Chapters 32, 33 / Introduction to the Animal Kingdom and Invertebrates

I. Introduction to Animals
   A. Characteristics
      1. multicellular eukaryotes
      2. cells are specialized to perform specific functions; cells → tissues → organs → organism
      3. heterotrophs
      4. motile at some point in their life
      5. sensory systems well-developed to respond to external environment
      6. sexual reproduction the norm

   B. Habitats
      inhabit marine, fresh water, or terrestrial environments

   C. Classifying animals
      1. overall body structure/development
         “simple” vs. “complex”, “primitive” vs. “advanced”, “lower” vs. “higher”
         Subkingdoms:
            Parazoa—sponges
            Eumetazoa—all other animals

      2. body symmetry (for Eumetazoa)
         a. radial—top and bottom, central body axis; adaptation for sessile lifestyle
         b. bilateral—equivalent right and left halves;
            three body axes: anterior-posterior, dorsoventral, right-left
            cephalization

      3. type of body cavity
         --germ layers: ectoderm, mesoderm, endoderm

         coelom = body cavity

         a. acoelomates
         b. pseudocoelomates
         c. coelomates

      4. embryonic development
         blastula
         blastopore

         a. protostomes—mouth develops first
         b. deuterostomes—mouth develops second

II. Phylum Porifera—sponges
sessile, aquatic organisms, > 90% marine; height: 1 cm to 2 m

**spongocoel**
**porocytes**
**osculum**
**spicules**

Level of organization: multicellular  
Symmetry: none or radial  
Digestion: filter feeders  

- **choanocytes** line spongocoel  
- **amoebocytes** in mesohyl of sponge

Circulation, Gas exchange, and Waste disposal: diffusion  
Nervous System: none  
Reproduction: asexual—budding  
sexual—**hermaphroditic**

### III. Phylum Cnidaria—hydras, jellyfishes, sea anemones, corals

most primitive eumetazoa; aquatic, mainly marine  
2 body shapes: **polyp** or **medusa**  
may form colonies  
**cnidocytes**

Level of organization: two tissue layers  
Symmetry: radial  
Digestion: **gastrovascular cavity**  
Circulation, Gas exchange, and Waste disposal: diffusion  
Nervous System: true nerve cells  
Reproduction: asexual—budding  
sexual—sexes separate

Examples:
A. **Hydra**  
1. lifecycle: usually alternate between polyp and medusa form  
alternation of sexual and asexual stages  

  - **Hydra** exists only in polyp form  
  tentacles surround mouth

2. may be solitary or exist in colonies  
   **Physalia**, Portuguese man-of-war, is a colony

B. jellyfish  
  medusa is most common body form, small larval polyp
C. sea anemones and corals
   exist only in polyp form
   gastrovascular cavity divided into chambers
   corals secrete skeletons of calcium carbonate

IV. Phylum Platyhelminthes—flatworms

   Level of organization: three tissue layers and well-developed organs
   Symmetry: bilateral, cephalization
   Digestion: two-way digestive tract, pharynx
   Circulation and Gas exchange: diffusion
   Waste disposal: protonephridia and flame cells
   Nervous system: simple; “brain”, 2 nerve cords connected with nerves
   Reproduction: asexual—budding
                  sexual—hermaphroditic

A. turbellaria—free-living flatworms
   mostly marine, some fresh water
   2 eyespots
   carnivorous—feed on smaller animals and carrion
   locomotion—cilia and mucus on ventral surface
   some learning capability

B. flukes
   Parasites with complex life cycles with more than one host
   Schistosoma, blood flukes
   1st host=snail (miracidia)
       ↓
   releases larvae (cercaria)
       ↓
   burrow into 2nd host
       ↓
   intestine
       ↓
   eggs in feces

C. tapeworms
   Parasites with 2-host life cycles
   Anchor to intestine with scolex (no brain nor sense organs); reproduce with proglottids

   Beef tapeworm
   1st host=cow (eggs)
       ↓
larvae encyst in muscle
↓
2nd host consumes
↓
intestines (larvae→adults)
↓
eggs in feces

V. **Phylum Nemertea**—proboscis worms
free-living, marine
separate digestive and circulatory system
tube-within-a-tube body plan
one-way digestive tract; **proboscis**

VI. **Phylum Mollusca**
representatives: snail, squid, clam
A. Characteristics
1. visceral mass
2. foot
3. mantle
4. radula
5. more complex organ systems:
   digestive tract, coiled within visceral mass
   circulatory (open)
   reproductive
   excretory
   nervous

B. Chitons ("many plates")
habitat: rocky intertidal zones
can use foot to form “suction cup”

C. snails, slugs, nudibranchs, abalones, limpets
1. largest class of mollusks
2. cephalized foot
3. respiration: aquatic species have gills; terrestrial species lack gills

D. clams, oysters, mussels, scallops
1. shells made of 2 halves
2. no distinct head
3. respiration and digestion (filtration)
4. move via foot
5. reproduction: larvae develop on gills of female

E. squids, octopi, nautiluses
1. most active mollusks
2. highly cephalized head
3. closed circulatory system
4. other characteristics:
   squid and octopus have strong beak
   nautiluses only one in class with shell
   squid and nautilus: move by "jet propulsion"

VII. Lophophorate Phyla:
    Characterized by the lophophore, a ciliated ring of tentacles surrounding the mouth.
    Includes:
    A. Brachiopods—lamp shells
    B. Phoronids—tube-dwelling marine worms
    C. Bryozoans—moss animals

VIII. Phylum Annelida: segmented worms
    A. Characteristics
       1. segmentation
       2. improved locomotion
    B. Earthworms
       “few bristles”
       1. setae
       2. d.t. with specialized regions
       3. closed circulatory system
       4. respiration through moist skin
       5. cerebral ganglia and ventral nerve
       6. waste removal—metanephridia
       7. reproduction: hermaphroditic but cross fertilize
    C. Polychaetes
       "many bristles"
       1. parapodia
       2. head may have eyes and antennae
    D. Leeches
       1. no appendages or setae
       2. external segmentation but lack internal septa found in oligochaetes and polychaetes
       2. carnivores or blood-sucking parasites
          parasites: anterior and posterior suckers
          release antisthetic and hirudin

IX. Phylum Rotifera—rotifers
    aquatic, microscopic
    “wheel animals”
Digestion: complete, one-way digestive tract; cilia, mastax, salivary and gastric glands, intestine

X. Phylum Nematoda—roundworms

- species vary in length
- pseudocoelom; cuticle
- many are parasitic
- Digestion: one-way digestive tract
- Reproduction: sexual—separate sexes

Trichinella, pork roundworm

\[
\begin{align*}
&1^{st} \text{ host consumes (eggs)} \\
&\downarrow \\
&\text{lariae develop in intestine} \rightarrow \text{organs or muscle} \\
&\downarrow \\
&2^{nd} \text{ host consumes} \\
&\downarrow \\
&\text{intestines (lariae} \rightarrow \text{adults}) \\
&\downarrow \\
&\text{new larvae intestine} \rightarrow \text{organs or muscle}
\end{align*}
\]

XI. Phylum Arthropoda

A. Characteristics

1. paired, jointed appendages
2. 3 body regions
3. exoskeleton
4. open circulatory system

B. Chelicerates

- body plan—cephalothroax and abdomen
  - chelicerae, pedipalps, and 4 pairs walking legs

  1. horseshoe crabs

  2. Arachnids—spiders, mites, ticks, scorpions
     - book lungs
     - silk glands
     - chelicerae may deliver venom

C. Crustaceans

- Characteristics:
  - some microsopic, some quite large
mandibles and biramous appendages
appendages on thorax and abdomen
2 prs. Antennae

1. lobsters, crayfish, crabs, shrimp
carapace
chelipeds
swimmerets, uropods

2. Isopods
marine; also includes terrestrial sow bugs and pill bugs

3. Copepods
small, shrimplike; make up krill

D. Insects
a. Characteristics:
uniramous appendages
1 pr. Antennae
mainly terrestrial; most fly
greatest in diversity and numbers
three pairs of legs
tracheal tubes
Malpighian tubules
metamorphosis
b. some major orders:
1) Diptera—flies, mosquitoes
2) Hemiptera—true bugs
3) Coleoptera—beetles, weevils
4) Hymenoptera—ants, bees, wasps
5) Lepidoptera—butterflies, moths
6) Odonata—damselflies, dragonflies
7) Homoptera—cicadas
8) Orthoptera—grasshoppers, mantids
c. economic importance:
pollination
food chain
pests
products
disease vectors

E. centipedes
carnivores
one pair walking legs per segment
poisonous claws
F. millipedes
detritivores
two pairs walking legs per segment
possess repugnatorial glands

XII. Phylum Echinodermata
A. Characteristics
1. all marine
2. CaCO3 endoskeleton
3. pentamorous body plan
4. bilaterally symmetrical larva undergoes metamorphosis
5. water vascular system: locomotion and feeding
   pore→canals→ampullae and valves→tube feet
6. circulatory system: open blood system or coelomic fluid;
   no specialized excretory system
7. nerves for sensation but no brain
8. many respire with gills
9. digestion:
   carnivorous or herbivorous
   mouth→stomach and digestive glands→anus
10. good ability to regenerate lost parts

B. Sea stars (starfish)
1. central disc with arms/rays
2. surface features: skin gills, pedicellaria
   a. aboral side (top): madreporite, anus
   b. oral side (bottom): mouth, ambulacral groove
3. internal: stomach, digestive glands, gonads, H2O vascular system, skeleton
4. separate sexes

C. Sea urchins, sand dollars
1. spines, long tube feet
2. test
3. special jaw-like mechanism for feeding

D. Sea lilies
   filter feeders, feathery arms

E. Brittle stars
   largest echinoderm group (diversity and numbers)
   resemble sea stars; can move much more rapidly

F. Sea cucumbers
1. flexible, soft, muscular body (endoskeleton reduced)
2. blood circulatory system
3. use tentacles to feed on algae