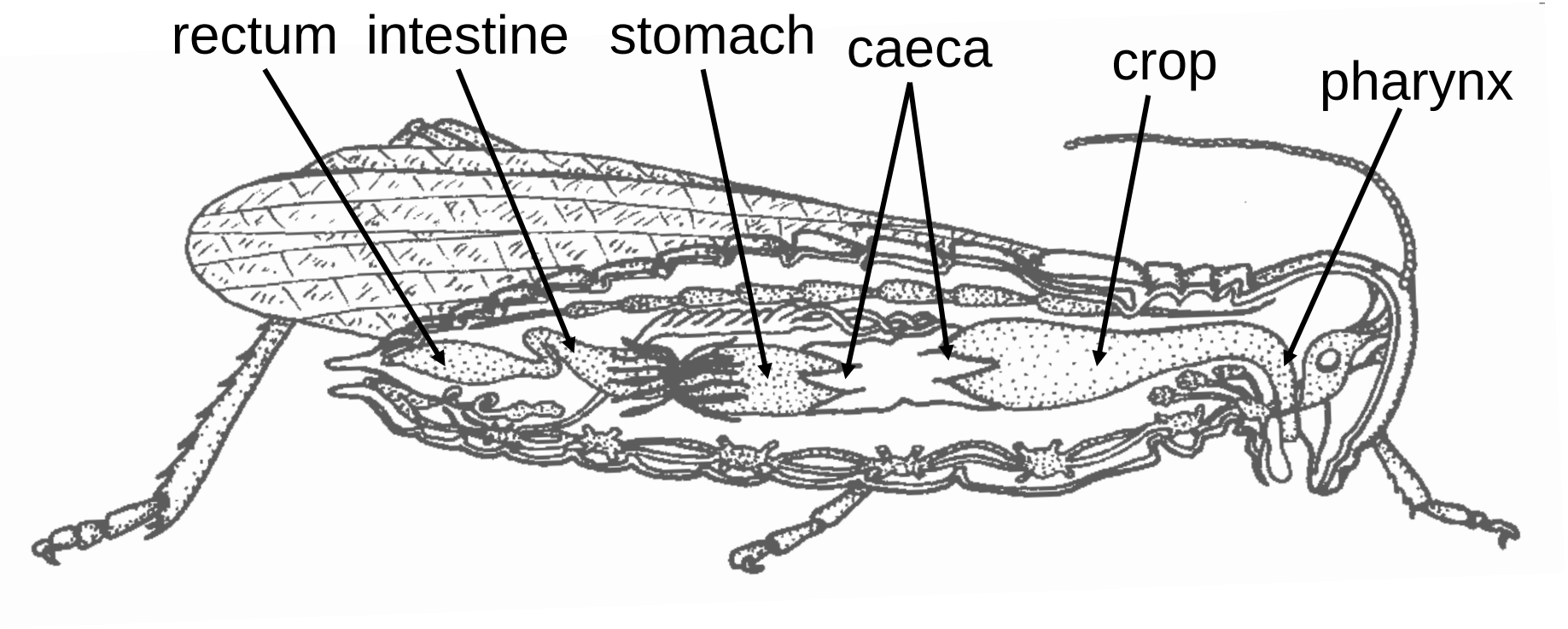
representative arthropod: grasshopper

Digestive system

The gut contains, in order from mouth to anus, the following organs:

1. pharynx = mouth cavity, chewing occurs here
2. crop = filled with food to be digested later
3. caeca = release digestive juice into stomach
4. stomach = absorbs nutrients from food
5. intestine = packs waste and digested food
6. rectum = faeces stored before expulsion

grasshopper internal anatomy

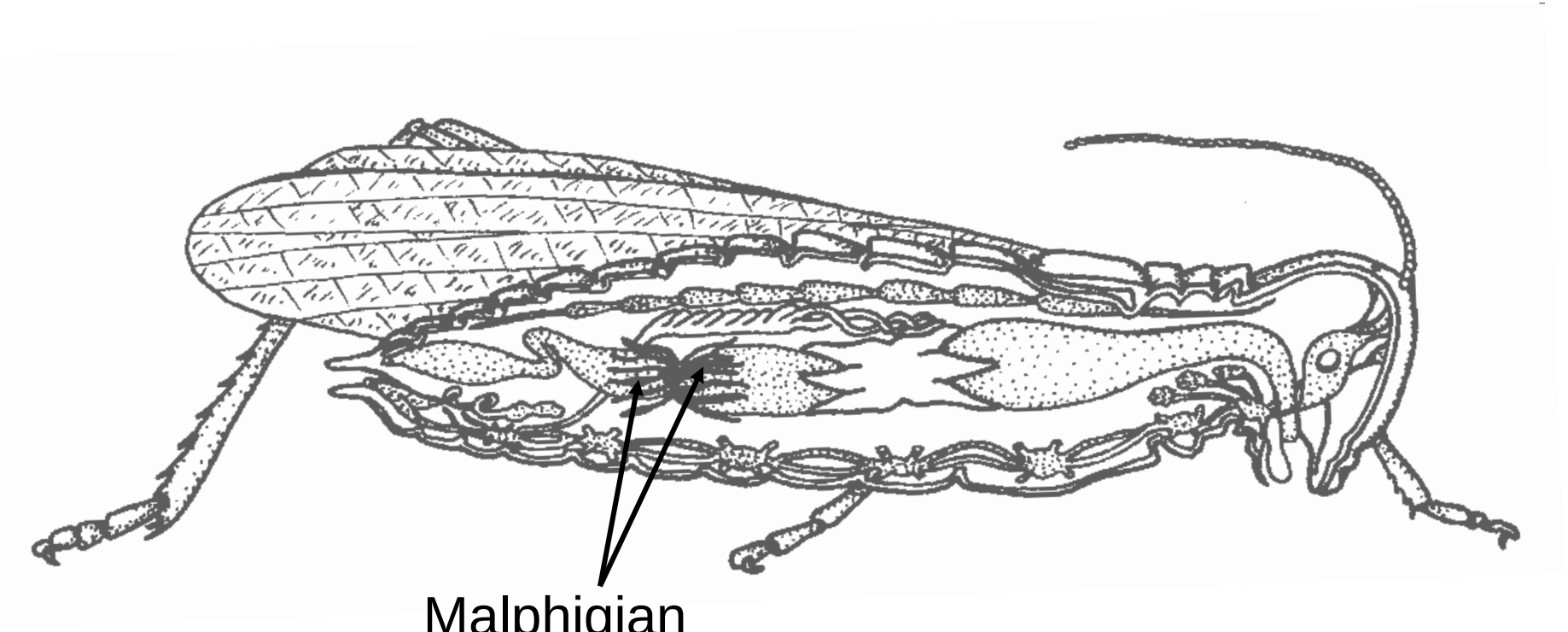


Excretory system

- crustaceans excrete waste as ammonia directly out of the gills
- insects have excretory organs called Malphigian tubules:

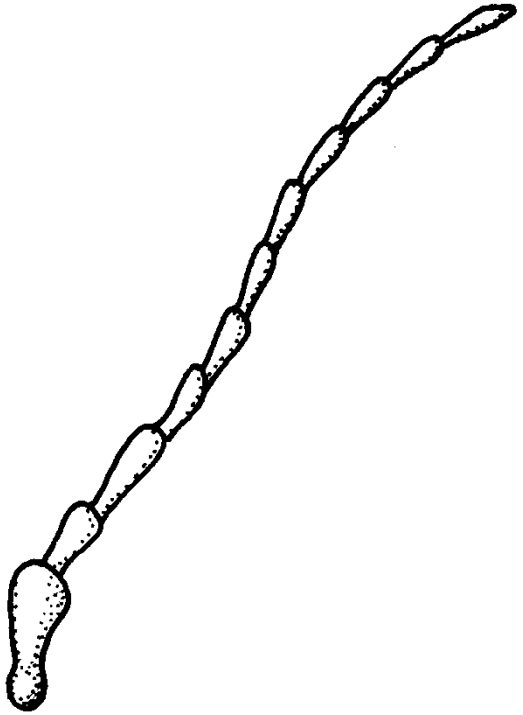
Malphigian tubules = organs which collect waste from the coelom and release it in the intestine

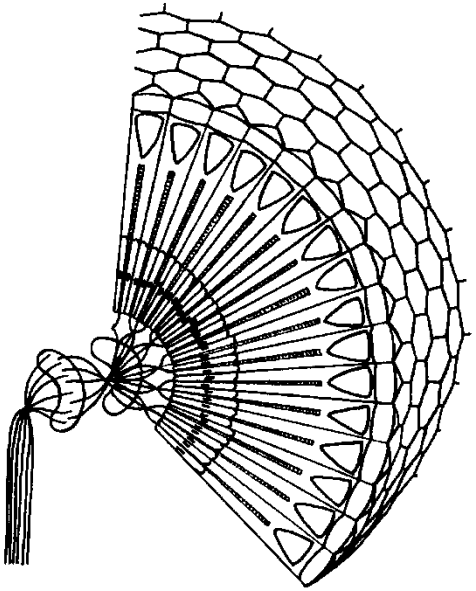
grasshopper internal anatomy (cont.)



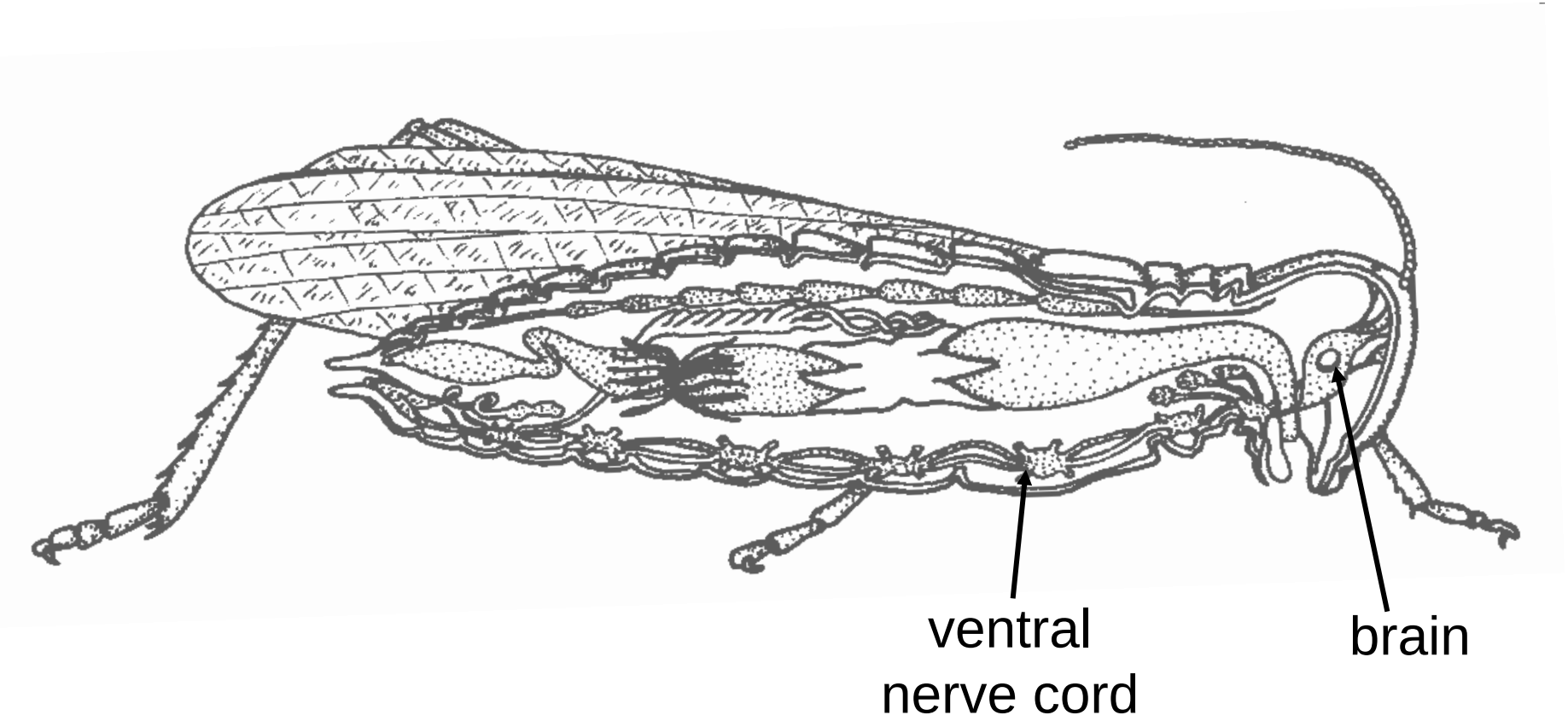
Nervous system

- small brain connected to paired ventral nerve cords
- most have jointed antennae which detect touch, vibrations, heat, or chemicals
- many have well-developed eyes which can be simple or compound





grasshopper internal anatomy (cont.)



