


# Cambrian and Ordovician

**Cambrian and Ordovician periods**

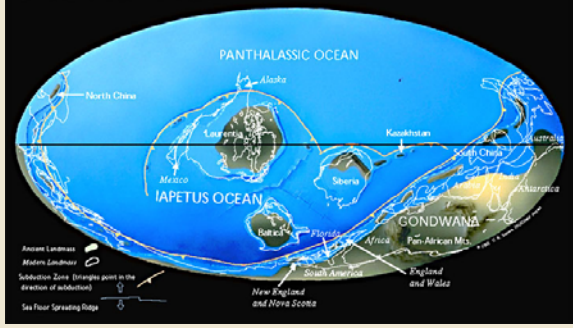


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Late Cambrian 514 Ma




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Figure 27-8

**Burgess shales – Yoho National park**



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**The Cambrian explosion**




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**Burgess shales and its unusual invertebrates**

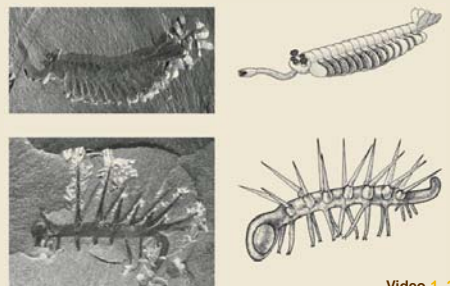


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**Burgess shales and its unusual invertebrates**



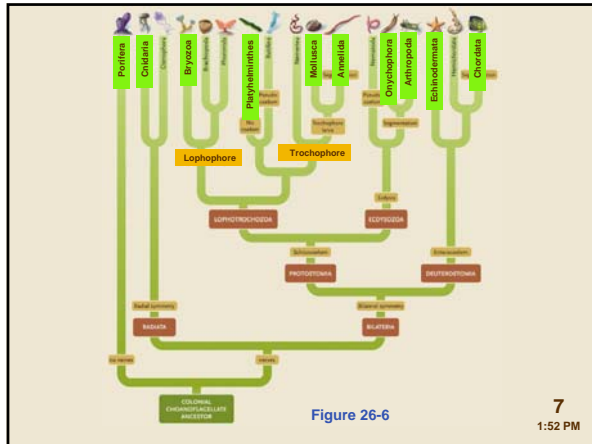
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Video [1](#), [2](#)

# Cambrian and Ordovician



### Animal architecture

- Tissues
- Symmetry and cephalization
- Embryology
- Body cavities

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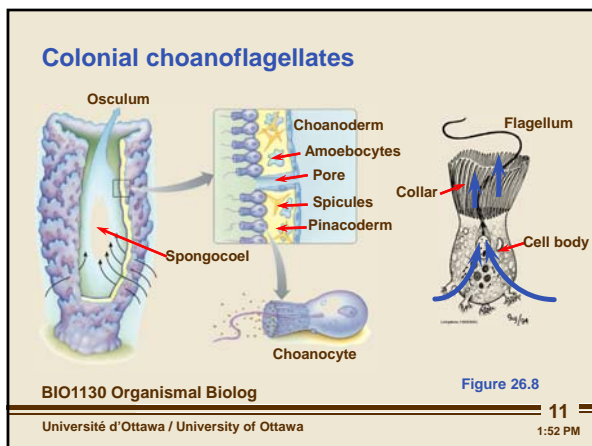
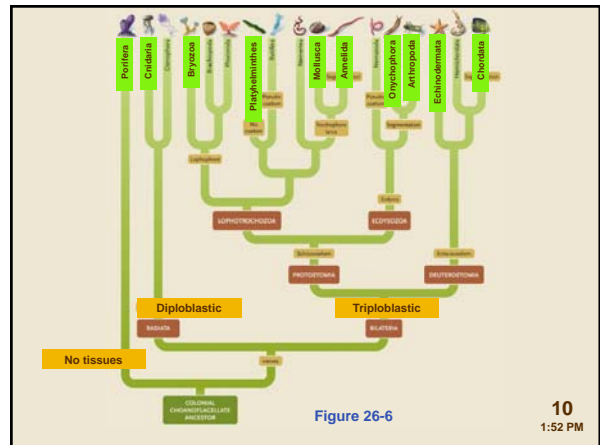
### Animal architecture: Tissues

