

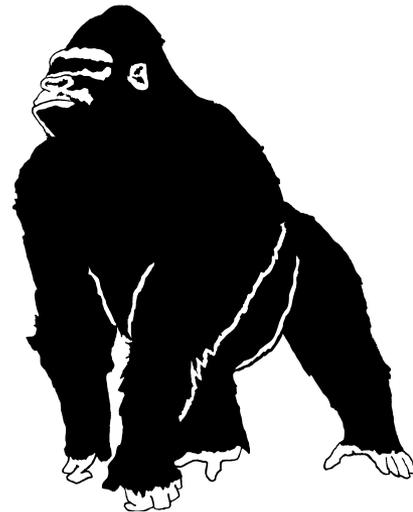
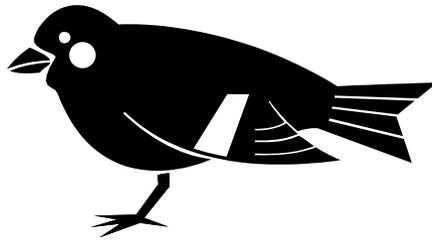
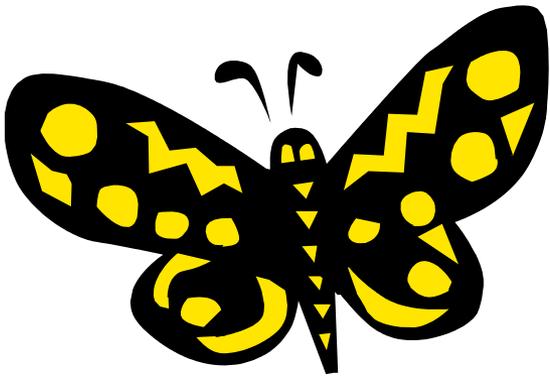
Overview of Invertebrates

General Features of Animals

- Heterotrophic
- Multicellular (eukaryotic)
- Cells lack rigid cell walls
- Cells are usually quite flexible.
- Cells (except sponges) are organized into structural & functional units—**TISSUES.**
- Move rapidly & in complex ways. How?

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- Specialized cells called **MUSCLE CELLS**.
 - Some fly (both verts. & inverts.)
 - Most reproduce sexually
 - Diploid (two copies of each chromosome).
 - Gametes (egg & sperm cells) are the only haploid cells in their life cycles.

- Animal's body plan results from a pattern of development programmed into the animal's genes by **NATURAL SELECTION.**



Before you do these notes – Read this

There is a 2-sided sheet on my desk that you fill in for these. BUT

DO NOT TELL ANYONE else about it. If they ask, shrug.

If they don't do these notes, that's on them

Phylum Porifera--Sponges

- Simplest animal (9,000 species)
- Live in the sea (some in fresh water)
- Bodies lack symmetry.
- Cells not organized into **tissues** (group of cells with a common structure & function) or **organs** (collection of tissues that work together to perform a particular function).

Porifera/Sponges (cont.)

- Masses of specialized cells embedded in a matrix (a gel-like substance)
- Sessile (doesn't move)
- No mouth or gut

Sponge Skeleton

- Diffuse network of fibers or minerals.
 - a. Spongin—a flexible protein.
 - b. Spicules—brittle part of the skeleton.
- Body perforated by tiny holes (or pores, thus the name Porifera!!)
- Choanocytes (flagellated collar cells in the internal cavity) trap food and water.

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- Amoebocytes—amoeba-like cell that supplies nutrition and removes wastes from sponge body cells.
 - Osculum (a large opening)-that eliminates waste and water.
 - Reproduction-sexual & asexual.
 - Side note: sponges are hermaphrodites.

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- **All the following phyla have organs, tissues, symmetry and are “true animals” or eumetazoans.**

Phylum Cnidaria/Jellyfish & Hydra

- Radially symmetric—body parts arranged around a central point (like a pizza!)
- Three distinct tissue layers—
outside ectodermal layer,
inside endodermal layer,
middle gel-like mesogleal layer.