Quiz tomorrow!

Identify and give the functions of the *internal* anatomy of a grasshopper:

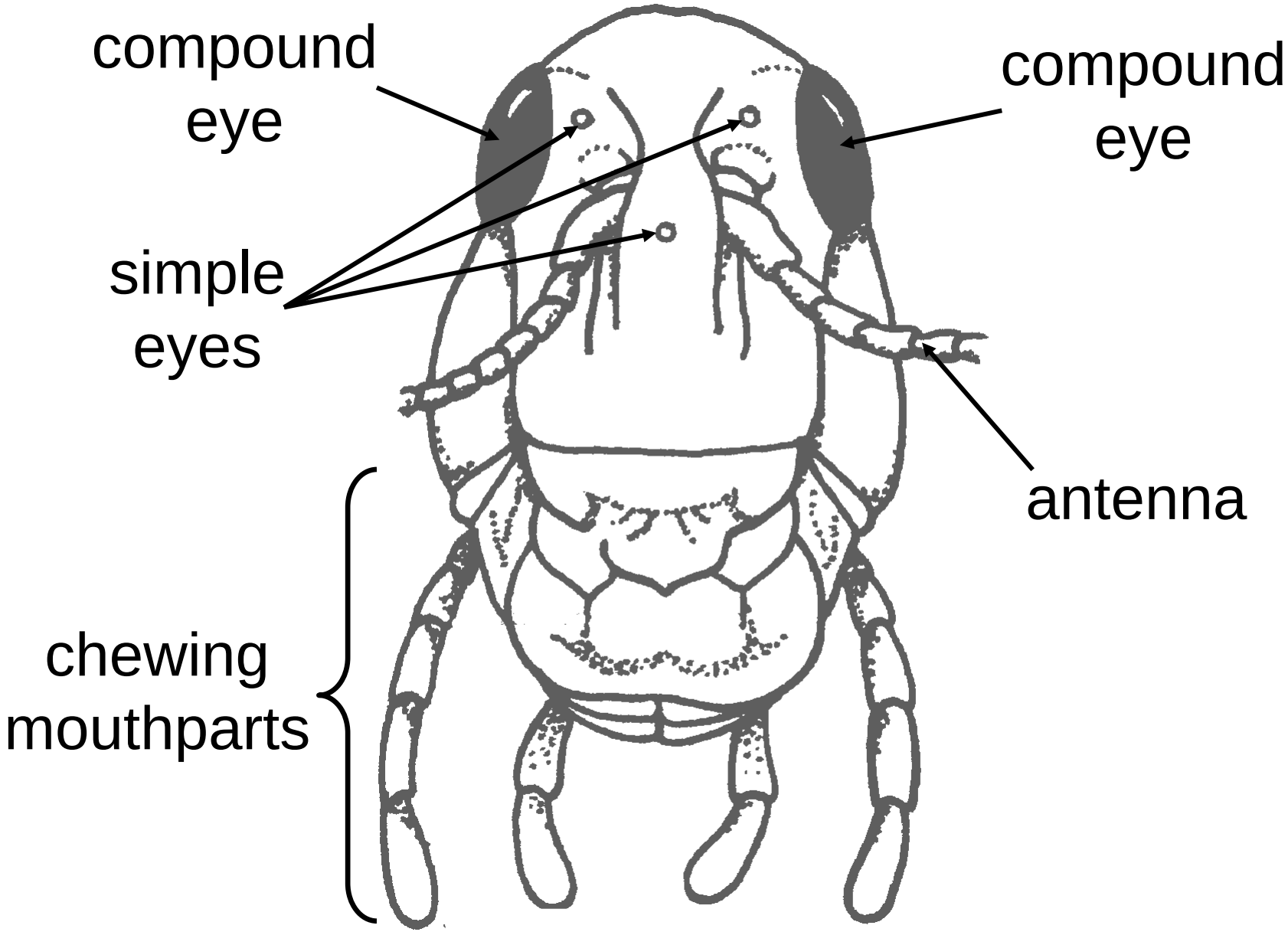
- page 26 of your notes, with the diagram at the bottom of the page

Grasshopper Dissection

Grasshopper dissection

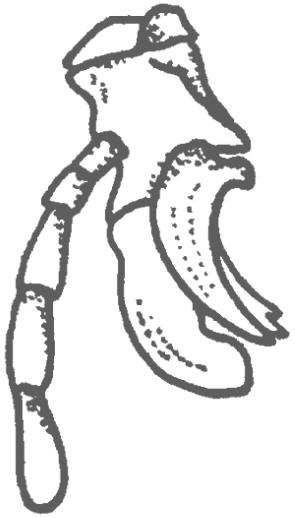
The plan is as follows:

1. external features – before cutting anything:
   A. observe the external anatomy
   B. label and colour the diagram
   C. list the functions of the anatomy
2. internal features
   A. observe the internal anatomy
   B. label and colour the diagram
   C. list the functions of the anatomy
3. answer Discussion questions

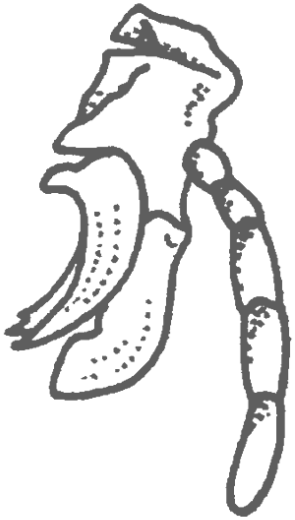

compound eye
compound eye
simple eyes
antenna
chewing mouthparts

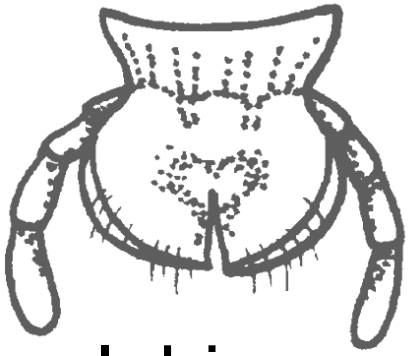
labrum

mandible
(paired)



maxilla
(paired)





