Animals

The Diversity of Life 3

What Is an Animal?

• Characteristics of Animals.
  – Are multicellular, exhibit embryonic development; fertilized egg turns into multicellular embryo (balls of cells called blastula) during early development.
  – Nutrition is heterotrophic, ingestive; most digest food internally.
  – No cell walls.

What Is an Animal?

• Characteristics of Animals.
  – Most are mobile (examples of exceptions: sponges, bryozoans).
  – Animal bodies are organized into tissues.
  – Animalia divided into between 36 and 41 phyla; single phylum, Chordata, includes all the most familiar animals—fish, reptiles, birds, and mammals.

Animal Types: The Family Tree

• Focus on features that were added during evolution.
  – Common ancestor probably protist called choanoflagellate, then split to yield Porifera (sponges); lack tissues and symmetry.

Essay: Redrawing the Family Tree

• Phylum Nematoda (roundworms) next to Phylum Arthropoda, (insects and spiders). Both had a common ancestor, and molt. Previously arthropods were classed with segmented worms because they both have segmented bodies. RNA and DNA sequence comparisons show arthropods and roundworms more closely related than arthropods and earthworms. Similar studies have also placed molluscs with the earthworms, whereas they were once with arthropods.
Animal Types: The Family Tree
• Focus on features that were added during evolution.
  – All the rest have some kind of symmetry. Some are radially symmetrical, with body parts evenly arranged around central axis (jellyfish, hydra, starfish). All others, except sponges and Cnidaria, have bilateral symmetry—being symmetrical from side to side—useful in headfirst mode of locomotion.

Animal Types: The Family Tree
• Focus on features that were added during evolution.
  – Body cavities in which organs are suspended called coelom, next separating factor phylum Platyhelminthes separates at this point. Coelom is lined with cells of mesodermal origin.

Animal Types: The Family Tree
• Focus on features that were added during evolution.
  – Protostomes, meaning “mouth first,” and Deuterostomes, “mouth second”, differ in what the blastopore develops into during embryonic development.

Phylum Porifera: The Sponges
• Sponges have no organs—their structure is very much a conglomerate of cells that can even be dissociated and will reform.

Phylum Porifera: The Sponges
• Composition—outer layer of cells pockmarked with pores that allow water to flow through, bringing in oxygen and food and expelling wastes through central pore called osculum.

Phylum Porifera: The Sponges
• Skeleton composed of spicules, or collagen.
• Sexual reproduction exists, with sperm released to travel to another sponge to contact eggs, which form mobile offspring, but sponges can reproduce merely by budding.

**Phylum Cnidaria: Jellyfishes and Others**

• Most cnidarians are ocean dwellers and include jellyfish, corals, hydrozoans, and sea anemones.

**Phylum Cnidaria: Jellyfishes and Others**

• Signature activity of cnidarians is harpooning and stinging prey with tiny extensions from a single cell.

• Basic body plan is sack, often turned upside down with single opening to outside that serves as both mouth and anus (gastrovascular cavity) that is surrounded by tentacles to sting prey and bring prey to mouth.

**Phylum Cnidaria: Jellyfishes and Others**

• Life cycle example: Hydrozoan, obelia, developmental stages—polyp and medusa (no stage in corals and sea anemones). Medusa-stage male releases sperm, and females release eggs that unite to form larva that settle to the bottom to become polyps. Polyps can bud off new cells to form entire colony, including more medusas.

**Phylum Cnidaria: Jellyfishes and Others**

• No true organs, but they do have nervous system and cells that function like muscles for swimming.

• Corals have no medusa stage, but as polyps they create coral reefs from limestone that they secrete to create an external skeleton.
Phylum Platyhelminthes: Flatworms
• Organs are present but no coelom, only a digestive tract; no system of blood circulation, so they must be flat to maximize surface to exchange gases.
• Two of three classes are parasites—examples are tapeworms, and flukes that cause schistosomiasis.

