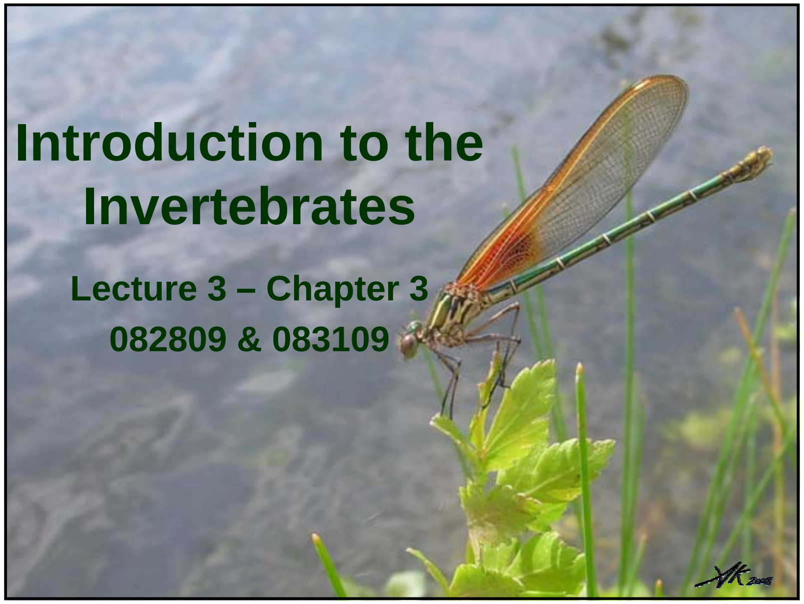

The Invertebrate Bauplan: Components of Animal Structure

Components of Animal Structure

I. Body Symmetry
II. Body Architecture: Complexity; Body Type
III. Locomotion and Support
IV. Feeding Mechanisms
V. Excretion and Osmoregulation
VI. Circulation and Gas Exchange
VII. Nervous Systems and Sense Organs
VIII. Reproduction

8/26 (I–III)

Components of Animal Structure

I. Body Symmetry
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VIII. Reproduction

IV. Feeding Mechanisms

Metazoans and heterotrophic protistans acquire nutrients by taking in organic matter from the environment.

1. Digestion
2. Feeding Strategies

IV. Feeding Mechanisms

Metazoans and heterotrophic protistans acquire nutrients by taking in organic matter from the environment.

1. Digestion
   1. Intracellular digestion
   2. Extracellular digestion
   3. Extracorporal digestion

IV. Feeding Mechanisms

Metazoans and heterotrophic protistans acquire nutrients by taking in organic matter from the environment.

1. Digestion
   1. Intracellular digestion
   2. Extracellular digestion
   3. Extracorporal digestion

All organisms move nutrients into cells by endocytosis, regardless of the method of digestion.

Endocytosis = phagocytosis + pinocytosis

Cellular capture of nutrients = "eating by cells" + "drinking by cells"

IV. Feeding Mechanisms

Phagocytosis -

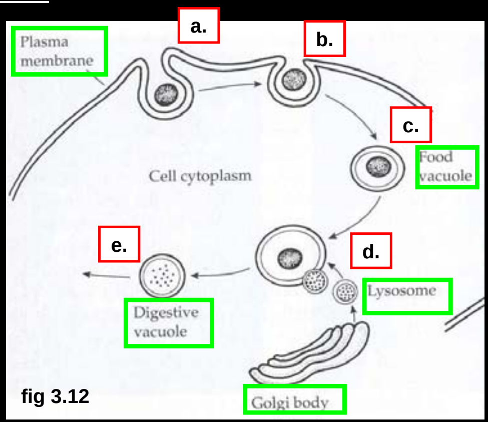


fig 3.12

IV. Feeding Mechanisms

Pinocytosis -

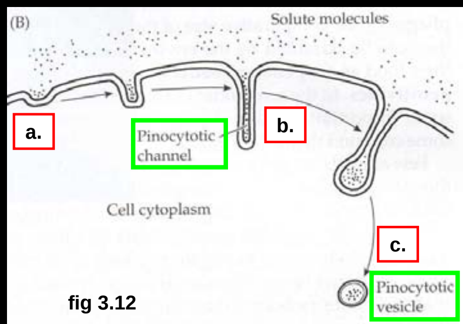


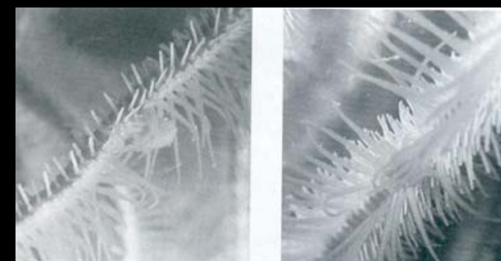
fig 3.12

IV. Feeding Mechanisms

Metazoans and heterotrophic protistans acquire nutrients by taking in organic matter from the environment.

1. Digestion
2. Feeding Strategies
   1. Suspension/filter feeding –

Fig 3.15 Tube feet of brittle star (Ph. Echinodermata)



IV. Feeding Mechanisms

Metazoans and heterotrophic protistans acquire nutrients by taking in organic matter from the environment.

1. Digestion
2. Feeding Strategies
   1. Suspension/filter feeding

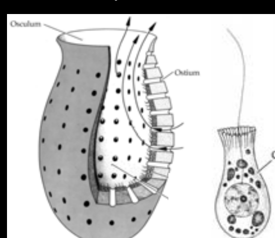


Fig 6.3 & 6.4 Sponges (Ph. Porifera)

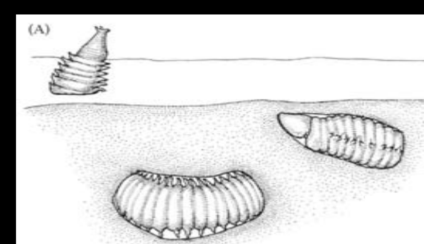
Crab and barnacles (Ph. Arthropoda)

IV. Feeding Mechanisms

Metazoans and heterotrophic protistans acquire nutrients by taking in organic matter from the environment.

1. Digestion
2. Feeding Strategies
   1. Suspension/filter feeding
   2. Deposit feeding (e.g. polychaete & oligochaete annelids, snails, sea urchins).

Fig 3.16 Polychaete annelid burrowing in sediment. A subsurface deposit feeder.



IV. Feeding Mechanisms

Metazoans and heterotrophic protistans acquire nutrients by taking in organic matter from the environment.

1. Digestion
2. Feeding Strategies
   1. Suspension/filter feeding
   2. Deposit feeding
   3. Herbivory (e.g. molluscs, polychaetes, arthropods, & sea urchins).

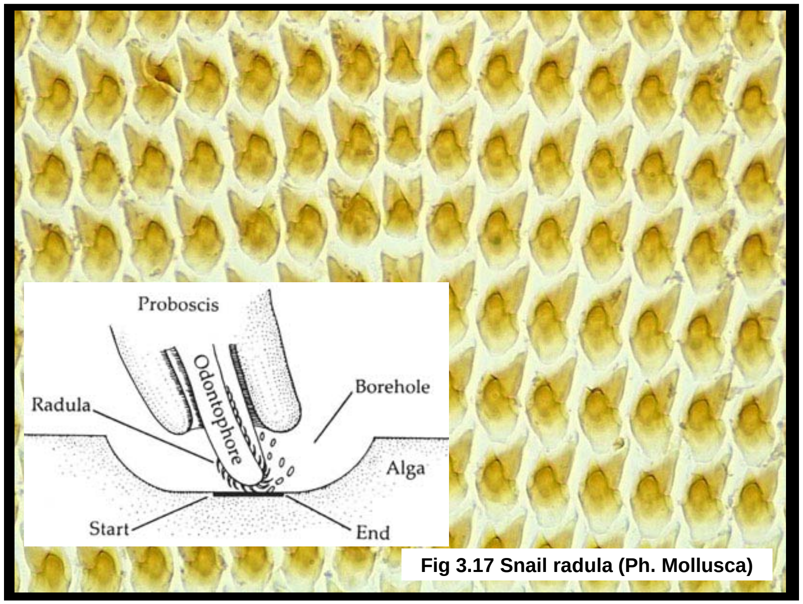


Fig 3.17 Snail radula (Ph. Mollusca)

IV. Feeding Mechanisms

Metazoans and heterotrophic protistans acquire nutrients by taking in organic matter from the environment.