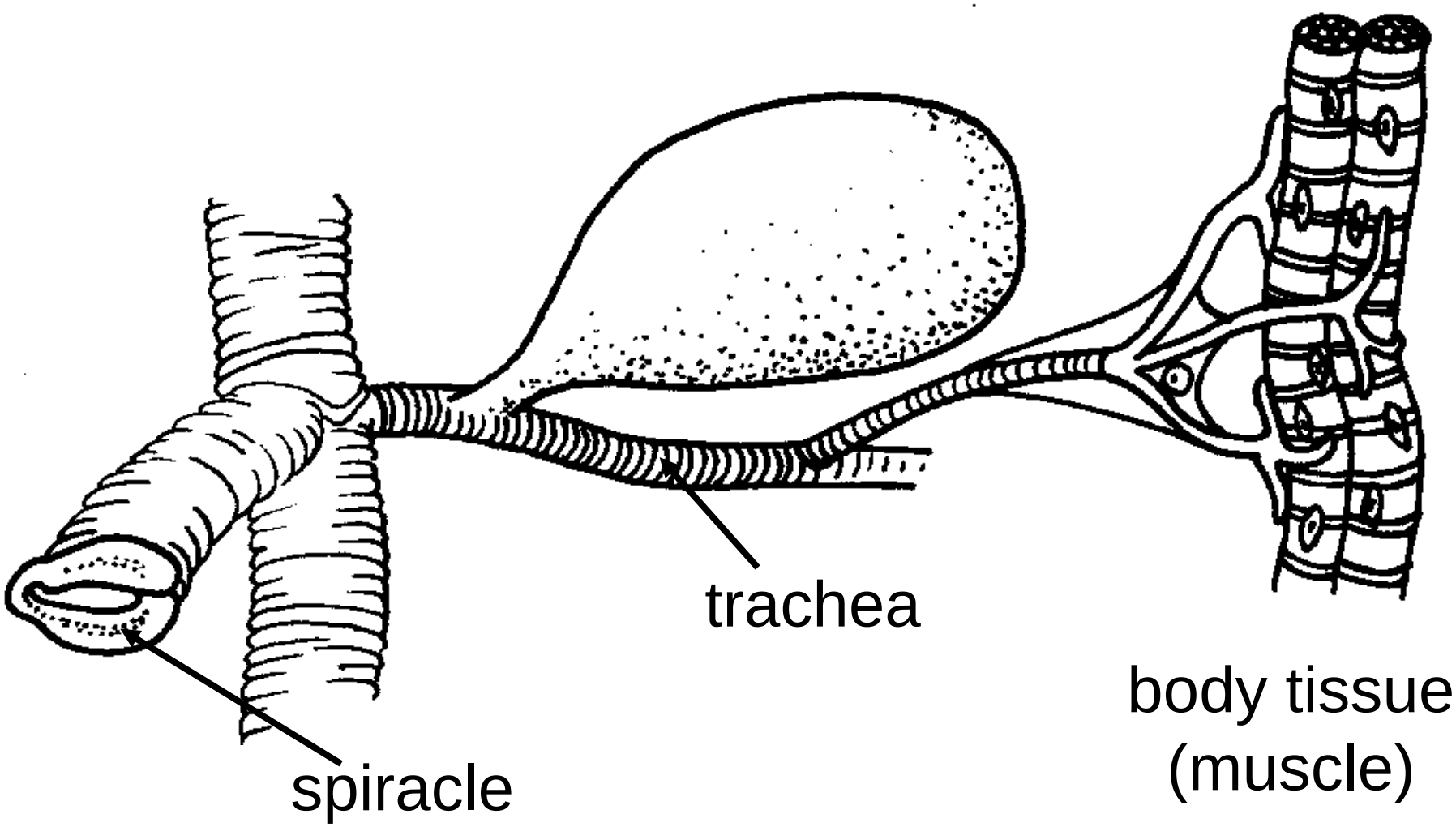
labium

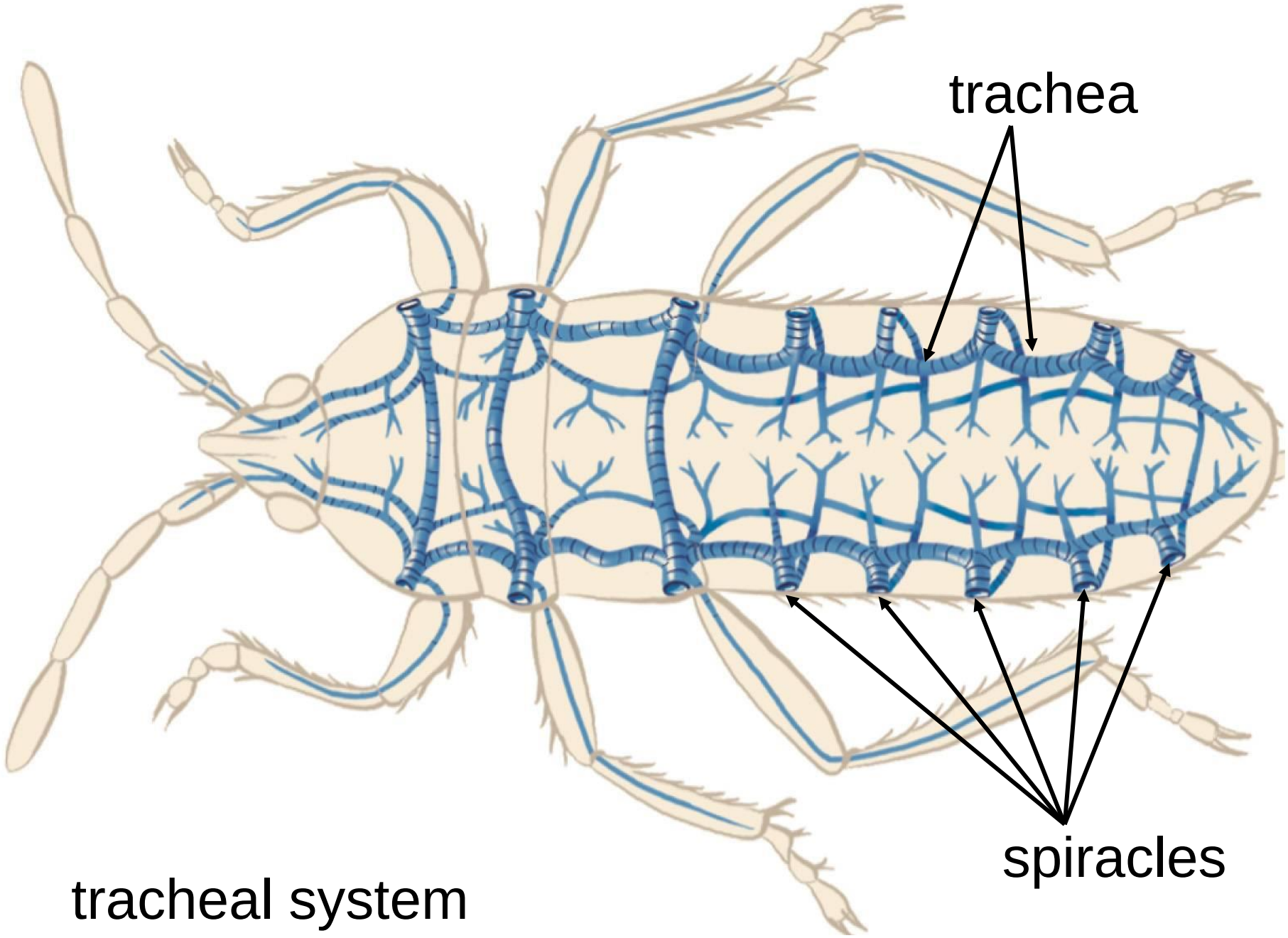
Arthropod anatomy (cont.) and Crustaceans

Circulatory system

- an open circulatory system with a long dorsal blood vessel serving as a heart
- the coelom is filled with blood and bathes the organs
- aquatic arthropods have gills (modified legs)
- terrestrial arthropods have a tracheal system: openings called spiracles lead to branching tubes (trachea) that bring air to the body

Tracheal system of an insect





tracheal system

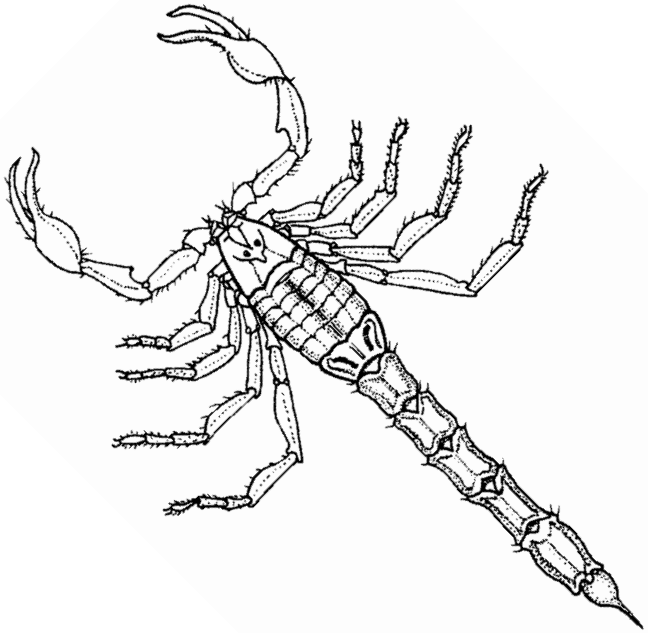
Exoskeleton

- the exoskeleton of arthropods is nearly waterproof
- the outer layer is hard and contains chitin, a molecule similar to cellulose or starch
- because it is an external skeleton, the muscles must attach to the inside
- the exoskeleton must be shed to allow the animal to grow – this is called moulting

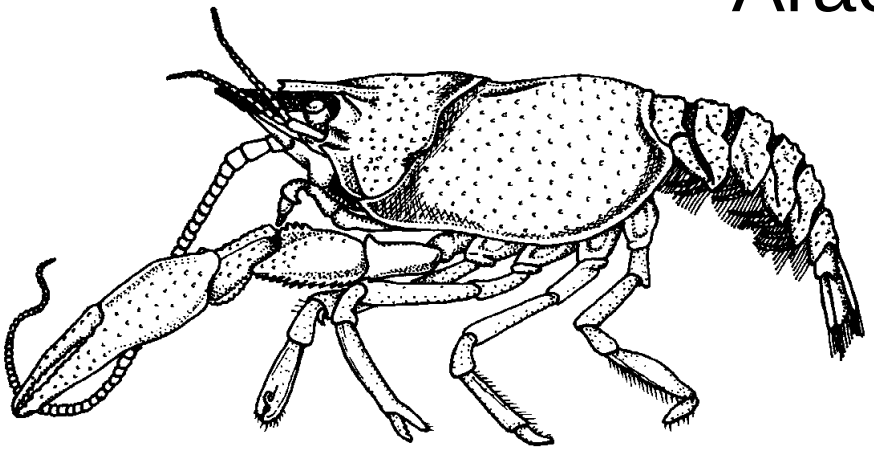
Arthropod diversity

We will look at three groups of arthropods:

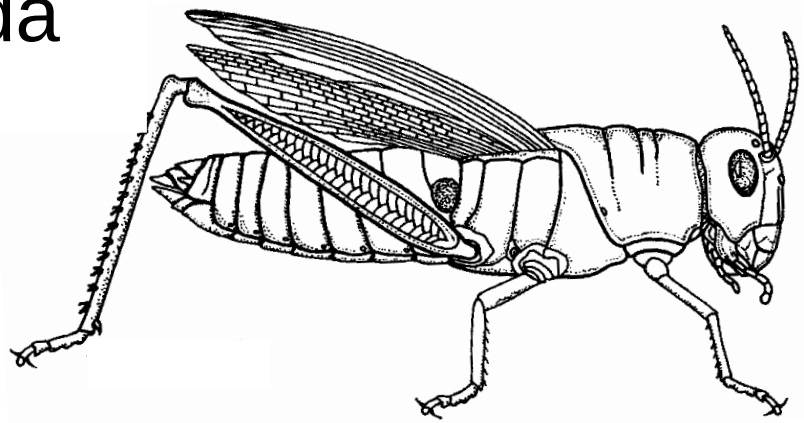
1. Crustaceans – crabs, lobsters, barnacles
2. Arachnids – spiders, scorpions, mites
3. Insects – centipedes, millipedes, beetles, flies, wasps, etc.



Arachnida



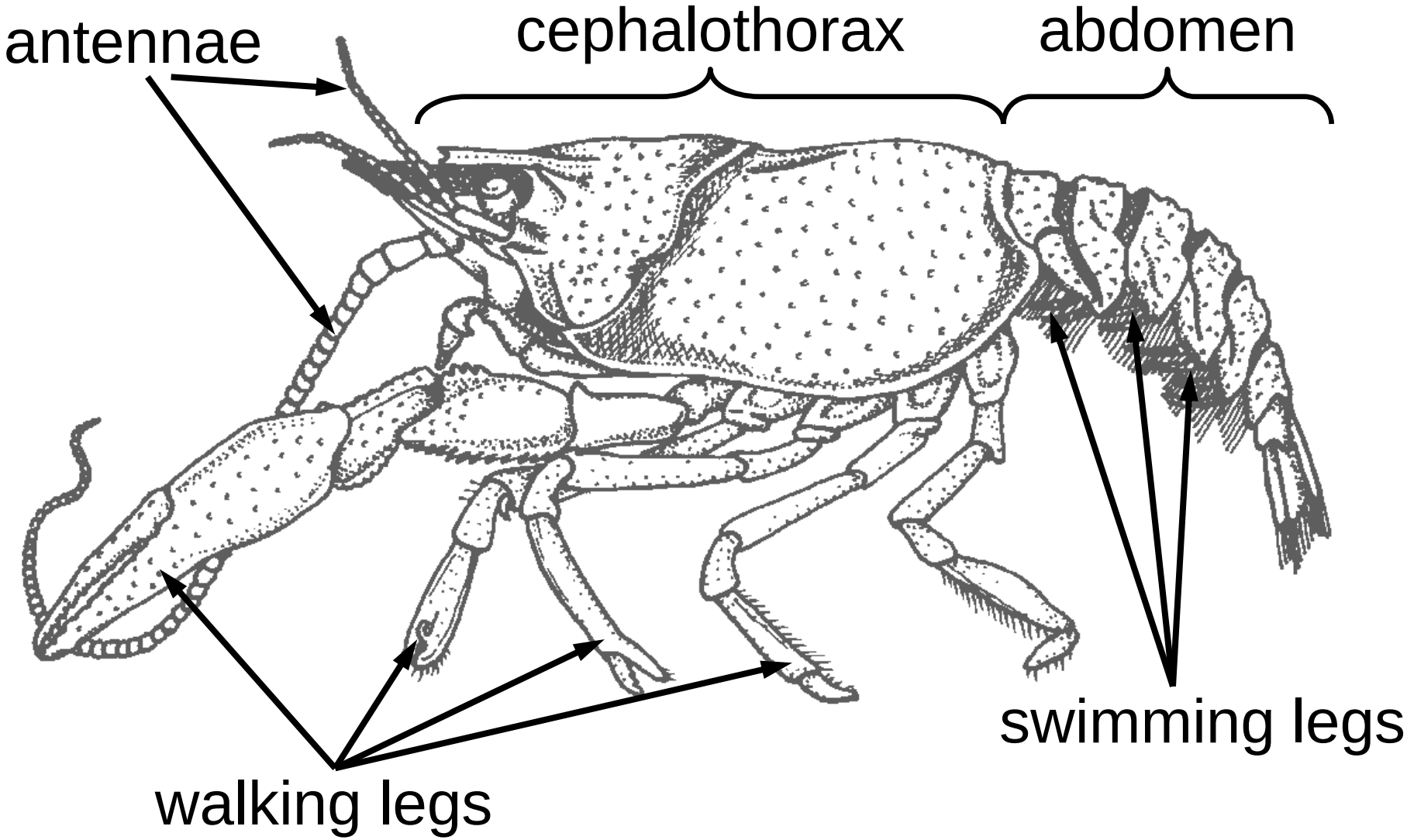
Crustacea



Insecta

Crustaceans

- two pairs of antennae
- legs have two branches
- the head and thorax are fused to form a cephalothorax
- many walking legs (up to 20), with swimming legs on the abdomen
- mainly marine, also freshwater and some terrestrial


antennae
cephalothorax
abdomen
swimming legs
walking legs

Diversity of crustaceans

barnacles = begin life as a typical crustacean larva, which glues its head to the rock and metamorphoses; legs are used for feeding