- No tissues
- \_\_\_\_\_ germ layers
  - Ectoderm and endoderm
- \_\_\_\_\_ germ layers
  - Ectoderm, mesoderm and endoderm

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### Sponge sex

- Choanocytes become sperm
- \_\_\_\_\_ (sponge stem cells) form egg

[http://www.watexplorer.com/fl\\_coo1192.htm](http://www.watexplorer.com/fl_coo1192.htm)

**Figure 26.7**

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# Cambrian and Ordovician

**Colonial choanocyte ancestor**

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**Animal architecture**  
**Symmetry and cephalization**

- Assymetric
- Radial symmetry
- Bilateral symmetry and \_\_\_\_\_

Figure 26.3

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Figure 26-6

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**Corals ?**

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**Coral reefs**

Polyp

Skeleton

Figure 26.13

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**Cnidocytes (Cnidaria)**

Nematocyst

Barbs

Cnidocil

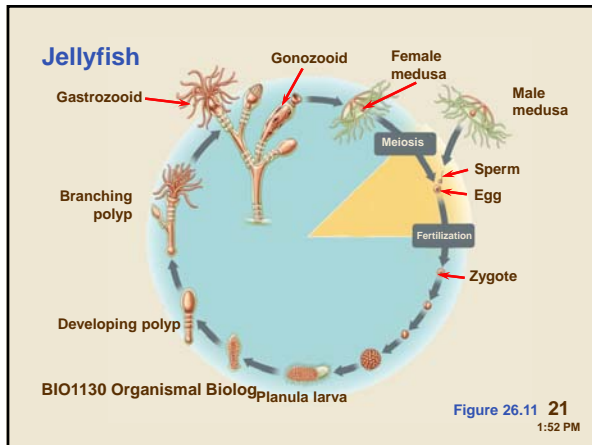
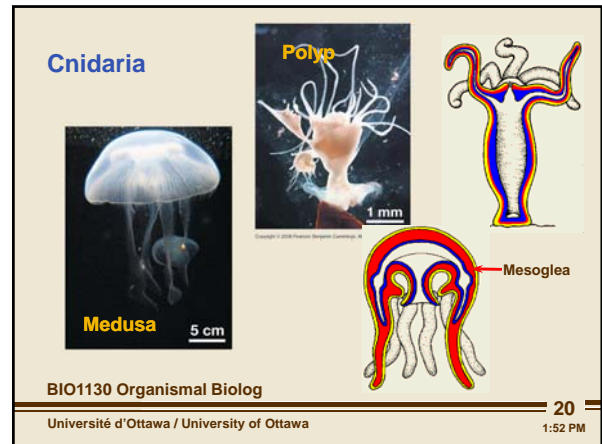
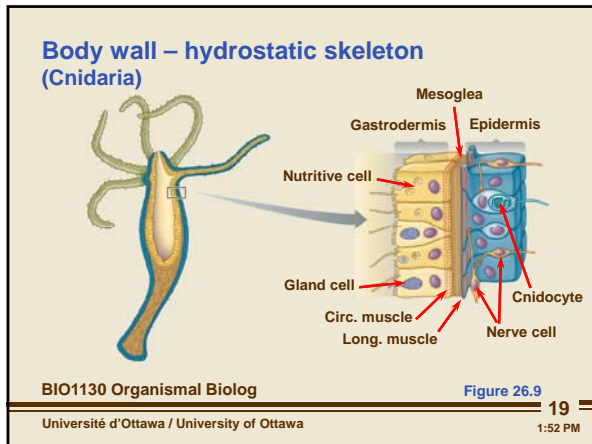
Figure 26.10