1. Digestion
2. Feeding Strategies
   1. Suspension/filter feeding
   2. Deposit feeding
   3. Herbivory
   4. Carnivory & Scavenging – (e.g. ciliate protists, polychaete annelids, octopuses, crabs, & sea stars).

Carnivorous Octopus (Ph. Mollusca)

http://www.youtube.com/watch?v=FFOEZh1Lbbg&feature=PlayList&p=68713C56DE93FD18&index=8

Components of Animal Structure

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V. Excretion and Osmoregulation

1. Nitrogenous wastes and water conservation
2. Osmoregulation and Habitat
3. Excretory and Osmoregulatory Structures

V. Excretion and Osmoregulation

1. Nitrogenous wastes and water conservation
2. Osmoregulation and Habitat
3. Excretory and Osmoregulatory Structures
    1. Water expulsion vesicles (= contractile vacuoles) (Protista).

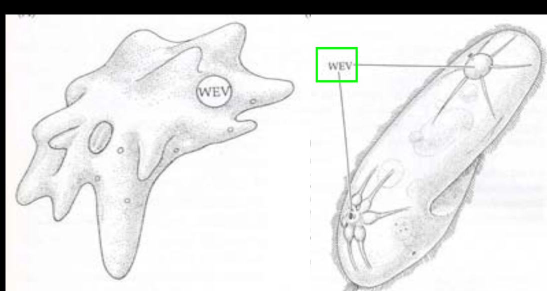
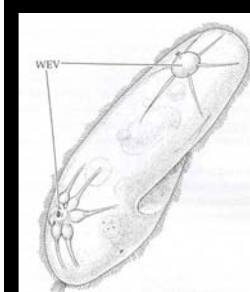


Fig 3.22 - Water expulsion vesicles (WEV) in an ameba and *Paramecium*.



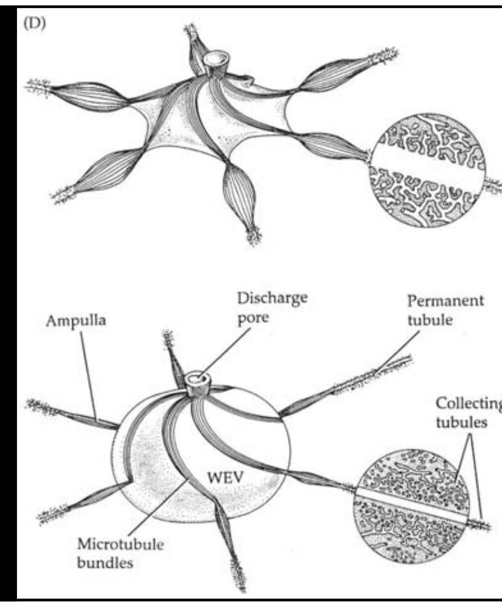


Fig 3.22 The WEV of *Paramecium* in emptied (top) and filled (bottom) condition.

V. Excretion and Osmoregulation

1. Nitrogenous wastes and water conservation
2. Osmoregulation and Habitat
3. Excretory and Osmoregulatory Structures
   1. Water expulsion vesicles
   2. Nephridia –
      excretion and/or osmoregulation.
      1. Protonephridia – open to the outside of the body and terminate internally in a closed unit. Cilia or flagella creating lowered fluid pressure that draws body fluids and wastes out.

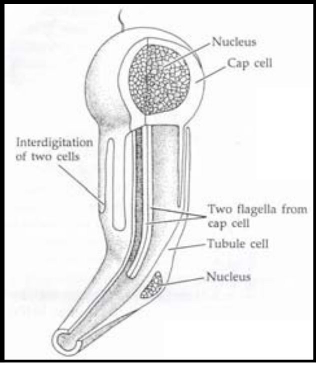


Fig 3.23 – Protonephridium

V. Excretion and Osmoregulation

1. Nitrogenous wastes and water conservation
2. Osmoregulation and Habitat
3. Excretory and Osmoregulatory Structures
   1. Water expulsion vesicles
   2. Nephridia -
      excretion and/or osmoregulation.
      1. Protonephridia
      2. Metanephridia – similar to protonephridia but open internally. Selectively absorb non-waste from internal fluids & send back into body.

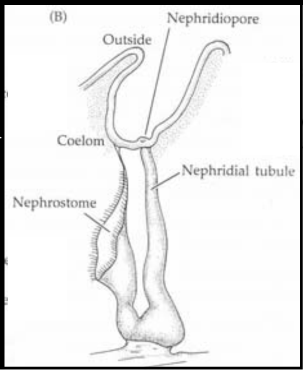


Fig 3.23 – Metanephridium from a polychaete worm

V. Excretion and Osmoregulation

1. Nitrogenous wastes and water conservation
2. Osmoregulation and Habitat
3. Excretory and Osmoregulatory Structures
   1. Water expulsion vesicles
   2. Nephridia
   3. other organs of excretion –
      - some lack excretory structures (sponges, echinoderms, & cnidarians)

      OR
      - more complicated systems (Antennal glands and Malpighian tubules)

VI. Circulation and Gas Exchange

The nature of the circulatory system is directly related to the size, complexity, and lifestyle of the organism in question.

VI. Circulation and Gas Exchange

1. Internal transport - Rudimentary

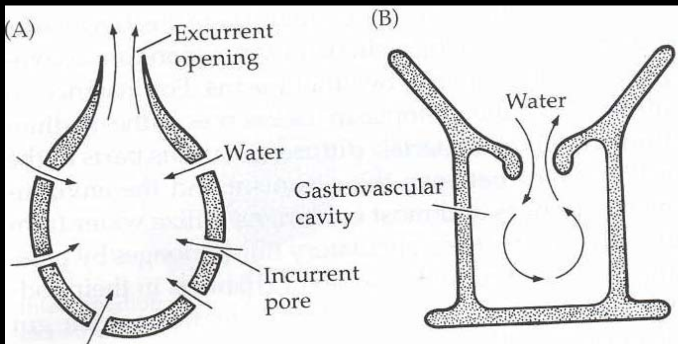


Fig 3.24 – Sponges (Ph. Porifera) and Anemones (Ph. Cnidaria) use environmental water as their circulatory fluid.

VI. Circulation and Gas Exchange

1. Internal transport - Rudimentary

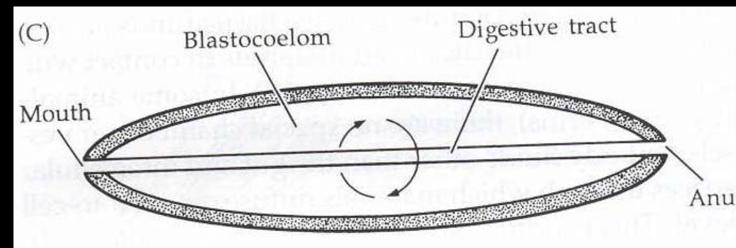


Fig 3.24 – Blastocoelomates (e.g. nematodes, rotifers) use fluids of body cavity for circulation

VI. Circulation and Gas Exchange

1. Internal transport
2. Circulatory systems
    1. <u>Closed circulatory system</u> – blood stays in distinct vessels and lined chambers.

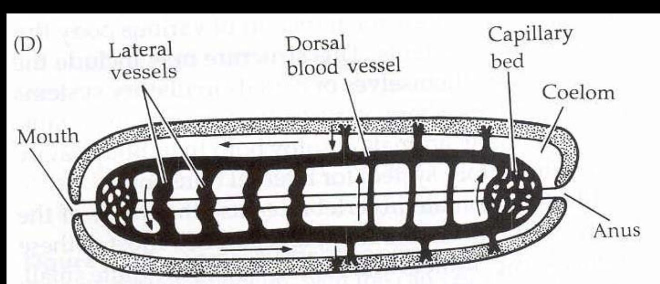


Fig 3.24 – Closed circulatory system in an earthworm (Ph. Annelida, vertebrates).

VI. Circulation and Gas Exchange

1. Internal transport
2. Circulatory systems
    1. <u>Closed circulatory</u> system
    2. <u>Open circulatory system</u> –hemolymph empties from vessels into the body cavity (=hemocoel) and directly bathes the organs.

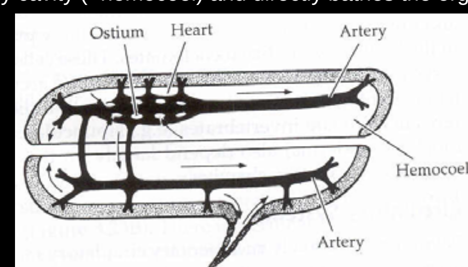


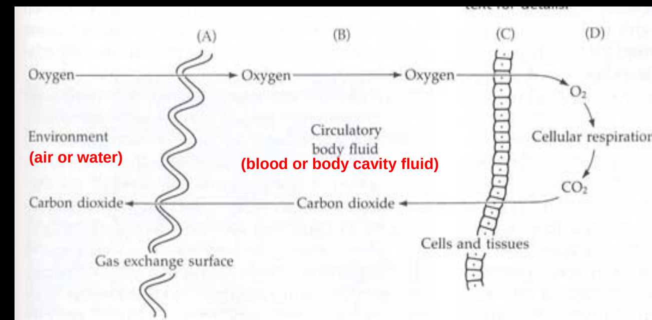
Fig 3.24 – Open circulatory system in an insect (Ph. Arthropoda, Ph. Mollusca (clams, snails).

VI. Circulation and Gas Exchange

1. Internal transport
2. Circulatory systems
3. Gas exchange and transport –

VI. Circulation and Gas Exchange

Gas exchange



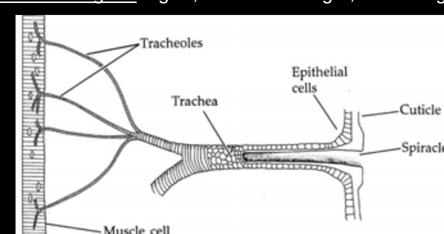
- Gases diffuse across a wet membrane, at the exchange site, down a concentration gradient.
- The gradient is maintained by the circulation of internal fluids to and away from these areas.

VI. Circulation and Gas Exchange

1. Internal transport
2. Circulatory systems
3. Gas exchange and transport
   1. Gas exchange surfaces
      1. Across body surface - Protists, tiny & soft bodied inverts (also vertebrate amphibians).

VI. Circulation and Gas Exchange

1. Internal transport
2. Circulatory systems
3. Gas exchange and transport
   1. Gas exchange surfaces
      1. Across body surface
      2. Specialized organs – gills, modified hindgut, book lungs, trachea, etc.



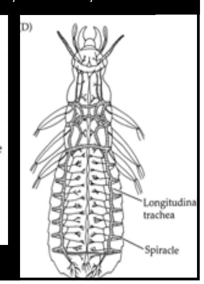


Fig 3.26 Tracheal system of an insect

VI. Circulation and Gas Exchange

1. Internal transport
2. Circulatory systems
3. Gas exchange and transport
   1. Gas exchange surfaces
      1. Across body surface
      2. Specialized organs
      3. Gills to increase surface area for increased gas exchange.

Fig 3.26
Polychaete (Ph. Annelida) tentacles; Sea slug (Ph. Mollusca) branchial plume; chiton with gills (Ph. Mollusca).

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VII. Nervous Systems and Sense Organs
VIII. Reproduction

8/27 (I–III)

VII. Nervous Systems & Sense Organs

1. Nervous system and body plan –
   1. Nerve net – nervous system is a non-centralized, diffuse meshwork

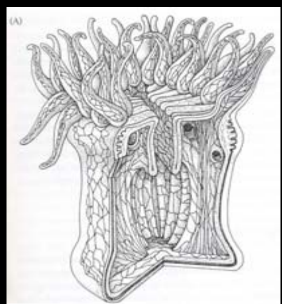

Figure 3.32 Nervous systems and symmetry. (A) The nerve net in a radially symmetrical sea anemone (cutaway view).

VII. Nervous Systems & Sense Organs

1. Nervous system and body plan –
   1. Nerve net
   2. Central nervous system – centralize and concentrate major coordinating elements. Cephalization.

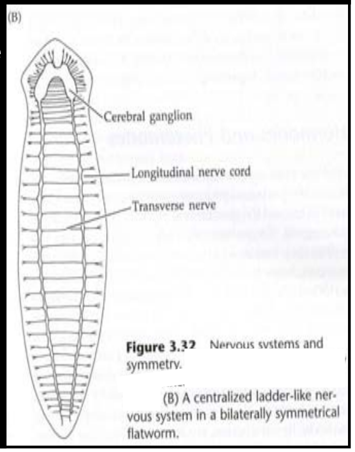

Figure 3.32 Nervous systems and symmetry.