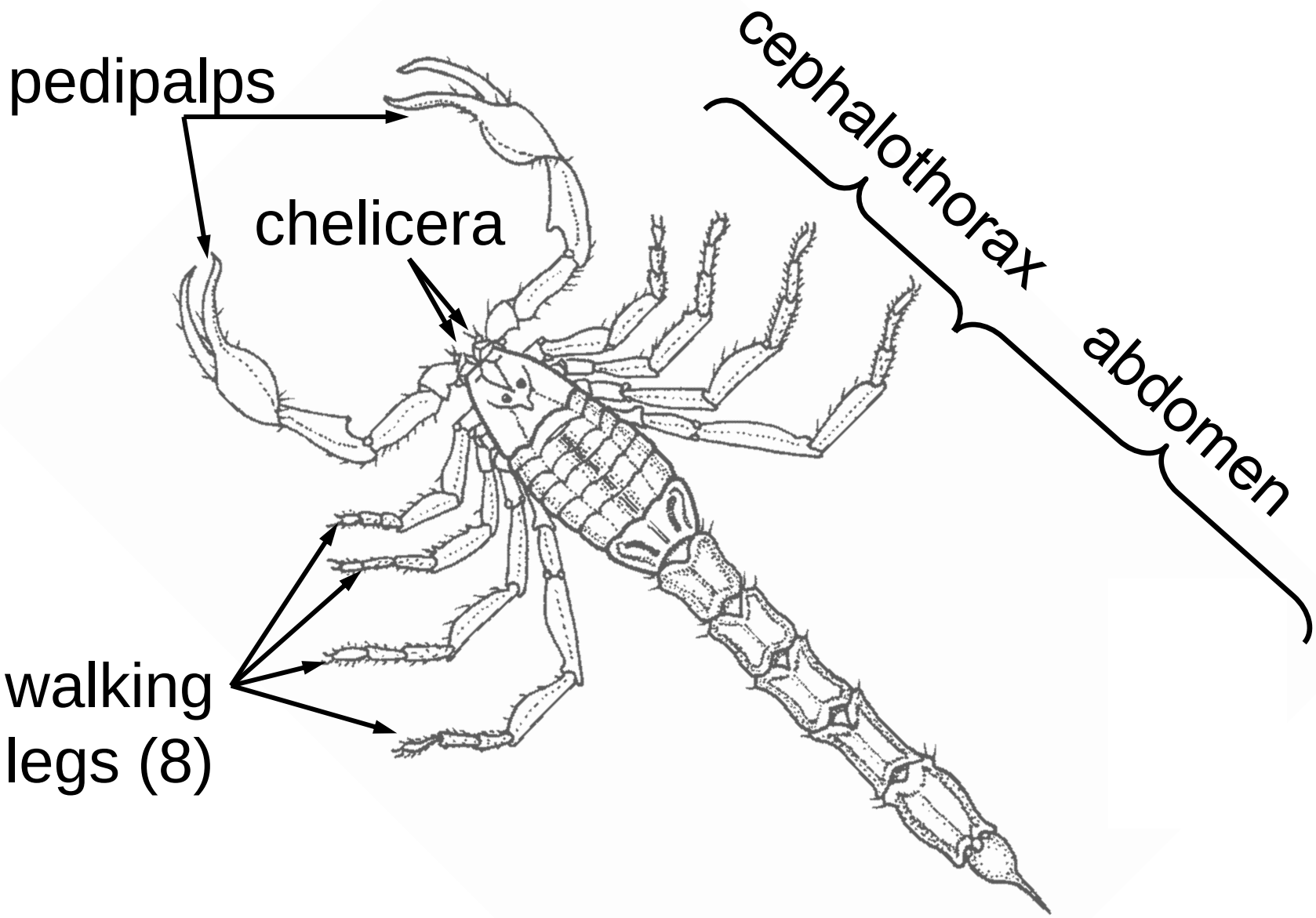
krill = these tiny shrimp are thought to be the most numerous organisms on Earth

sea lice = small crustaceans that are parasitic on fishes – large numbers can kill young animals

Arachnids and insects

Arachnids

- no antennae and no chewing mouth parts
- head and thorax fused into cephalothorax
- typically have 8 walking legs
- first pair of legs are called chelicerae, second pair of legs pedipalps
- mostly terrestrial – breathe with a lung-like organ called a book lung


pedipalps
chelicera
cephalothorax
abdomen
walking
legs (8)

Diversity of arachnids

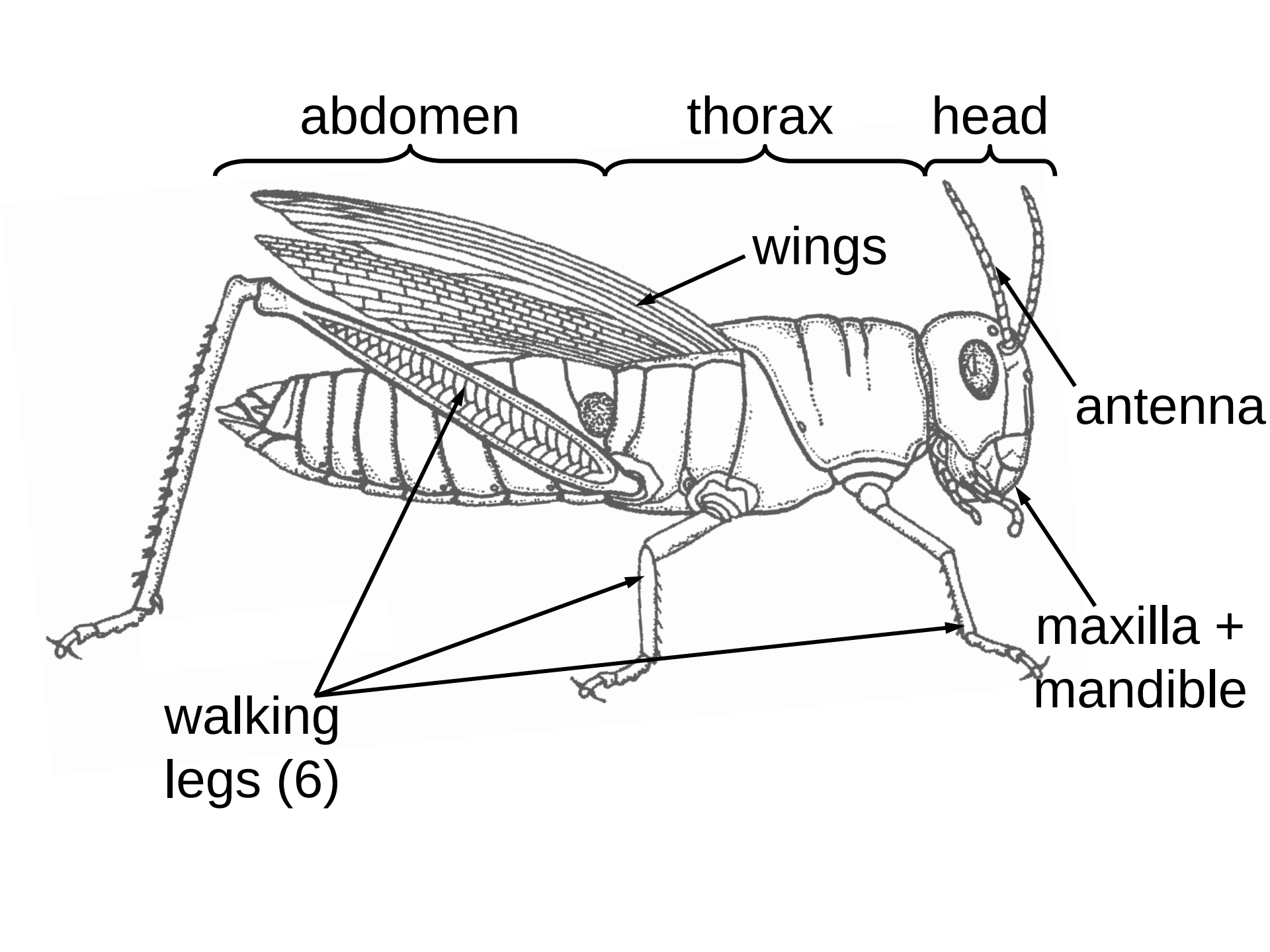
spiders = chelicerae modified into large fangs which inject poison to immobilise prey, capture food in complex webs of silk

scorpions = tip of the abdomen bears a large sting which is used mostly for defense, pedipalps form large claws for capturing prey

mites = important predators and decomposers; some are parasitic, such as ticks

Insects

- three body regions: head, thorax, abdomen
- have 6 walking legs (which are not branched)
- single pair of antenna, two paired mouth parts called mandibles and maxillas, wings
- almost all terrestrial
- most diverse group of animals on Earth


abdomen
thorax
head
wings
antenna
maxilla +
mandible
walking
legs (6)

Diversity of insects

About 85% of insects are found in 4 Orders:

1. Coleoptera – beetles, front wing forms a case which covers the hind wing
2. Lepidoptera – moths and butterflies, wings covered with tiny scales
3. Diptera – flies, hind wings just small stumps
4. Hymenoptera – wasps, bees, ants, wings held together with small hooks

Phylum Echinodermata

Starfishes, urchins, and sea cucumbers, oh my!

Invertebrate evolution

- echinoderms and chordates develop differently from the other invertebrate phyla
- in the phyla up to now, the first pocket that forms on the embryo (= the blastopore) becomes the mouth
- in echinoderms and chordates the blastopore becomes the anus

Phylum Echinodermata

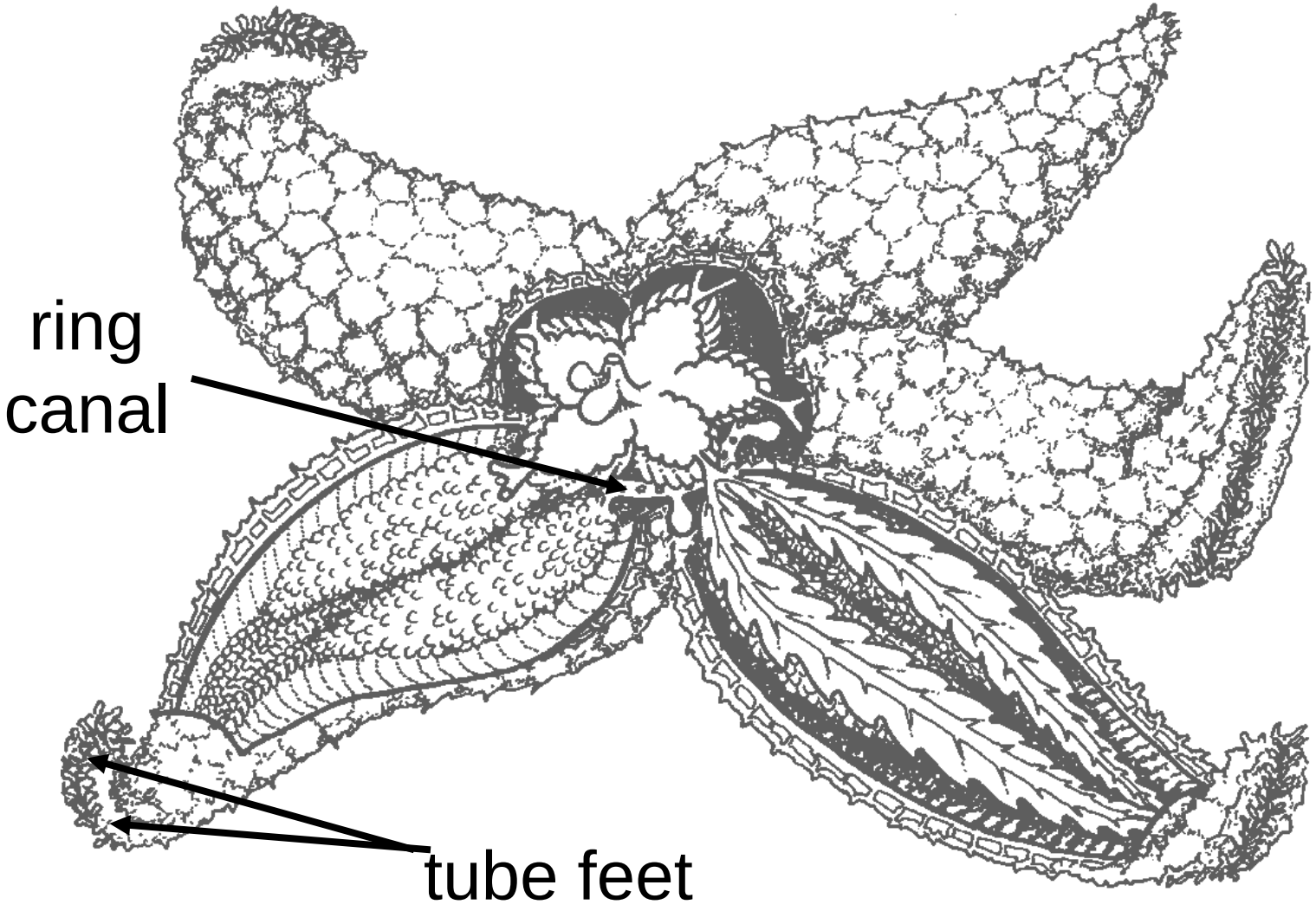
- 3 embryonic germ layers
- true coelom, part of which is a unique water vascular system
- complete gut
- have an internal skeleton of calcium carbonate
- all marine

Water vascular system

- forms a ring canal around the mouth and extends into the arms

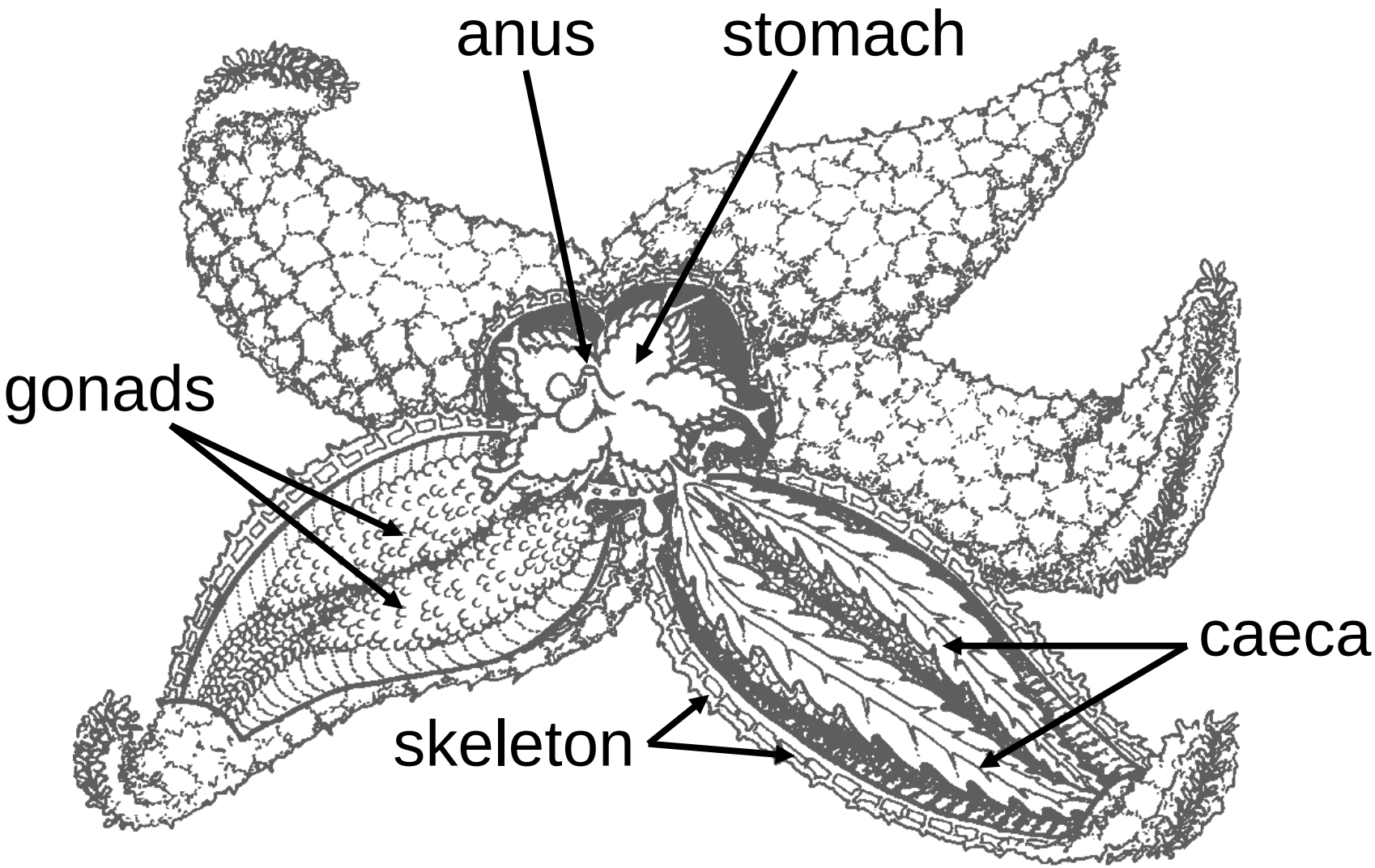
madreporite = porous plate where water enters water vascular system

- from arm canals branch small tentacles called tube feet
- tube feet are used to move and hold prey
- WVS acts as a circulatory system, excretion and respiration occur through the tube feet


ring
canal
tube feet

Echinoderm anatomy

- radial symmetry based on the number five – this is NOT primitive (like cnidarians)
- complex nervous system radiating into the arms, but lacking a brain
- ventral mouth, dorsal anus; central stomach with digestive caeca in the arms


anus
stomach
gonads
caeca
skeleton

Echinoderm diversity

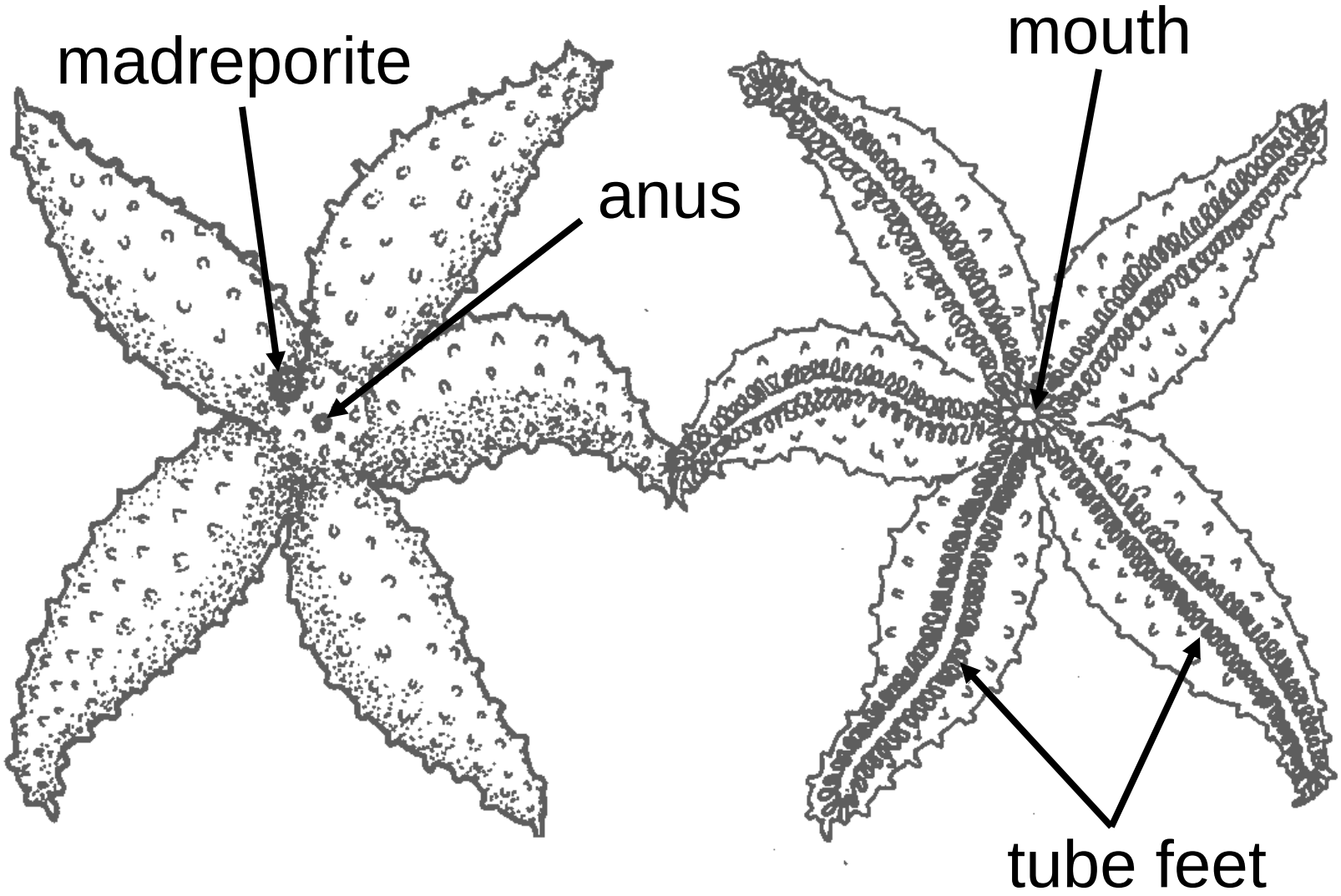
There several important groups of living echinoderms:

1. asteroids – starfishes
2. ophiuroids – brittle stars, basket stars
3. echinoids – sea urchins, sand dollars
4. holothuroids – sea cucumbers
5. crinoids – sea lilies

Phylum Echinodermata observation

1. starfish whole mount: top and bottom view
   - tube feet, madreporite, mouth, anus
2. urchin whole mount: top and bottom view
   - tube feet, madreporite, mouth, anus