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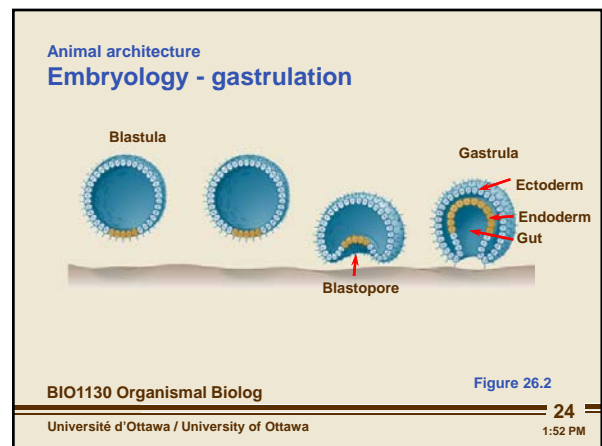
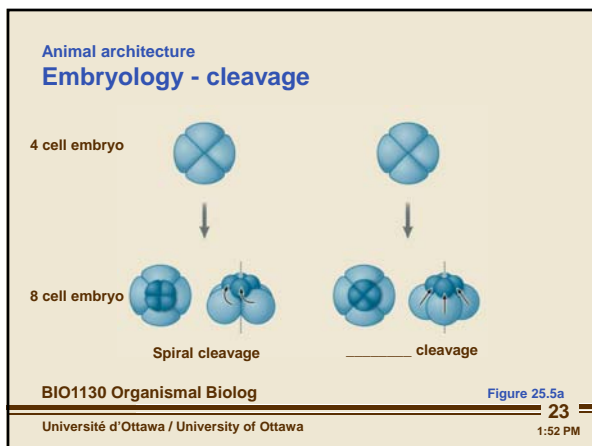
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# Cambrian and Ordovician



- Animal architecture**
- Tissues
  - Symmetry and cephalization
  - Embryology
  - Body cavities
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# Cambrian and Ordovician

**Animal architecture**  
**Embryology – coelom formation**

■ Ectoderm  
■ Mesoderm  
■ Endoderm  
■ Coelom

Schizocoel      Gut (Archenteron)      Enterocoel

BIO1130 Organismal Biolog Figure 26.5b

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■ Ectoderm  
■ Mesoderm  
■ Endoderm  
■ Coelom

Porifera, Cnidaria, Bryozoa, Phlebobranchia, Platyhelminthes, Mollusca, Annelida, Cephalopoda, Amphipoda, Crustacea, Echinodermata, Chordata

Spiral, blastopore mouth, schizocoel      Spiral, blastopore mouth, enterocoel

BIO1130 Organismal Biolog Figure 26-6

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**Animal architecture**  
**Body cavities**

- Acoelomate
- Coelomate
- Pseudocoelomate

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**Animal architecture**  
**Body cavities - Acoelomate**

■ Ectoderm  
■ Mesoderm  
■ Endoderm  
■ Coelom

Epidermis, Gut, Internal organs, Body wall

BIO1130 Organismal Biolog Figure 26.4a

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**Flat worms**  
**(Platyhelminthes)**

Digestive system, Pharynx, Mouth

BIO1130 Organismal Biolog Figure 26.16

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**Flat worms**  
**(Platyhelminthes)**

Ovary, Yolk glands, Oviduct, Seminal receptacle, Genital pore, Testis, Sperm duct, Seminal vesicle, Penis

BIO1130 Organismal Biolog Figure 26.16

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**Animal architecture**  
**Body cavities - Pseudoelomate**

Legend:  
 ■ Ectoderm  
 ■ Mesoderm  
 ■ Endoderm  
 ■ Coelom

Labels:  
 Epidermis  
 Gut  
 Pseudocoelom  
 Body wall  
 Internal organs

BIO1130 Organismal Biolog Figure 26.4b

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**Nematoda**

Labels:  
 Intestine  
 Pseudocoel  
 Gonad  
 Epidermis  
 Muscle  
 Cuticle  
 Nerve cord

BIO1130 Organismal Biolog Figure 26.34

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**Animal architecture**  
**Body cavities - Coelomate**

Legend:  
 ■ Ectoderm  
 ■ Mesoderm  
 ■ Endoderm  
 ■ Coelom

Labels:  
 Epidermis  
 Coelom  
 Body wall  
 Internal organs  
 Mesentery  
 Gut  
 Peritoneum

BIO1130 Organismal Biolog Figure 26.4c

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Phylogenetic tree showing relationships between various animal groups. Key nodes include Lophophore, Trochophore, Moulting, Lophotrochozoa, and Ecdysozoa.

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**Two main protostome groups**

- **Lophotrochozoa**
  - Lophophore or
  - Trochophore larval stage
- **Ecdysozoa**

BIO1130 Organismal Biolog Figure 33-5

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**Brachiopods**

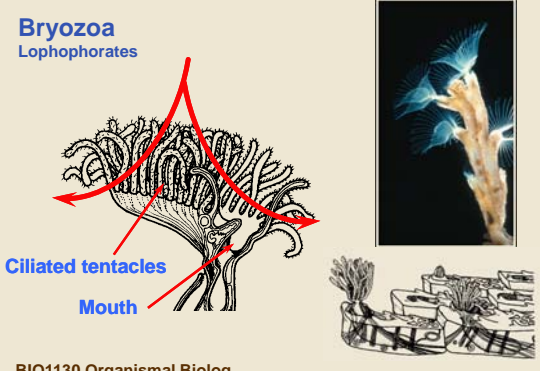
BIO1130 Organismal Biolog Figure 33-5

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# Cambrian and Ordovician

**Bryozoa**  
Lophophorates



Ciliated tentacles  
Mouth

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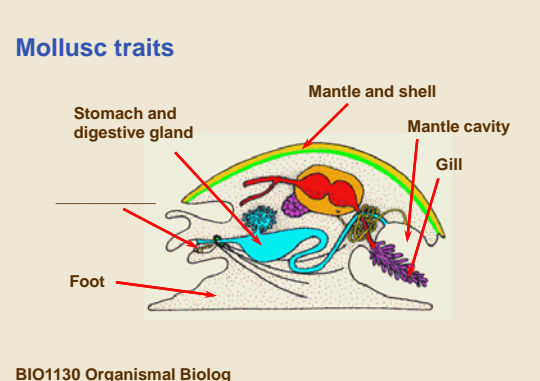
**Molluscs**  
Trochozoa



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**Mollusc traits**



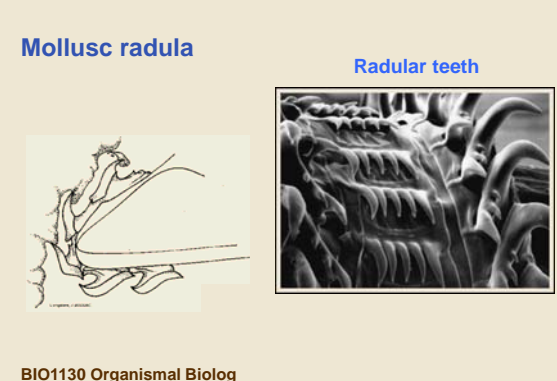
Stomach and digestive gland  
Mantle and shell  
Mantle cavity  
Gill  
Foot

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**Mollusc radula**

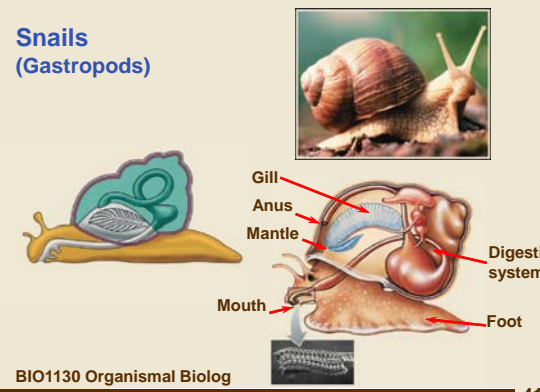
Radular teeth



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**Snails**  
(Gastropods)

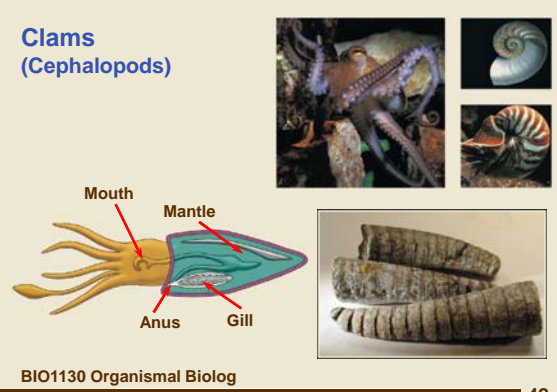


Gill  
Anus  
Mantle  
Digestive system  
Mouth  
Foot

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**Clams**  
(Cephalopods)



Mouth  
Mantle  
Anus  
Gill

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**Ammonites**

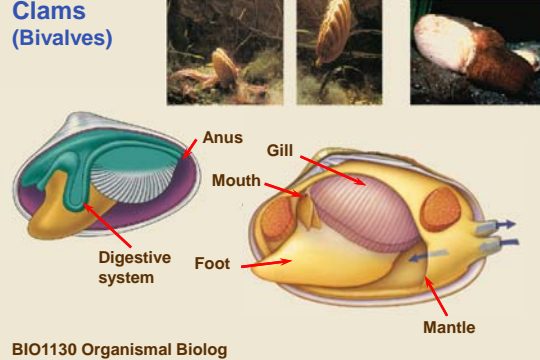


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**Clams (Bivalves)**



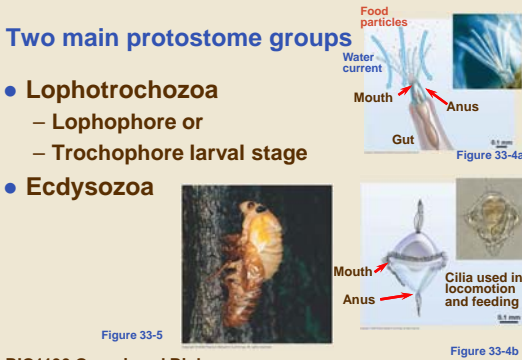
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**Two main protostome groups**

- **Lophotrochozoa**
  - Lophophore or
  - Trochophore larval stage
- **Ecdysozoa**



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**Annelida: marine worms**

Trochozoa

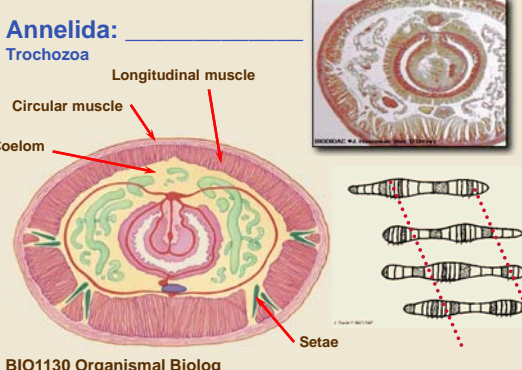


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**Annelida: Trochozoa**



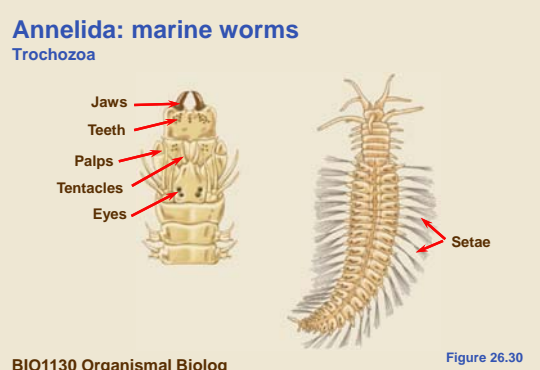
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**Annelida: marine worms**

Trochozoa



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# Cambrian and Ordovician

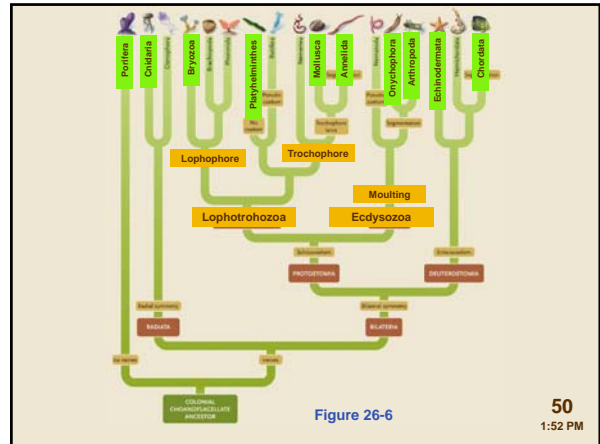
**Priapulids**  
Trochozoa

Mouth  
Introvert covered with scalids (barbs)  
Trunk  
Caudal appendages

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**Onychophora**  
Ecdysozoa

Antenna  
Oral papilla  
Jaw  
Claw

Video

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**Arthropoda: Trilobites**  
Ecdysozoa

Video

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**Arthropoda: Chelicerata**  
Ecdysozoa

Chelicera  
Pedipalp  
Prosoma  
Walking legs  
Operculum  
Book gill cover

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**Arthropoda: Crustacea**  
Ecdysozoa

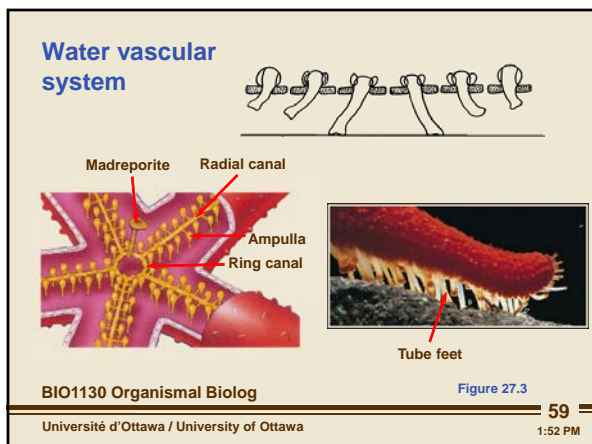
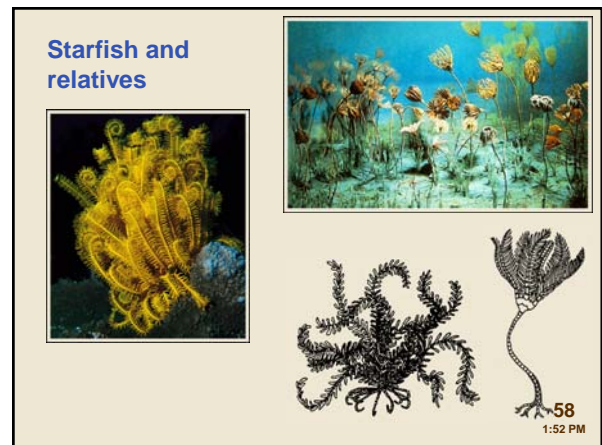
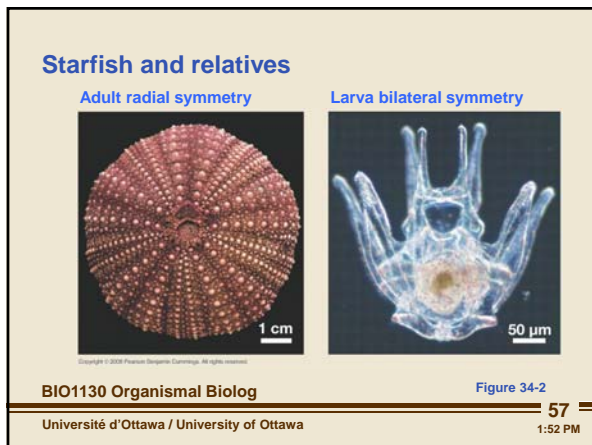
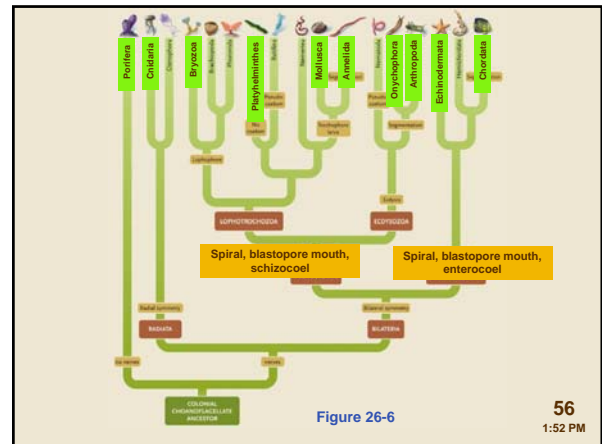
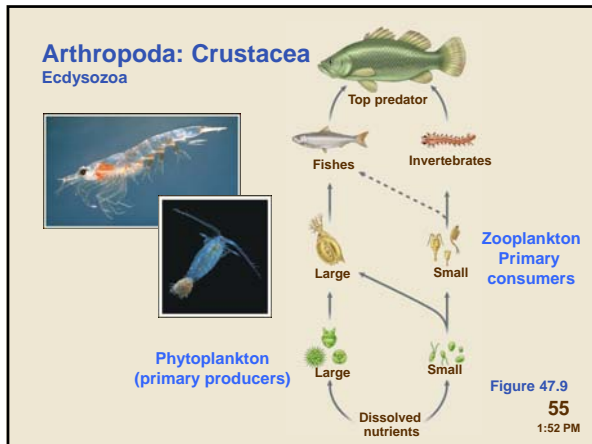
(Head and thorax)  
Antenna  
Mouthparts  
Cheliped  
Walking legs  
Swimming legs (Swimmerets)  
Tail (Uropods and telson)

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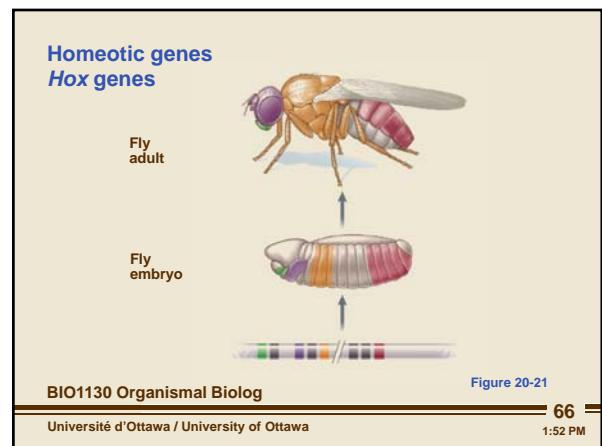
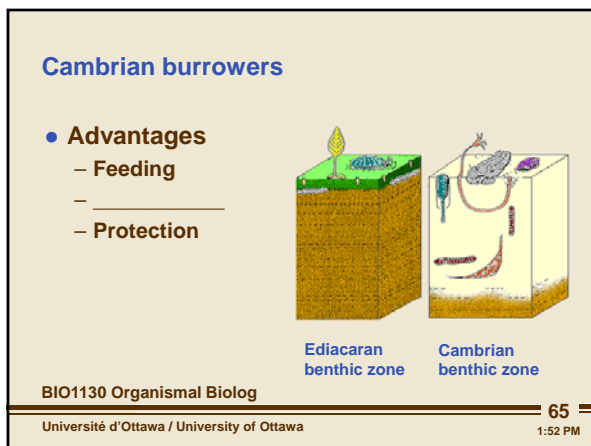
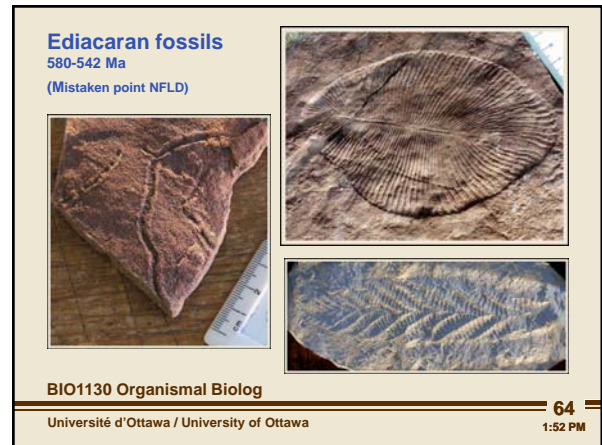
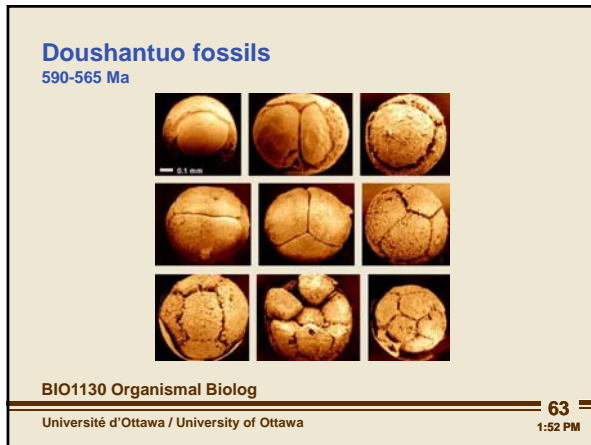
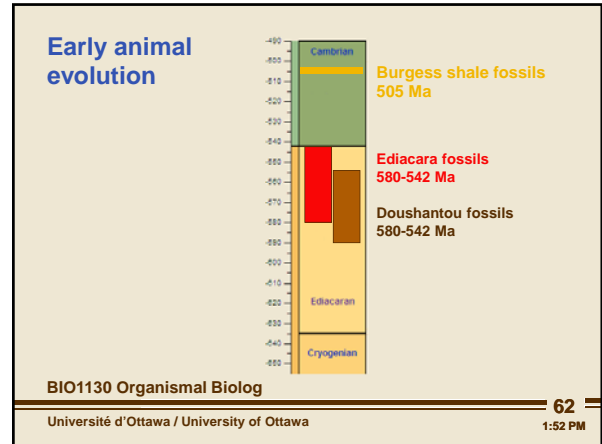
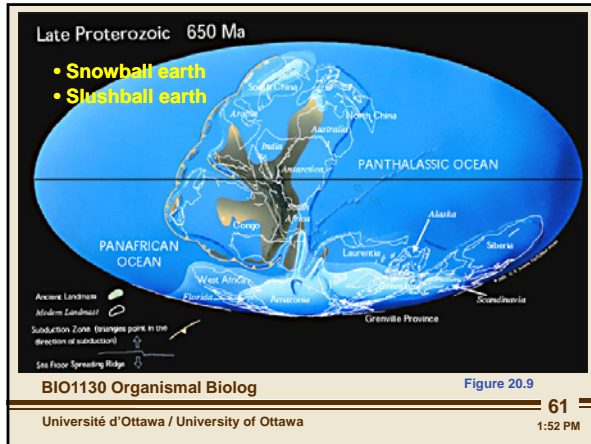
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# Cambrian and Ordovician