Cnidarians (cont.)

- Two basic body types—
 - a. medusa-free floating, gelatinous, often umbrella shaped (i.e. jellyfish)
 - b. polyps-cylindrical, pipe-shaped & usually attached to a rock (ie. sea anemone).
- Carnivorous-capture prey with tentacles.

Cnidarian Eating Habits

- Use their cnidocytes (stinging cells which occur only in cnidarians, thus the phylum name!).
- Within each cnidocyte is a nematocyst (small barb-like harpoon used to spear prey).

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- Major evolutionary innovation in Cnidaria is the extracellular digestion of food.
 - Food is therefore digested outside the cell in a digestive cavity.
 - This evolutionary advancement is seen in every one of the following phyla.

One Last Thing About Cnidaria

- Have a very simple nervous system called a nerve net.
- Reproduce-asexually (by budding) or sexually (by releasing gametes)
- Some of these organisms are also hermaphrodites.

Another Evolutionary Advance

- Bilateral symmetry now occurs in all phyla-
- Anterior-front end (our head)
- Posterior-back end (our feet)
- Dorsal-top surface (our back)
- Ventral-bottom surface (our front)
- **This allows different parts of the body to specialize.**

Phylum Platyhelminthes

Flatworms

- Simplest animals with bilateral symmetry.
- Simplest animals with organs (a collection of different tissues that work together as a unit to perform a particular function).
- Most members have heads.
- Lack circulatory and respiratory systems.

Flatworms (cont.)

- Has only a digestive tube with one opening- food in and waste out of mouth.
- Live in water as carnivores or parasites.
- Can sense light, chemicals & water flow.
- Locomote-cilia or muscle cells.
- Reproduce-sexually or asexually.

Three classes of flatworms

1. Trematoda—parasitic fluke
 - Endoparasitic (inside host)
 - Ectoparasitic (outside host)
2. Turbellaria-free-living marine flatworms
3. Cestoda-parasitic tapeworms (do not have mouths or digestive systems).

Phylum Nematoda

Roundworms

- Bilaterally symmetrical (like flatworms)
- Nervous system (like flatworms)-of sensory receptors and nerve cells.
- Tube-like digestive tract (Unlike flatworms) so food goes in one end, comes out somewhere else.
- Why would this be an advantage?

Because

- More food can be processed faster.
- With a one-opening digestive system, there are times when an organism cannot eat because it's eliminating waste products.

Reproduction

- Unlike flatworms, roundworms reproduce only sexually.
 - Most species-separate sexes
 - Fertilization occurs within the female.

Bad News & Good News

- Like flatworms, many roundworms are parasitic.
- Beneficial roundworms
 - Decompose organic matter
 - Recycle nutrients
 - Prey on tiny organisms harmful to plants.

Phylum Annelida-Earthworms

- Known as segmented worms
- True coelomates-have cavities completely lined with mesoderm.
- Locomotion
 - muscles run both lengthwise and around the body, contract against the firm-walled coelom.
 - Have external structures for movement-setae

Cute and Smart

- Well developed nervous system
 - Small brain that extends into a solid nerve cord running along ventral side of worm.
 - Specialized sense organs-sensitive to light, temperature, moisture, vibrations & chemicals.
- Sense organs located at both ends of worm.
- How might this help the earthworms?

Excretory System

- Nephridia-specialized structures for eliminating waste.
- Two nephridia in each segment.

Respiratory System

- Lack a true respiratory structure—gas exchange takes place by diffusion across the worm's skin.

Reproduction in Earthworms

- Asexually by regeneration
- Most often sexually
- Some have separate sexes
- Most are hermaphrodites.

Hermaphrodites-How Does That Work??

- Two earthworms join to exchange sperm inside a small internal pouch.
- Each worm then secretes a band of mucus that forms a cocoon around its body.
- When the worm slips out of the cocoon, it releases its own eggs and its mate's sperm into the cocoon, where fertilization occurs.