Phylum Platyhelminthes: Flatworms
• Third class is Turbellaria, whose members are usually free-living: Dugesia anatomy—head with pair of primitive eyes (ocelli), a concentration of nerve cells (cerebral ganglion), and nerve trunk. Mouth is mid-body through which it shoots its pharynx that coats prey with digestive enzymes and then sucks semi-liquid material back in. Food then enters through pharynx to a highly branched digestive tract that releases digested food to diffuse to tissues.

Phylum Platyhelminthes: Flatworms
• Most flatworms are hermaphroditic—one animal possesses both male and female sex organs, but can also reproduce after being severed in half.
• Gastrula stage embryo composed of three germ layers—ectoderm, endoderm (like cnidarians and porifera), and a third germ layer, the mesoderm. Animals with two germ layers are called diploblastic; those with three germ layers are called triploblastic.

Phylum Annelida: Segmented Worms
• Characteristics.
  – Body segmentation—repetition of body parts in an animal.

Phylum Annelida: Segmented Worms
• Characteristics.
  – Movement possible because of contraction of different muscles in those segments
  – No lungs; absorb oxygen through skin.
– Hermaphrodites.
– 17,000 named species, including earthworms, ocean species, and leeches.

Phylum Mollusca: Snails, Oysters, and Squid

• Characteristics.
  – Probably 50,000–100,000 species, 8 totally different classes. Three most important classes are: gastropods (snails, slugs), bivalves (oysters, clams, and mussels), and cephalopods (octopus, squid, and nautilus).

Phylum Mollusca: Snails, Oysters, and Squid

• Characteristics.
  – All have a mantle (dorsal layer of tissue that usually secretes material to form a shell). Most have a mantle cavity that is generally the site of gills, or primitive lungs in the case of land snails. Filter-feeding bivalves like clams and oysters also obtain food this way.

Phylum Mollusca: Snails, Oysters, and Squid

• Characteristics.
  – Many have a muscular foot, which may have been lost (oysters, sessile), or evolved into different structures (squid).
  – Many have radula—tooth-sprouting membrane used to scrape surfaces for food.

Phylum Mollusca: Snails, Oysters, and Squid

• Characteristics.
  – Other common organs like heart, kidney, and stomach—cephalopods have closed circulation within blood vessels. Most molluscs have an open circulatory system where blood
- Flows into sinuses to bathe surrounding tissues.
- Sexual reproduction—gastropods and bivalves can be either separate male and female sexes, or hermaphroditic, but cephalopods are all single-sexed.

**Phylum Nematoda: Roundworms**

- Characteristics.
  - Probably 100,000 species.
  - Very small but have a pseudo-coelom, containing digestive tract with two openings, mouth and anus.
  - Have numerous ecological roles like eating pests for farmers, and human parasites like trichinosis and hookworm.
  - Sexual reproduction—generally separate male and female sexes; cannot reproduce by splitting in two.

**Phylum Arthropoda: So Many, but Why?**

- Characteristics.
  - Exoskeleton composed of carbohydrate chitin embedded in protein, which must be occasionally shed (molted). Can be calcified in some marine species.

**Phylum Arthropoda: So Many, but Why?**

- Characteristics.
  - Attached by muscles to paired, jointed appendages.

**Phylum Arthropoda: So Many, but Why?**

- Characteristics.
  - Three subphyla.
    - Subphylum Uniramia.
      - Insects, millipedes, and centipedes.
      - Probably 10 million species of insects, 200 million insects for every person on Earth; much coevolution with flowering plants.
Insects typically have three body segments—head, thorax, and abdomen. Their main body cavities are bathed in an open circulatory system, and their reproduction is mainly sexual with single sexes.

**Phylum Arthropoda: So Many, but Why?**

- **Characteristics.**
  - Three subphyla.
    - **Subphylum Crustacea.**
      - Shrimps, lobsters, crabs, and barnacles.
      - All have five pairs of appendages extending from head, two pairs of antennae, and three pairs of feeding appendages.

**Phylum Arthropoda: So Many, but Why?**

- **Characteristics.**
  - Three subphyla.
    - **Subphylum Chelicerata.**
      - Spiders, ticks, mites, and horseshoe crabs.
      - Have two small appendages (chelicerae) near mouth with pincers that are used in feeding or for venom-injection in spiders.