- An explanation for the Cambrian explosion**
- Snowball earth
  - Burrowing
  - Shelled arms race
  - Developmental – *hox* genes
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# Cambrian and Ordovician




# Cambrian and Ordovician

### Homeotic genes *Hox* genes


Normal fruit fly



Homeotic mutant



Homeotic mutant

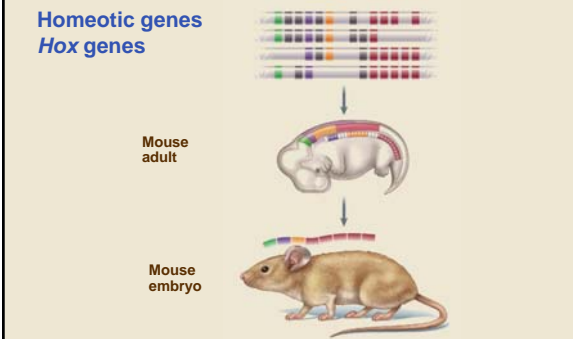


BIO1130 Organismal Biolog Figure 21-12

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### Homeotic genes *Hox* genes

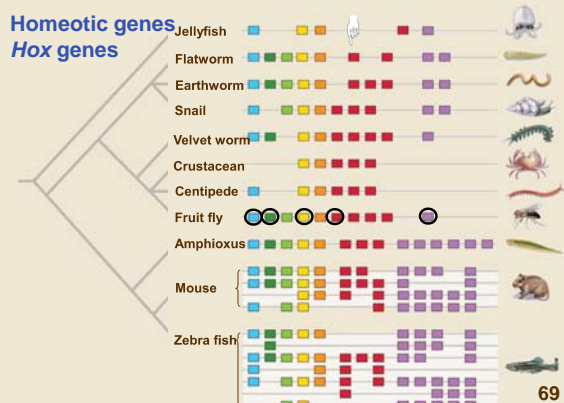


BIO1130 Organismal Biolog Figure 20-21

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### Homeotic genes *Hox* genes

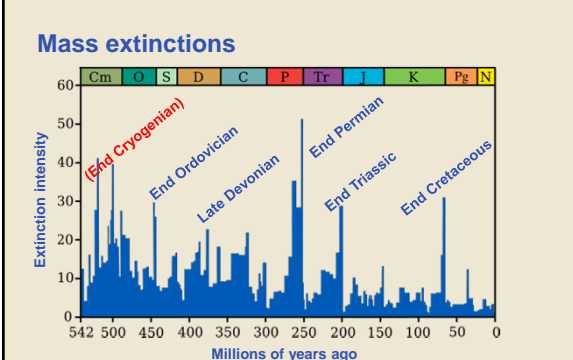


BIO1130 Organismal Biolog Figure 27-14

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### Mass extinctions

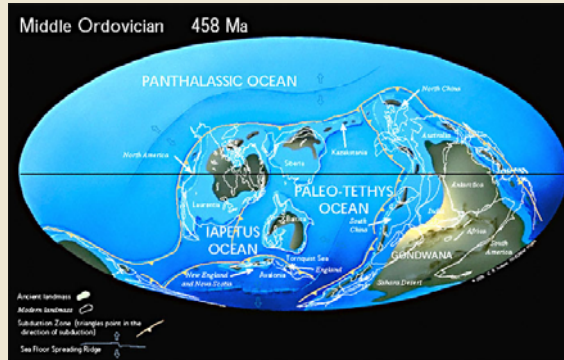


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### Middle Ordovician 458 Ma



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