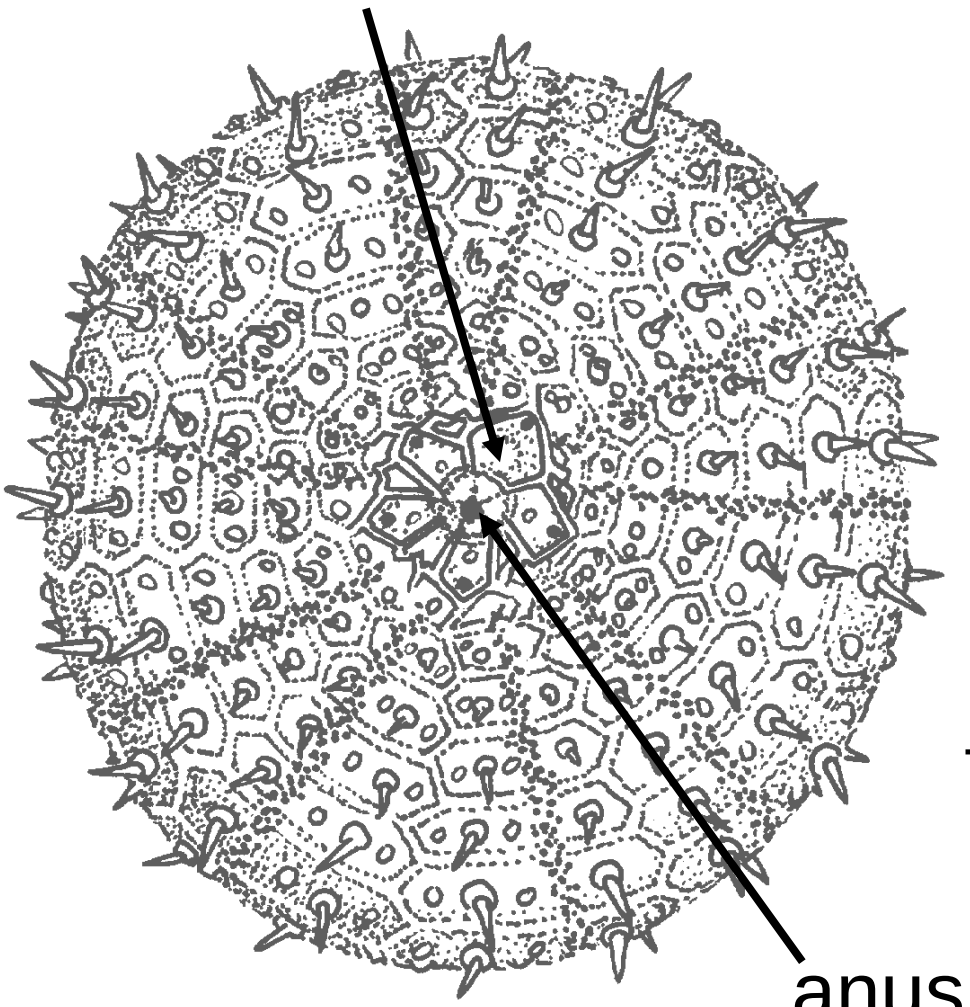
1. starfish whole mount



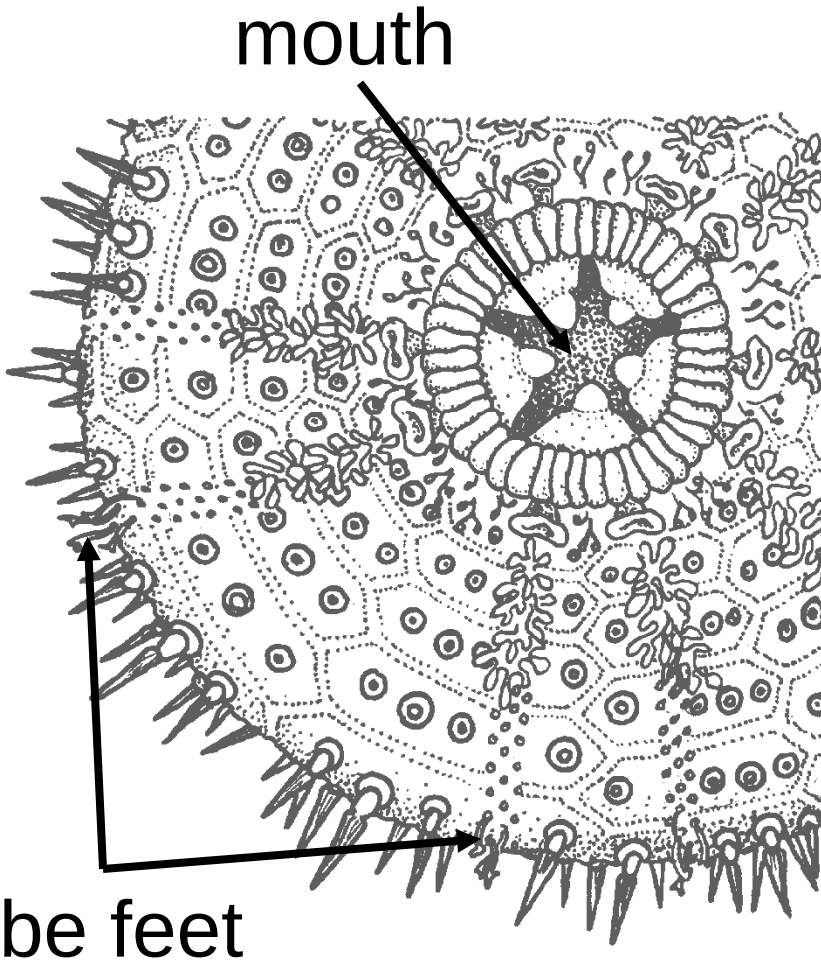
top view

bottom view

2. urchin whole mount



top view



bottom view

Phylum Chordata

You will need:

- three colours of pencil crayon or pen (preferably blue, green, red)

Phylum Chordata

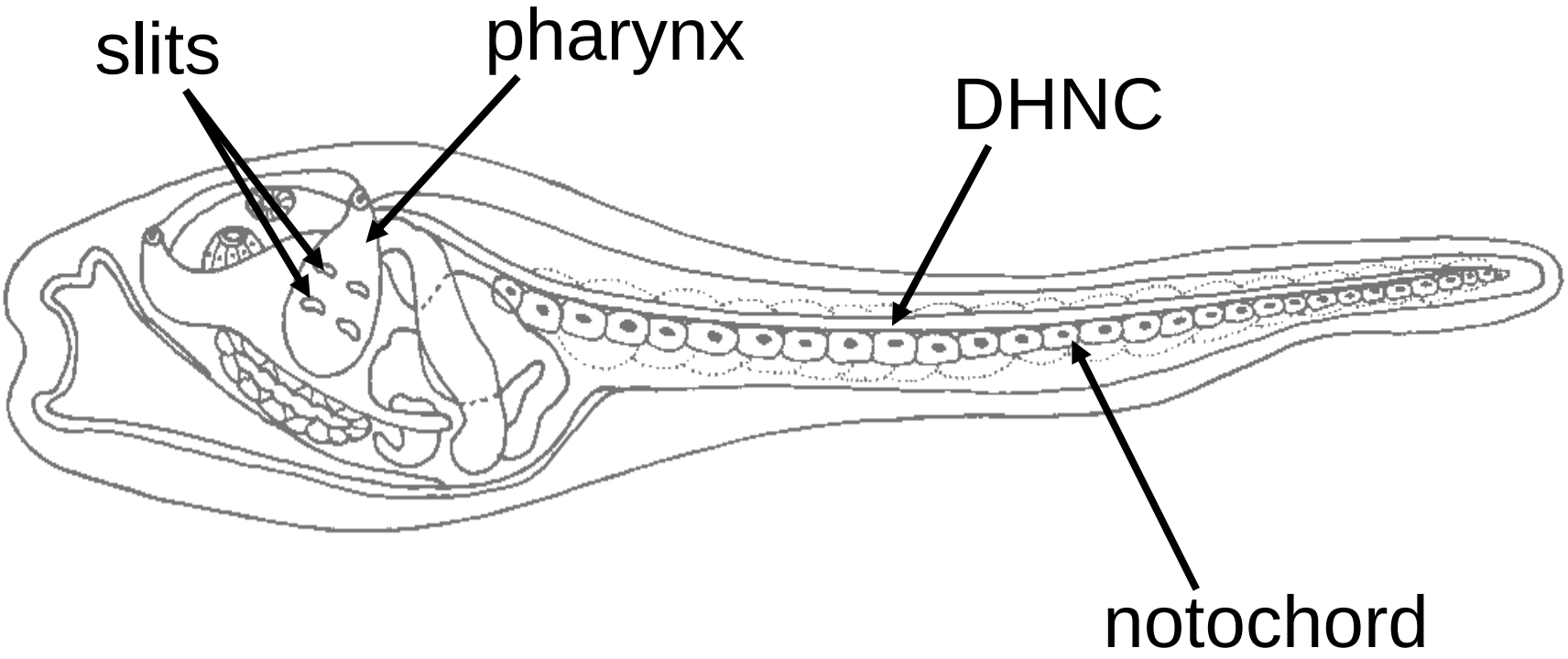
- 3 embryonic germ layers
- true coelom
- complete gut
- some have an internal skeleton
- primitively marine, but also terrestrial

Basic chordate body plan

All chordates have, at some time in their life, these three characteristics:

1. notochord – a stiff rod of tissue that supports the animal (NOT vertebrae!)
2. pharynx with slits – the first part of the gut has slits, which are used for feeding
3. dorsal hollow nerve cord (DHNC) – the nerve cord is above the notochord, and shaped like a hollow tube