**Phylum Echinodermata: Sea Stars and Deuterostomes**

- 7000 identified species.

**Phylum Echinodermata: Sea Stars and Deuterostomes**

- Most have feature for movement that involves forcing water into a series of suction-tipped tube feet.
Deuterostomes

- Evolved from bilateral symmetry to radial symmetry.
- Some sessile, some mobile.

Phylum Chordata: Mostly Animals with Backbones

- Three subphyla.
  - Cephalochordata—one small, eel-like creature called a lancelet.
  - Urochordata—three classes of animals, biggest of which are bag-like ocean-dwelling tunicates (sea squirts).
  - Vertebrata—defining feature from other chordates is presence of a vertebral column, flexible column of bones that extends from anterior to posterior.

Phylum Chordata: Mostly Animals with Backbones

- 50,000 species.
- 4 distinguishing features.
  - Notochord—rod-shaped support structure composed of cells and surrounding fibrous tissue that runs from head to tail; lost in most vertebrates after embryonic development.
  - Dorsal nerve cord—annelids and arthropods have ventral nerve cord.

Phylum Chordata: Mostly Animals with Backbones

- 4 distinguishing features.
  - Pharyngeal slits—perforations of the pharynx serve to trap food in filter-feeding lancelets, gills in fish, and middle ear in humans.
  - Post-anal tail.
Vertebrate Evolution

• Development of jaws: lamprey has sucking disk with teeth that it hangs on with and extracts fluids for food. Lampreys are environmental destructive force in the Great Lakes.

Vertebrate Evolution

• Cartilage to bone—half of all vertebrate species are fish, and most have a bony skeleton.
• Sharks have cartilage and no swim bladder for buoyancy.

Vertebrate Evolution

• Bony fish (ray-finned) have dorsal fins supported by straight-line structures that look like rays.

Vertebrate Evolution

• Single species of bony fish that has lobed fins important as ancestor of limbs of tetrapods (four-limbed vertebrates).

Vertebrate Evolution

• Transition to land-dwelling vertebrates—amphibians were first land vertebrates for 75 million years before reptiles. They have fully aquatic embryos and larvae; and adults must spend time in moist environments; examples are frogs, salamanders, and newts.

Vertebrate Evolution

• Amniotic egg: important feature for reptiles and birds that have terrestrial development of eggs and must protect them from desiccation. Three main reptiles are turtles, lizards and snakes, and crocodiles.
Vertebrate Evolution

• Major events in evolution of land vertebrates.
  – Dinosaurs to birds—evidence comes from bone similarities in relative leg sizes, types of hips, and long S-shaped necks; includes transitional fossil remains of *Archeopteryx*.

Vertebrate Evolution

• Mammals—all have mammary glands and near-constant internal body (endothermic) temperature that requires more food energy, but allows constant movement and life in cold climates. Most have hair and eggs that develop internally (viviparous).

Vertebrate Evolution

• Three types of mammals.
  – Monotremes—egg-laying mammals such as duck-billed platypus and spiny anteaters with milk, but no nipples.
  – Marsupials—young develop inside mother in egg that has a membranous shell, after membrane disappears, the young suckle from nipple of mother in pouch in case of kangaroos.

Vertebrate Evolution

• Three types of mammals.
  – Placental—mammals whose young derive nutrition from mother’s circulation through a placenta.

The Diversity of Life III

Chapter 22 Review

All animals (select all that apply)
Bilateral symmetry is a condition in which
A coelom is
An animal has bilateral symmetry, but no coelom. What phylum is it in?
Only _____ are endothermic, a physiological condition whose chief direct cost is _____.
A marine animal with radial symmetry goes through both medusa and polyp stages in its life cycle. Which of the following features is it certain not to have? (Select all that apply.)
The world’s largest invertebrates, the _______, always _______.
In earthworms, we can see a clear example of the widespread animal feature known as
Which of the following is not a physical feature of all vertebrates at some point in their lives? (Select all that apply.)
If an animal has an exoskeleton, paired jointed appendages, and goes through the process of molting, it is: