Major patterns of baupläne

**Diploblastic**
- **Ecdysozoa**
- **Lophotrochozoa**
- **Deuterostome**

Protostome?

**Triploblastic**
- **Cleavage**
- **Blastulation**
- **Gastrulation**

Phylum Mollusca “soft body”

- Bauplan / development:
  - Triploblastic
  - Bilateral symmetry w/ cephalization
    - Bivalves lack cephalization
    - Gastropods have torsion
  - Protostome
  - Lophotrochozoa
  - Eucelomate - reduced
  - Hemocoel / Open circulatory system [except cephalopods]

- Special features:
  - Muscular foot, visceral mass, and mantle, usually w/ shell
  - Mantle cavity w/ gills
  - Radula

Molluscan body plan

- Visceral mass
- Mantle
- Foot
- Coelom
- Intestine
- Gonads
- Mantle cavity
- Anus
- Gill
- Nerve cords
- Esophagus
- Stomach
- Shell
- Mouth

Figure 33.16

Phylum Mollusca

2nd most diverse phylum: >100,000 spp.

- Class Polyplacophora: chitons
- Class Gastropoda: snails & slugs
- Class Cephalopoda: octopus & squid
- Class Bivalvia: clams & mussels

Polyplacophora

“bearing many [8] plates” — chitons

Polyplacophora

- Anterior valve
- Mantle cavity w/ ctenidia [gills]
- Posterior valve
- Foot
- Anus
- Mouth w/ radula
- Girdle (mantle)
- Shell
Gastropod molluscs

- The most distinctive characteristic of this class is a developmental process known as torsion, which causes the animal’s anus and mantle to end up above its head.

![Figure 33.19: Torsion in Gastropods](image)

- In early development, left side of body grows faster than right side.
- Results in a 180° twist of visceral mass relative to head-foot axis.
- Relocates anus & mantle cavity behind head:
  - Ventilation of gills & elimination of feces
  - Retraction of head into shell aperture

Cephalopods

- The mantle cavity of a bivalve contains gills that are used for feeding as well as gas exchange.

![Figure 33.21: Movement of the Ventilating Currents & Food Capture](image)

Bivalve molluscs

- The mantle cavity of a bivalve contains gills that are used for feeding as well as gas exchange.

Phylum Arthropoda: bugs

- The most diverse and widely distributed taxon on Earth!
- >1,000,000 known species
- Found in every habitat — usually as the dominant life form.
**Phylum Arthropoda: bugs**

- **Bauplan / development:**
  - Triploblastic
  - Bilateral symmetry w/ cephalization
  - Protostome
  - Ecdysozoa
  - Euscleromate
  - Hemocoel / Open circulatory system

- **Special features:**
  - Segmentation → tagmata
    - usually: head / thorax / abdomen
  - Chitinous exoskeleton / ecdysis
  - Paired jointed appendages — usually one pair per segment

---

**Open circulation in aquatic arthropods (crustacea)**

- heart → hemocoel → gills → heart

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**Arthropods**

- **Segmented body covered by an exoskeleton**
- **Numerous specialized jointed appendages**
  - Usually one pair per segment

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**Arthropoda, Class [Subphylum]: Crustacea**

- ~30,000 spp.
- **Major Sub-Classes & Orders:**
  - Sub-cl.: Branchiopoda
    - Or.: Cladocera — water fleas
  - Sub-cl.: Maxillopoda
    - Or.: Copepoda — copepods
    - Or.: Cirripedia — barnacles
  - Sub-cl.: Malacostraca
    - Or.: Amphipoda — side-swimmers, beach hoppers
    - Or.: Isopoda — pill bugs, sea lice
    - Or.: Euphausiacea — krill
    - Or.: Decapoda — shrimp, crabs, lobsters

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**Arthropoda, Class [Subphylum]: Crustacea**

Growth and development in steps (n-stars) & stages defined by molts
Planktonic crustaceans
- Esp. copepods & euphausids (krill)
- The most abundant animals on earth

Phylum Echinodermata
- Bauplan / development:
  - Triploblastic
  - Pentameral radial symmetry
  - Eucelomate
  - Deuterostome
  - 3 circulatory systems — reduced open hemal system around gut
    - ciliated hydrocoel — gas exchange via dermal gills
    - ciliated hydrocoel — gas exchange via tube feet
- Special features:
  - Water vascular system
  - Tube feet & pedicellaria
  - Calcareous endoskeleton (mesodermal ossicles with mutable, lockable collagenous ligaments)

Water Vascular System
- network of hydraulic canals — unique to echinoderms
  - branch into tube feet
  - function in locomotion, feeding, and gas exchange

Ring / Radial Nervous System
generally runs under/parallel to water vascular canals

Hemal System
open vascular circulation
Phylum Echinodermata

~7,000 spp. — all marine

- Class **Asteroidea**: sea stars
  - Coelom & viscera extend into hollow arms
  - Eversible cardiac (oral) stomach — external digestion

- Class **Ophiuroidea**: brittle stars; serpent stars; basket stars
  - Viscera confined to central disk
  - Slender, flexible arms
  - Blind gut
  - Suspension feeders

- Class **Echinoidea**: sea urchins; sea biscuits; sand dollars
  - Cross-section of seastar arm

- Class **Holothuroidea**: sea cucumbers
  - Digestive gland

*Cross-section of seastar arm*
**Phylum Echinodermata**

- **Class Ophiuroidea**: brittle stars
  - Viscera confined to central disk
  - Slender, flexible arms
  - Blind gut / Suspension feeders

**Seastar / Urchin / Sea cucumber**

- **Asteroidea**: Water vascular, Hemal, & Nervous systems

**Phylum Echinodermata**

- **Class Echinoidea**: sea urchins; sea biscuits; sand dollars

**Phylum Echinodermata**

- **Class Echinoidea**: sea urchins; sea biscuits; sand dollars
Animals

Phylum Echinodermata
• Class Holothuroidea: sea cucumbers
  – elongated body
  – oral tube feet modified into feeding tentacles

Phylum Echinodermata
• Class Holothuroidea: sea cucumbers
  – elongated body
  – oral tube feet modified into feeding tentacles

Phylum Echinodermata
• Class Holothuroidea: sea cucumbers
  – some large deposit feeders lose dorsal bands
  – bilateral symmetry

Echinoderm Development

Phylum Echinodermata
• Class Holothuroidea: sea cucumbers
  – elongated body
  – oral tube feet modified into feeding tentacles

Numbers of species

Kingdom Animalia
~30 phyla / disputed clades*

* Probably not true monophyletic clades

For nearly every facet of early metazoan [animal] history there is an array of hypotheses that cannot be definitively falsified by the available data.