Basic chordate body plan



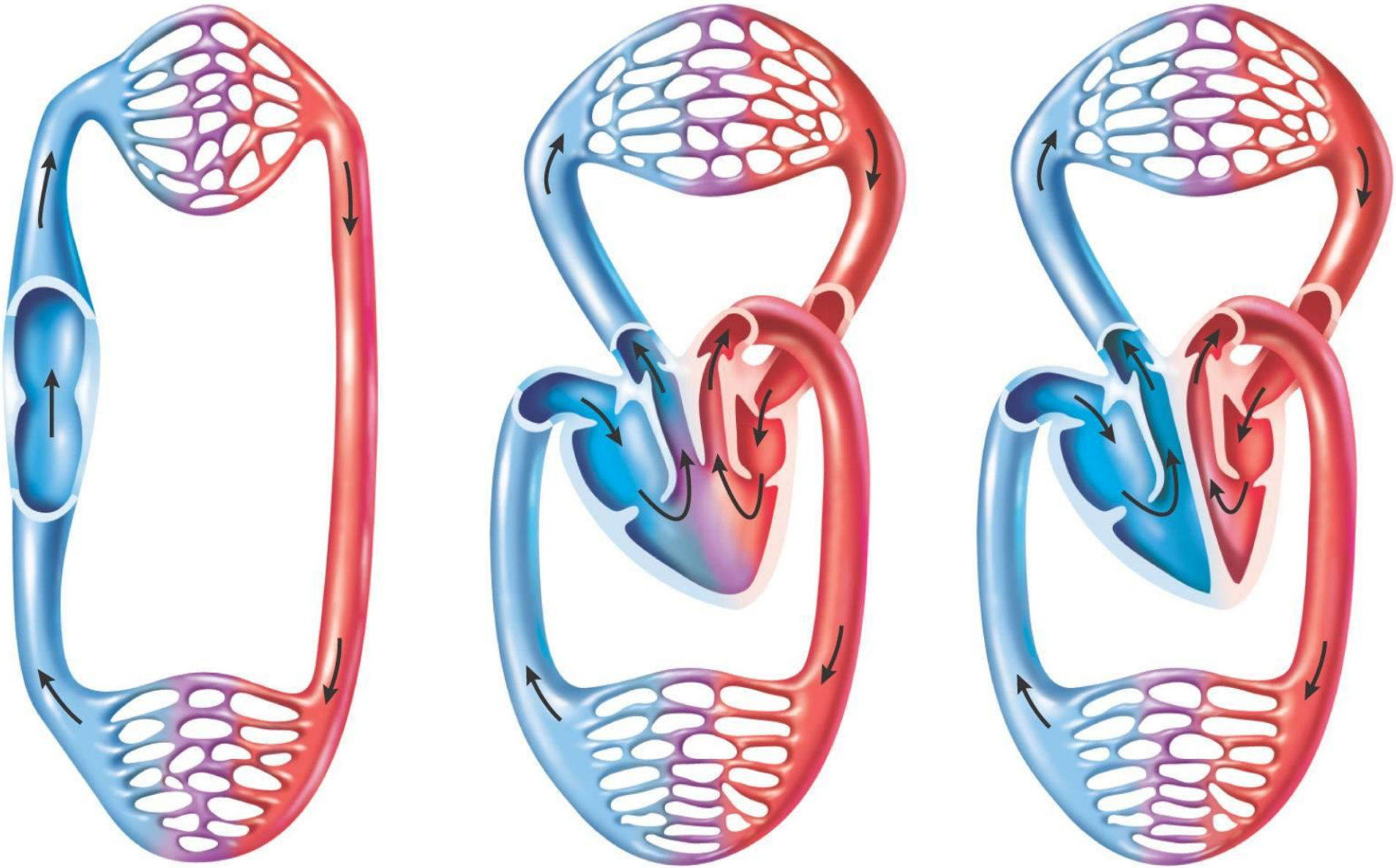
Organ systems

1. digestive system = invertebrates are simple filter feeders, vertebrates have specialised guts for herbivory or carnivory
2. excretory system = invertebrates excrete by diffusion, vertebrates develop an organ called the kidney

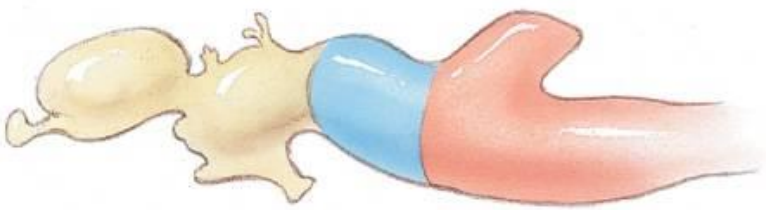
filter-feeding
invertebrate
chordate

Organ systems (cont.)

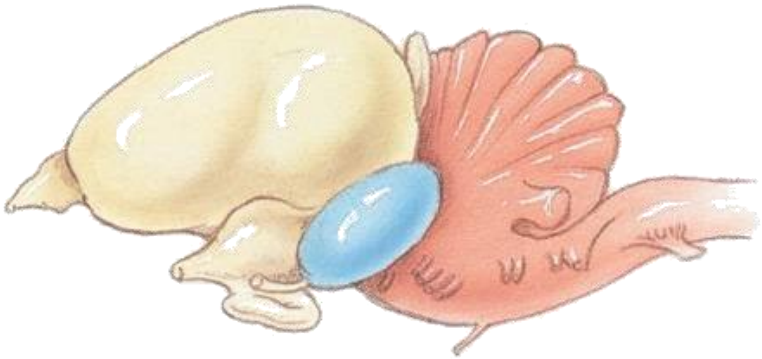
3. circulatory system = invertebrate chordates have open circulatory systems, vertebrates have closed circulatory systems
4. nervous system = most chordates are highly cephalised; advanced vertebrates have the largest brains and most complex sensory organs of any organism



fish reptile mammal

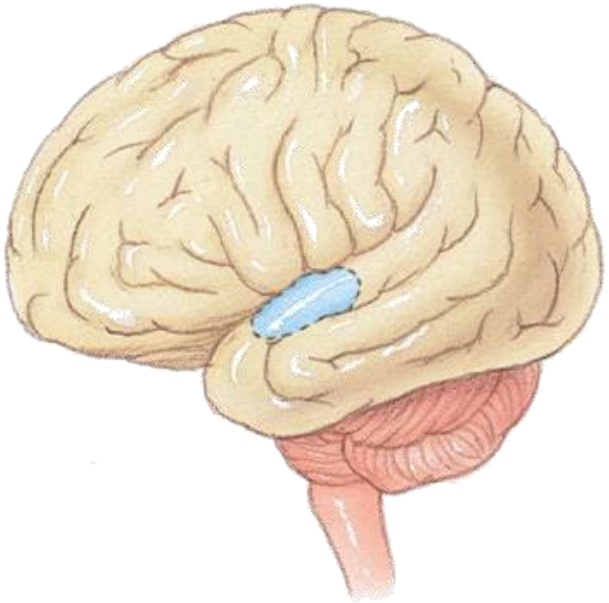


embryo



goose

shark

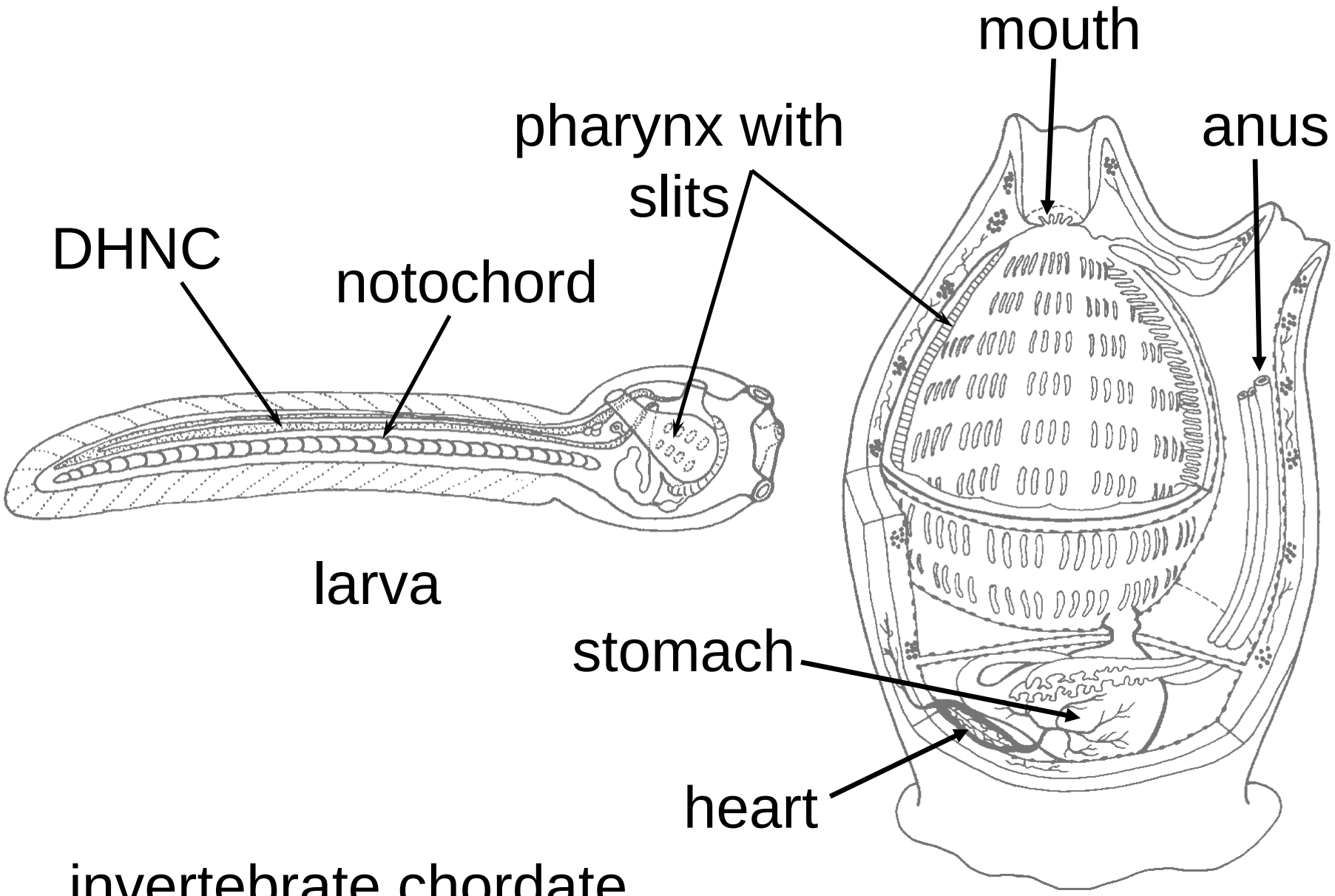


human

Some chordate brains

Invertebrate chordates

- many chordates are NOT vertebrates
- adults are sac-shaped; a large pharynx with slits filters food out of the flowing water
- only larvae possess all the chordate characteristics



invertebrate chordate anatomy

Vertebrate chordates

You will need:

- four colours of pencil crayon or pen (preferably red, blue, green, orange)

Vertebrate chordates

- all vertebrates possess the typical chordate features at some point
- a new support structure, the vertebral column, surrounds the notochord and DHNC, giving the muscles something to pull against
- in evolved vertebrates the notochord remains as the discs between the vertebrae

Vertebrate diversity

There are 7 Classes of living vertebrates:

1. Agnatha – lampreys, hagfishes
2. Chondrichthyes – sharks, rays, chimaeras
3. Osteichthyes – fishes
4. Amphibia – frogs, salamanders
5. Reptilia – lizards, snakes, turtles
6. Mammalia – mammals
7. Aves – birds

