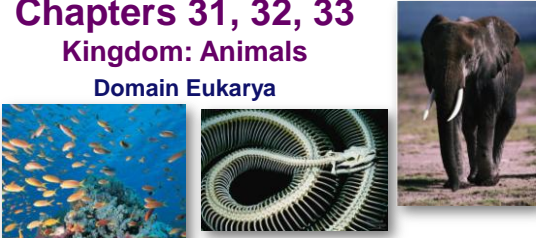
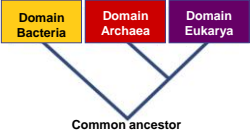


Chapters 31, 32, 33

Kingdom: Animals

Domain Eukarya

Animal Characteristics

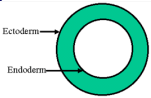
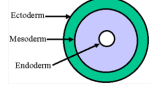

- **Heterotrophs**
 - ◆ must ingest others for nutrients
- **Multicellular**
 - ◆ complex bodies
- **No cell walls**
 - ◆ allows active movement
- **Sexual reproduction**
 - ◆ no alternation of generations
 - ◆ no haploid gametophyte



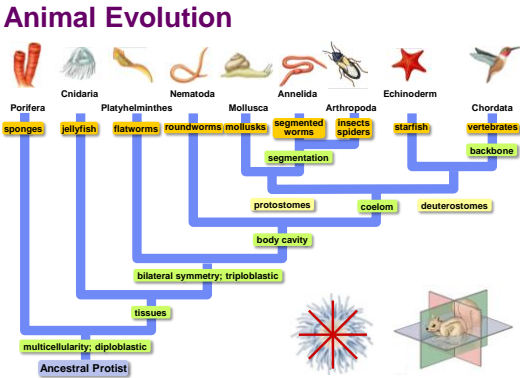

Germ Layers

How do different animals develop from a zygote?

- **2 germ layers: diploblastic**
 - ◆ ectoderm
 - ◆ endoderm
- **3 body layers: triploblastic**
 - ◆ ectoderm
 - ◆ mesoderm
 - ◆ endoderm

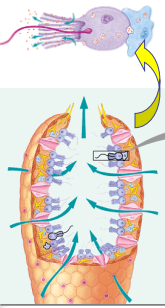

Animal Evolution



Invertebrate: Porifera

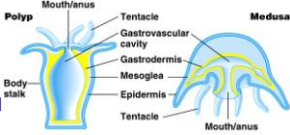


- **Sponges**
 - ◆ no distinct tissues or organs
 - do have specialized cells
 - ◆ no symmetry
 - ◆ sessile (as adults)

food taken into each cell by endocytosis

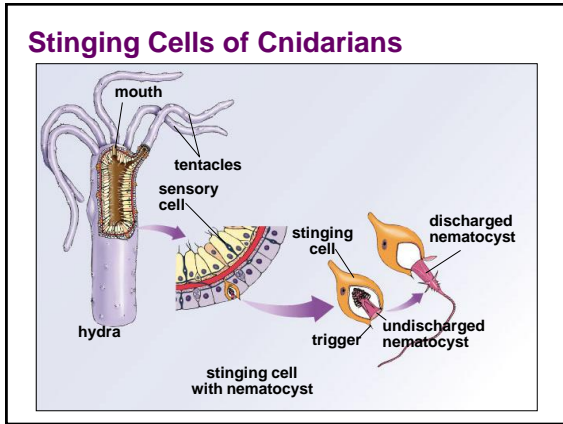



Invertebrate: Cnidaria

- **Jellyfish, hydra, sea anemone, coral**
 - ◆ tissues, but no organs
 - ◆ two cell layers
 - ◆ radial symmetry
 - ◆ predators
 - tentacles surround gut opening
 - extracellular digestion
 - ◆ release enzymes into gut cavity

(a) Sea anemone: a polyp (b) Jelly: a medusa



Germ Layers

How do different animals develop from a zygote?

- 2 germ layers: **diploblastic**
 - ♦ ectoderm
 - ♦ endoderm
- 3 body layers: **triploblastic**
 - ♦ ectoderm
 - ♦ mesoderm
 - ♦ endoderm

Labels: Blastopore, Ectoderm, Endoderm, Mesoderm.

Body Cavity

How much is the digestive tract separated from the rest of the body?

- acoelomate
- pseudocoelomate
- coelomate

3 body layers: triploblastic

- ♦ ectoderm
- ♦ mesoderm
- ♦ endoderm

Labels: ectoderm, mesoderm, endoderm, pseudocoel, coelom cavity.

Triploblastic Clade: Protostome

How does the triploblastic blastospore develop?

- ‘Mouth First’
- Bilateral symmetry
- Anterior brain
- Ventral nervous system
 - ♦ consisting of paired or fused longitudinal nerves

3 body layers: triploblastic

- ♦ ectoderm
- ♦ mesoderm
- ♦ endoderm

- arthropods and mollusks are major clades

Invertebrate: Platyhelminthes

- Flatworms
 - ♦ tapeworm, planaria
 - ♦ mostly parasitic
 - ♦ bilaterally symmetrical
 - allows high level of specialization within parts of the body
 - now have a mouth at one end & an anus at the other!

Labels: acoelomate, ectoderm, mesoderm, endoderm.

Invertebrate: Nematoda

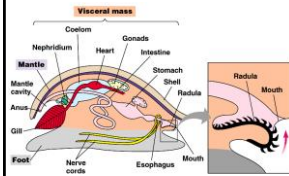
- Roundworms
 - ♦ bilaterally symmetrical
 - ♦ have both mouth & anus
 - well-developed digestive system
 - ♦ many are parasitic
 - hookworm

Labels: C. elegans, pseudocoelomate.

Invertebrate: Mollusca

▪ **Mollusks**

- ◆ clams, snails, squid
- ◆ bilaterally symmetrical (with exceptions)
- ◆ soft bodies, mostly protected by hard shells
- ◆ true **coelem**



Invertebrate: Annelida

▪ **Segmented worms**

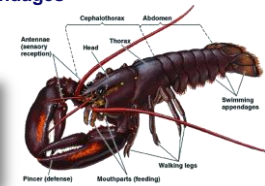
- ◆ earthworms, leeches
- ◆ segments are not specialized
- ◆ bilaterally symmetrical
- ◆ true coelem



Invertebrate: Arthropodia

▪ **Spiders, insects, crustaceans**

- ◆ most successful animal phylum
- ◆ bilaterally symmetrical
- ◆ segmented
 - allows jointed appendages
- ◆ exoskeleton
 - chitin + protein



Arthropod Groups

arachnids
8 legs, 2 body parts
spiders, ticks, scorpions



crustaceans
gills, 2 pairs antennae
crab, lobster, shrimp



insects
6 legs, 3 body parts

Triploblastic Clade: Deuterostome

How does the triploblastic blastospore develop?

- **'Mouth Second' (Butt First)**
 - ◆ mouth at opposite end of embryo
- **Early developmental radial cleavage**
- **Coelem development**
 - ◆ From mesodermal pockets that bud off gastrula rather than splitting off mesoderm
- **3 body layers: triploblastic**
 - ◆ ectoderm
 - ◆ mesoderm
 - ◆ endoderm

Invertebrate: Echinodermata

▪ **Starfish, sea urchins, sea cucumber**

- ◆ radially symmetrical; deuterostome
- ◆ spiny exoskeleton



Chordata

- Vertebrates
 - fish, amphibians, reptiles, birds, mammals
 - internal bony skeleton
 - backbone encasing spinal column
 - skull-encased brain

hollow dorsal nerve cord
becomes brain & spinal cord
becomes gills or Eustachian tube
pharyngeal pouches
postanal tail
becomes tail or tailbone
notochord
becomes vertebrae

Vertebrates: Fish

salmon, trout, sharks

- Characteristics
 - body structure
 - bony & cartilaginous skeleton
 - jaws & paired appendages (fins)
 - scales
 - body function
 - gills for gas exchange
 - two-chambered heart; single loop blood circulation
 - ectotherms
 - reproduction
 - external fertilization
 - external development in aquatic egg

gills
body

450 mya

Transition to Land

Evolution of tetrapods

Lobe-finned fish
Early amphibian

Vertebrates: Amphibian

frogs, salamanders, toads

- Characteristics
 - body structure
 - legs (tetrapods)
 - moist skin
 - body function
 - lungs (positive pressure) & diffusion through skin for gas exchange
 - three-chambered heart; veins from lungs back to heart
 - ectotherms
 - reproduction
 - external fertilization
 - external development in aquatic egg
 - metamorphosis (tadpole to adult)

lung
buccal cavity
glottis closed

350 mya

Vertebrates: Reptiles

dinosaurs, turtles, lizards, snakes, alligators, crocodile

- Characteristics
 - body structure
 - dry skin, scales, armor
 - body function
 - lungs for gas exchange
 - thoracic breathing; negative pressure
 - three-chambered heart
 - ectotherms
 - reproduction
 - internal fertilization
 - external development in amniotic egg

leathery embryo shell
amnion
chorion
allantois
yolk sac

250 mya

Vertebrates: Birds

finches, hawk, ostrich, turkey

- Characteristics
 - body structure
 - feathers & wings
 - thin, hollow bone; flight skeleton
 - body function
 - very efficient lungs & air sacs
 - four-chambered heart
 - endotherms
 - reproduction
 - internal fertilization
 - external development in amniotic egg

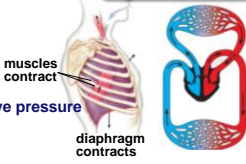


trachea
lung
anterior air sacs
posterior air sacs

150 mya

Vertebrates: Mammals

mice, ferret
elephants, bats
whales, humans

- **Characteristics**
 - ◆ **body structure**
 - hair
 - specialized teeth
 - ◆ **body function**
 - lungs, diaphragm; negative pressure
 - four-chambered heart
 - endotherms
 - ◆ **reproduction**
 - internal fertilization
 - internal development in uterus
 - ◆ nourishment through placenta
 - birth live young
 - mammary glands make milk

220 mya / 65 mya

Vertebrates: Mammals

- **Sub-groups**
 - ◆ **monotremes**
 - egg-laying mammals
 - duckbilled platypus, echidna
 - ◆ **marsupials**
 - pouched mammals
 - short-lived placenta
 - koala, kangaroo, opossum
 - ◆ **placental**
 - true placenta
 - shrews, bats, whales, humans