(B) A centralized ladder-like nervous system in a bilaterally symmetrical flatworm.

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VIII. Reproduction

8/27

VIII. Reproduction

The biological success of any species depends upon its members staying alive long enough to reproduce.

VIII. Reproduction

1. Asexual reproduction

** ADVANTAGES
– rapid
– overwintering

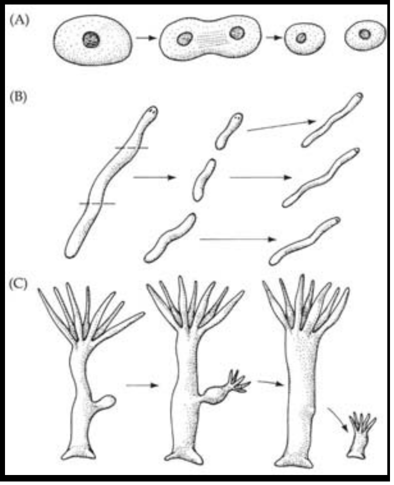


Fig 3.33 (a) simple **mitotic binary fission** (b) **fragmentation** (c) **budding** (*Hydra*)

VIII. Reproduction

1. Asexual reproduction
2. Sexual reproduction

** ADVANTAGES
– high genetic diversity

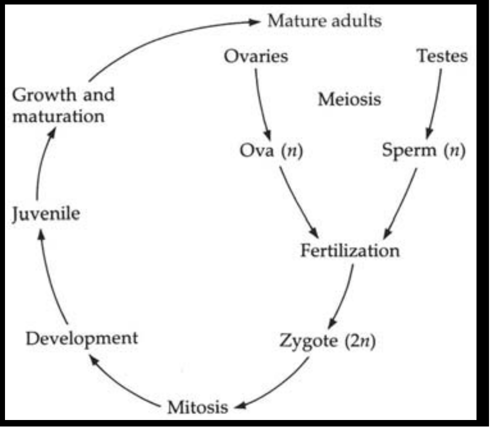
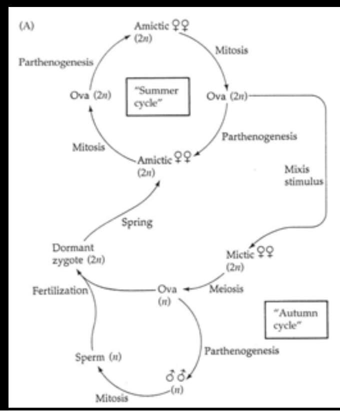


Fig 3.35 A generalized Metazoan lifecycle.

VIII. Reproduction

1. Asexual reproduction
2. Sexual reproduction
3. Parthenogenesis



Take-home Messages 8/28

All organisms move nutrients into cells by endocytosis, regardless of the method of digestion.

Suspension feeding is the primary mode of feeding in a large number and diverse array of taxa.

Invertebrates have differing ways of dealing with metabolic waste that are closely based on their environments.

Mode of excretion and need for osmoregulation are related to surface-to-volume ratio (bauplan) and environment.

The nature of the circulatory system is directly related to the size, complexity, and lifestyle of the organism in question.

Take-home Messages 8/31

The nature of the circulatory system is directly related to the size, complexity, and lifestyle of the organism in question.

The structure of the nervous system of any animal is related to its bauplan and its mode of life.

The biological success of any species depends upon its members staying alive long enough to reproduce itself.

Study Questions - 082809

1. What are the four fundamentally different mechanisms used by invertebrates for removing small food particles from the environment?
2. How do osmoregulatory requirements differ among marine, freshwater and terrestrial invertebrates?
3. Differentiate between circulation in a closed and open circulatory systems.
4. Gas must diffuse across a moist gas exchange surface. What are two adaptations in terrestrial invertebrates that enable them to exchange gas without loosing moisture to the environment?

Study Questions - 083108

1. Gas must diffuse across a moist gas exchange surface. What are two adaptations in terrestrial invertebrates that enable them to exchange gas without loosing moisture to the environment?

2. Differentiate between “nerve net” and “ladder-like” nervous systems.

3. Define cephalization and explain how it relates to bilateral symmetry and motility.

4. Name one advantage and one disadvantage to asexual reproduction AND sexual reproduction in invertebrates.