Class Agnatha

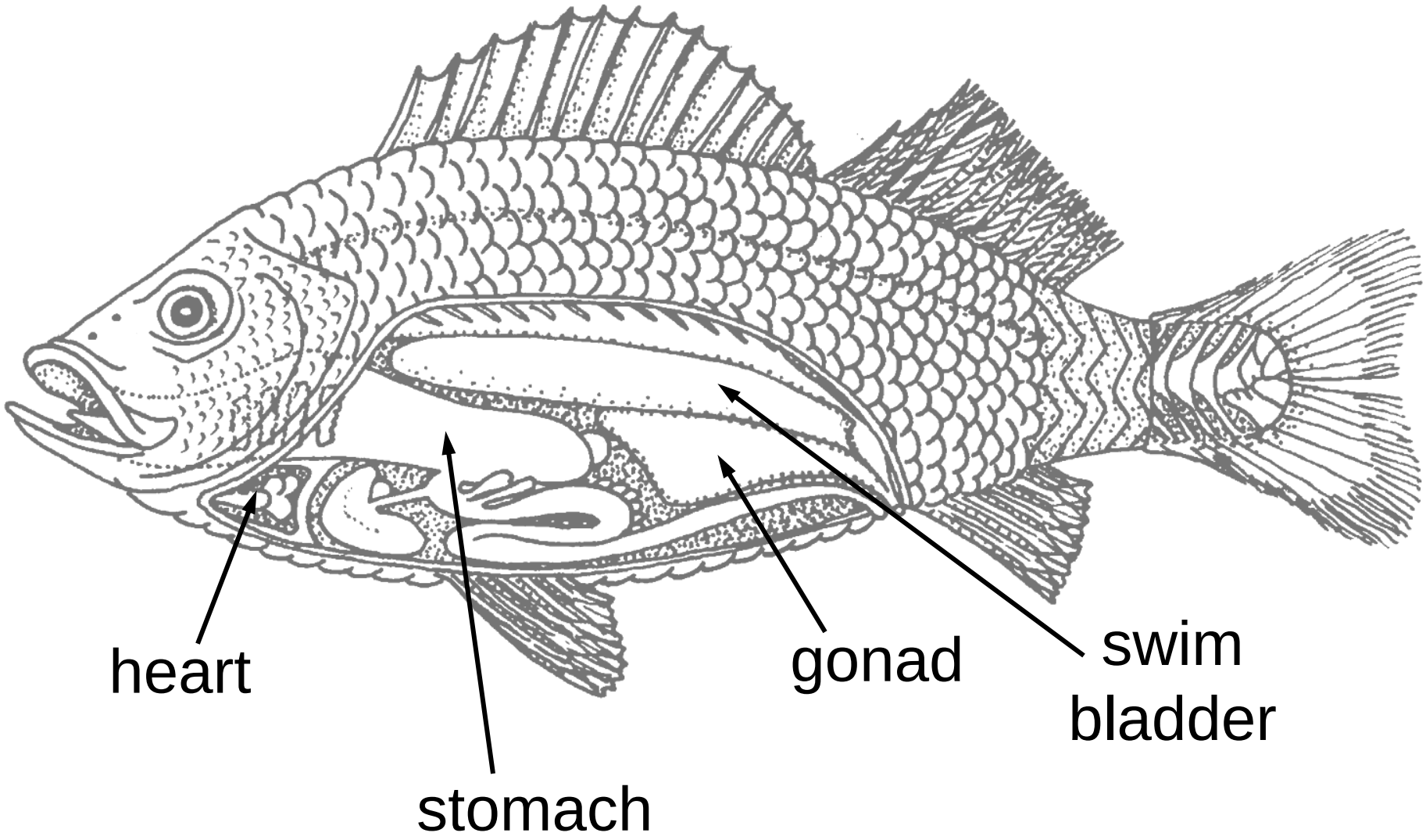
- cartilage skeleton
- lack jaws, though the lamprey has horny ‘teeth’ surrounding the mouth
- hagfish is a scavenger in the deep ocean, lamprey is an external parasite of fishes

Class Chondrichthyes

- cartilage skeleton
- jaws with true teeth that are constantly replaced throughout life
- most are marine predators and scavengers

Class Osteichthyes

- bony skeleton
- both marine and freshwater forms
- most successful vertebrates in numbers and diversity
- a bony fish, similar to the living coelocanth, is the likely ancestor of amphibians


heart
stomach
gonad
swim
bladder

Quiz next class!

Identify and give the functions of the anatomy of invertebrate chordates:

- today’s notes, with the diagram at the bottom of the page

Terrestrial vertebrates

You will need:

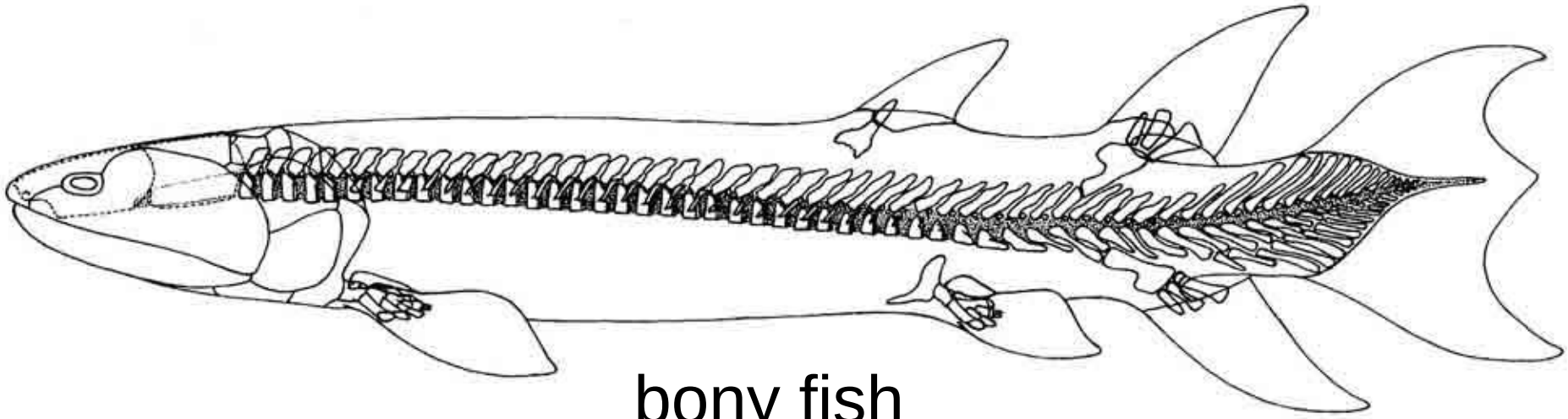
- four colours of pencil crayon or pen (preferably red, blue, green, orange)

Terrestrial vertebrates

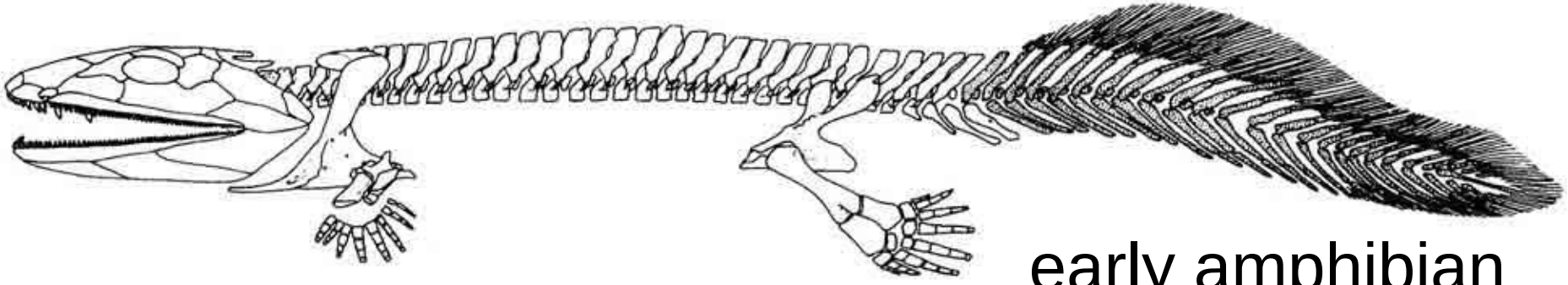
- four (or less) legs, evolve from the pectoral and pelvic fins of fishes
- swim bladder of fishes evolves into the lung

swim bladder = gas-filled organ which keeps bony fishes buoyant

lung = respiratory organ of terrestrial vertebrates



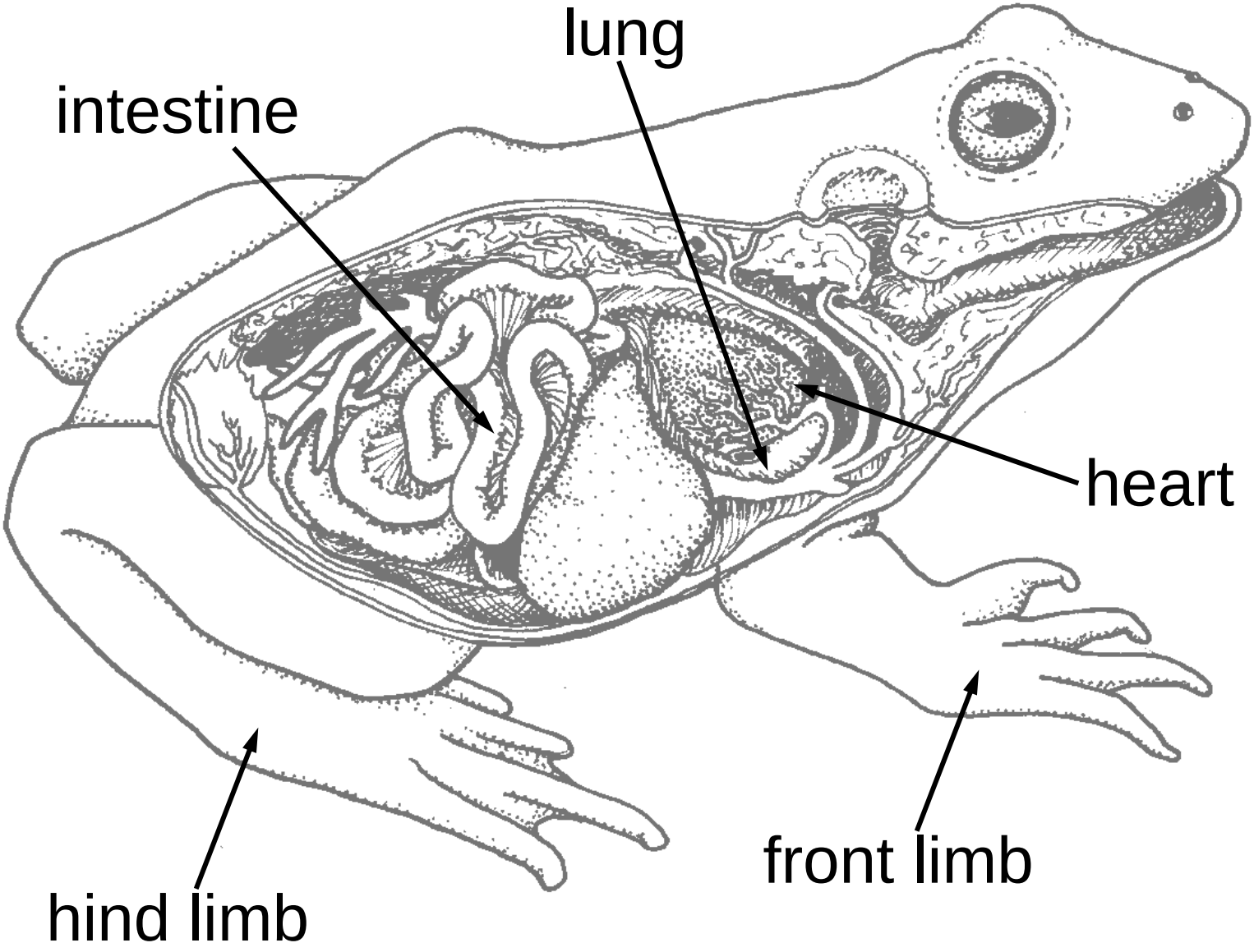
bony fish



early amphibian

Class Amphibia

- bony skeleton
- teeth constantly replaced
- eggs have a gelatinous covering and must be kept moist
- adults respire partly with their thin, moist skin, and partly with a small lung
- larvae are aquatic, metamorphose into amphibious adults


lung
intestine
heart
front limb
hind limb

Class Reptilia

- bony skeleton
- teeth constantly replaced
- thick skin with scales, limiting water loss
- first fully terrestrial vertebrates, rely on the environment to heat their body (‘cold-blooded’)

Class Mammalia

- bony skeleton
- teeth are replaced only once during life
- only primitive mammals lay eggs, more evolved forms give birth to live young
- thick skin with hair
- heat the body through metabolic means (‘warm-blooded’)

Class Aves

- bony skeleton
- adults lack teeth
- egg has a hard shell
- thick skin with feathers
- ‘warm-blooded’