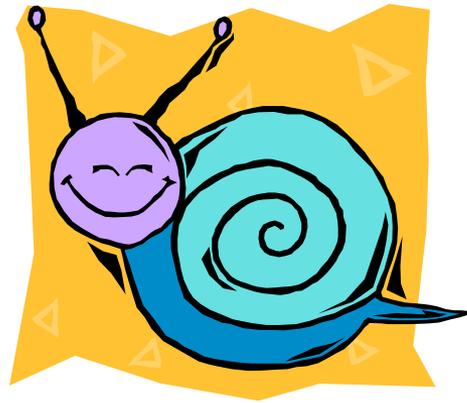
Why do we care about Earthworms?

- Important in the marine food chain.
- Important in the terrestrial food chain.
- Play an essential role in plant growth.
- Leeches-scientists are studying the painkilling and anti-clotting chemicals in leech saliva.

Phylum Mollusca

Snails, Slugs, Scallops, Squids

- Mollusks and all animals that evolved after them have a body cavity (coelom) that is completely enclosed within mesoderm.
- What's so special about that?



Another Evolutionary Advancement

- The position of the coelom allows physical contact between the mesoderm and endoderm—permitting tissue interactions that lead to the development of highly specialized organs (like hearts & stomachs).



Three Distinct Body Regions

- Visceral Mass—contains the body organs.
- Mantle—soft tissue that drapes over the internal body organs.
- Muscular foot (used for locomotion or attachment)—mucus secreted from the broad, flat foot provides a layer of slime on which the snail can glide.

Most (not all) Share a Fourth Characteristic

- An open circulatory system.
- Blood is enclosed in vessel in some places, but flow freely over body tissues in other places.

Respiratory System

- Gills in aquatic mollusks.
- Lung-like mantle cavity in terrestrial mollusks.

Locomotion

- Clams burrow.
- Snails slide on their mucus.
- Squids and octopus take in water and forcefully expel it.
- Some mollusks are sessile.

Digestion

- Two openings.
- Some have a coiled tract that increases the length and enables more food to be digested; more nutrients to be absorbed.

Nervous System

- Some have a simple nervous system but lack true sense organs.
- Octopus have a complex nervous system- includes brain, eyes, and sense organs.

Reproduction

- Separate sexes
- Reproduce sexually.
- Internal and external fertilization.

Three Classes

- Gastropods-snails and slugs.
- Bivalves-clams, oysters, scallops.
- Cephalopods-octopus and squids.

HW Bonus Points/Formal Drawing- 38 pts.

- Diagram the anatomy of a clam on page 703. Label and summarize, in your own words, the caption. +10
- 16 labels +8
- Summarized caption +5
- Color +5
- Sharpie +5
- Neat +5

Next Major Evolutionary Advancement

- Segmentation-the building of a body from a series of similar segments.
- Phylum Annelida would fit in here but we wanted to group the worms together so they got an advanced showing!

Phylum Arthropoda

Grasshoppers, crayfish, lobsters

- Largest and most diverse animal phylum.
- Characteristics:
 - Segmented bodies (most have the segments fused into larger body regions)
 - Jointed appendages (arthropoda means “jointed feet”)
 - Exoskeleton (made of chitin)

Exoskeleton

- Hard covering on the outside of the body
 - Provides support & protection
 - Limits size of organism so organism molts & sheds.

