INVERTEBRATES

0. KINGDOM ANIMALIA

multicellular animals - larger, no cell wall or chloroplasts

invertebrates - vast majority of animal species
- lack bony skeleton & backbone

(vertebrates) - cartilage or bony endoskeleton
- part of phylum Chordata

1. SPONGES

Porifera - most radially symmetric
- cells in mesoglea (jelly), no true tissue
- spicules (calcium / silicon needles)
- spongin (flexible protein fibers)
- sessile on marine bottom

canal system - water enters pores
- travels thru canals (in body wall)
- into spongocoel (central chamber)
- exits osculum (large opening)
- collar cells (flagellum for filter-feeding)

calcareous sponges - small vase-shape

glass sponges - siliceous flower-basket

bath sponges - majority of species, spongin

2. CNIDARIANS

Cnidaria - radially symmetric
- digestive cavity with no anus
- tentacles with nematocysts (toxic cells to trap prey)
- thick mesoglea, shallow marine

dimorphism - 2 diff body forms
- polyp - tubular, thin, sessile
- medusa - inverted, thick, free-swimming

hydrozoans
- colony of polyps or small medusa (round gonads)
- Portuguese Man-of-war (gas-filled float)

true jellyfish - polyps during larval stage
- large medusa in adults (with C-gonads)

anemones - thick polyp, no medusa stage

corals - small polyps secrete calcium cup

3. FLATWORMS

Platyhelminthes - small & flat
- bilaterally symmetric (left-right)
- distinct head with sense organs
- internal organs (no mesoglea, digestive cavity lack anus)

planaria - cross-'eyed' with 'ears'
- pharynx extends from mid-bottom to catch prey

flukes - ovoid with 2 adhesive suckers
- ecto- & endoparasitic

tapeworms - parasitic in vertebrate intestines
- chain of proglottids (segment of gonads in egg-case)

4. ROUNDWORMS

Nematoda - smooth surface, rounded cross-section
- digestive tract (mouth separate from anus)
- widest ecological range (all habitats, predators, scavengers, parasites)

5. MOLLUSCS

Mollusca - 'shellfish'
- boxy shell (Ca, soft tissues exposed, enlarged at edges)
- open circulatory sys (heart with incompl blood vessel)

chitons - 8 jointed shell plates
- flat foot attaches to rock surfaces
- grazes on algae in intertidal zone

tusk shells - tubular shell with 2 openings
- burrows in sediment, tentacles for filter-feeding

gastropods - single shell, flat foot
- most diverse / abundant, mostly herbivorous
- snails (coiled shell, head retracts)

- abalone & limpets (cone shell)
- nudibranchs (sea slugs, no shell)

bivalves - clams, oysters, mussels, scallops, etc.
- two opposing valves with hinge
  (ligaments open, muscles close)
- gills filter-feed, no head, sessile

cephalopods - advanced, no shell
- octopus (8 arms, largest brain among inverts)
- squids (8 arms + 2 tentacles)
- nautilus (unique coiled / chambered shell)

6. SEGMENTED WORMS

Annelida - segments (septum adapted for burrowing)
- closed circulatory sys (blood confined to blood vessels)

bristleworms - omnivore with teeth
- parapodia (fins for crawling / swimming)
- long setae (bristles for traction)

tubeworms - no parapodia or setae
- tube (Ca, sand, 'paper', or just burrow in sediment)
- tentacles for filter-feeding

7. ARTHROPODS

Arthropoda - segments specialized
- head–thorax–abdomen regions
- jointed shell (protect tissue, Ca or chitin, molted)
- few marine insects (flies & water-striders)

horseshoe crabs - ancient group, shallow marine predator
- dorsal shield with telson (spike)

sea spiders - floats in plankton, tiny body with 8 thin legs

crustaceans - dominant marine inverts
- biramous appendages (clawed)
- crabs & shrimps, barnacles (attach head, legs filter)
- isopods (pillbugs, also on land)

8. ECHINODERMS

Echinodermata - radial symmetry
- pentamerous (multiples of five)

- endoskeleton (skin cover spines)
- water-vascular sys (unique, vessels circulates water)

sea lilies - stalked or free-swimming
- 5 pairs branched arms filter-feed

sea urchins - spiny test, no arms
- sand dollars - flat, short spines

sea stars - large disk, 5 thick arms with tube feet

brittle stars - most active, small disk, 5 thin flexible arms

sea cucumbers - long & bilateral
- tentacles for feeding, no arms

9. CHORDATES

Chordata - share similarities in embryos (notochord, dorsal hollow nerve cord, gill slits, & post-anal tail)

tunicates - small & barrel-shaped, clear cellulose tunic
- water enters atrium (chamber) & filtered by branchial sac (throat)

lancelets - elongate & flat, adults retain chordate features

(vertebrates) - bony endoskeleton
- chordate features only during embryo
- 2 pairs limbs (pectoral & pelvic)
- 3 groups of fish + 4 groups of land tetrapods