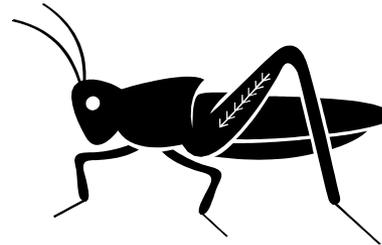
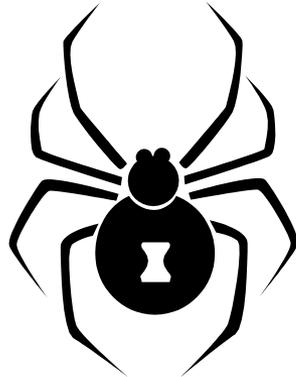
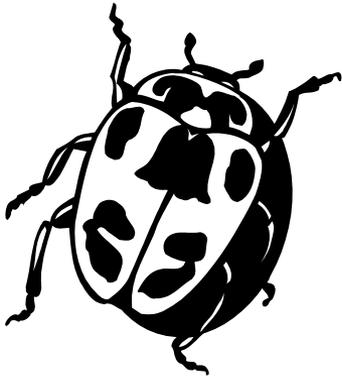
Systems

- Extensive muscular system
- Nervous system--ventral nerve cord & brain
- Open circulatory system
- Respiration system
 - Aquatic forms-external gills
 - Terrestrial forms-tracheal tubes where gas exchange occurs (ex. grasshopper=spiracle)

Crustaceans

- Two body regions-
 - cephalothorax & abdomen
- Two pairs of antennae
- Pair of jaw-like mandibles
- At least four pairs of walking legs
- Eyestalks with compound eyes (many separate lenses that work together to form a single image).

Arthropod Diversity



A Major Evolutionary Change

- Mollusks, annelids, and arthropods followed a particular pattern of development.
- Echinoderms and chordates have developed very differently from the other coelomates.

During Embryonic Development

- Embryos of these animals coelomates begin as hollow balls of cells.
- Balls of cells indent to form a ball of two cell layers thick with an opening called a
 - BLASTOPORE to the outside.

Development of the Mouth

- In annelids, mollusks, and arthropods, the mouth develops from or near the blastopore.
- These animals are called PROTOSTOMES (first mouth).

New and Different Coelomates

Echinoderms and Chordates

- The anus, not the mouth, develops from or near the blastopore.
- Mouth forms later on another part of the embryo.
- These animals are called
DEUTEROSTOMES (second mouth)

Say “hi” to your aunt Sally Starfish

- Considered one of the most fundamental changes in a body plan in the history of animal evolution.
- This suggests a common ancestor between echinoderms and chordates.

Great Variation in Echinoderms

- But 4 common characteristics:
 - 1. Endoskeleton (spiny skin)-individual plates called ossicles.
 - 2. Five-part radial symmetry-most have 5 arms extending radially from a central point.
 - 3. Water-vascular system-for locomotion
 - 4. Coelomic circulation and respiration

Feeding

- Mouth in underside of body; sucks partly digested food thru stomach which can be pushed out thru mouth opening (starfish).
- Mouth at one end of body surrounded by tube feet that help gather food and push it into mouth (sea cucumber & sea urchin).

Reproduction

- Sexually
- Most often external fertilization.
- Some reproduce asexually by regeneration (starfish) but for regeneration to occur a portion of the central part of the body must be present.

Phylum Chordata

Tunicates & Vertebrates

- Chordates are coelomate animals that have a flexible dorsal rod called a notochord.
- Also have pharyngeal slits (develop in wall of pharynx and connect mouth to digestive tract).
- Dorsal nerve cord to which nerves are attached.
- In vertebrates, the notochord is replaced during embryonic development by a vertebral column.

Not all Chordates are Vertebrates

- Invertebrate chordates
 - Tunicates-attach to ocean bottom
 - Lancelets-fishlike marine animals

Chordates that are Vertebrates

- Two evolutionary advancements:
 - 1. Vertebral column-notochord is replaced by a hollow, bony vertebral column (backbone) that surrounds and protects the dorsal nerve cord.
 - 2. Head-distinct and well-differentiated head containing a skull and a brain.
- All have an internal skeleton made of bone and cartilage.

Seven Classes of Chordata

- Agnatha-Jawless Fish
- Chondrichthyes-Cartilagenous Fish
- Osteichthyes-Bony Fish
- Amphibia
- Reptilia
- Aves
- Mammalia