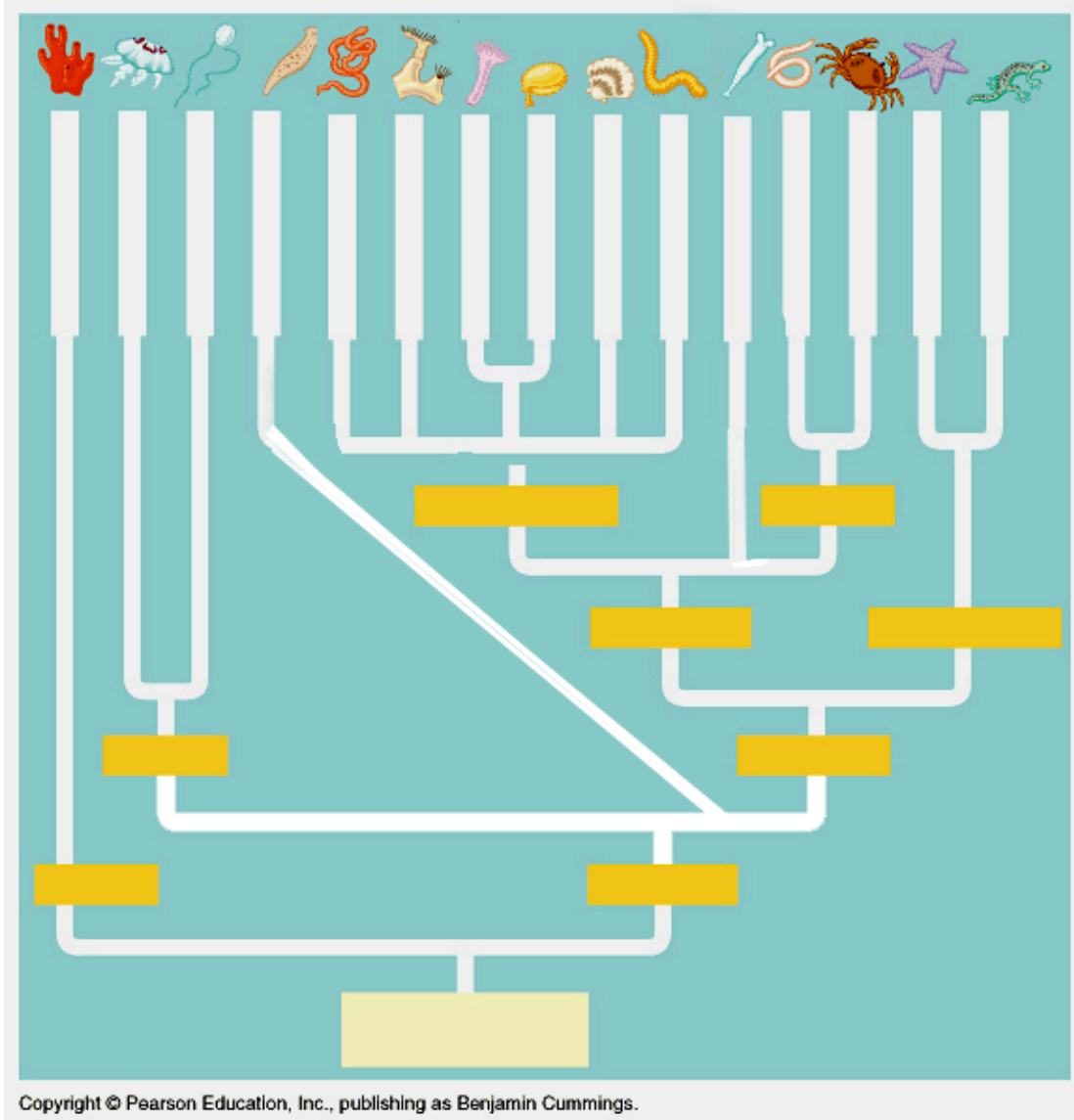


# *Kingdom Animalia - Evolution of Form and Function*

by Dana Krempels

The following figure represents a phylogenetic tree of fifteen major animal phyla. Use the tree to do the following exercise.



## **A. Identification of major taxa and their defining characteristics: A Review**

1. Fill in the names of the indicated phyla in the vertical boxes just under the illustration of a representative of each phylum.
2. Use the list of defining characteristics below and place them in the appropriate boxes on the phylogenetic tree. Note that more than one character may be placed in the same box, so you should use the letters (a, b, c, etc.) in the boxes, rather than trying to write out the complete phrase. Also remember that each character should appear on the tree where it first occurs in the animals above it on the tree.

**USE YOUR TEXT READINGS AND NOTES FOR THIS WORKSHOP!**

- a. lophophore feeding apparatus
- b. body cavity lined on parietal side w/ mesoderm
- c. space between endoderm and ectoderm filled with non-cellular mesogloea
- d. coelom formed via enterocoely
- e. mesoderm derived from endoderm
- f. mesogloea between endoderm and ectoderm contains cellular components
- g. cellular division of labor
- h. complete digestive system
- i. diploblasty
- j. triploblasty
- k. coelom formed via schizocoely
- l. bilateral symmetry
- m. radial symmetry
- n. cnidoblast stinging cells
- o. true tissues
- p. nervous system embryonically dorsal
- q. secondary opening becomes the anus
- r. secondary opening becomes the mouth

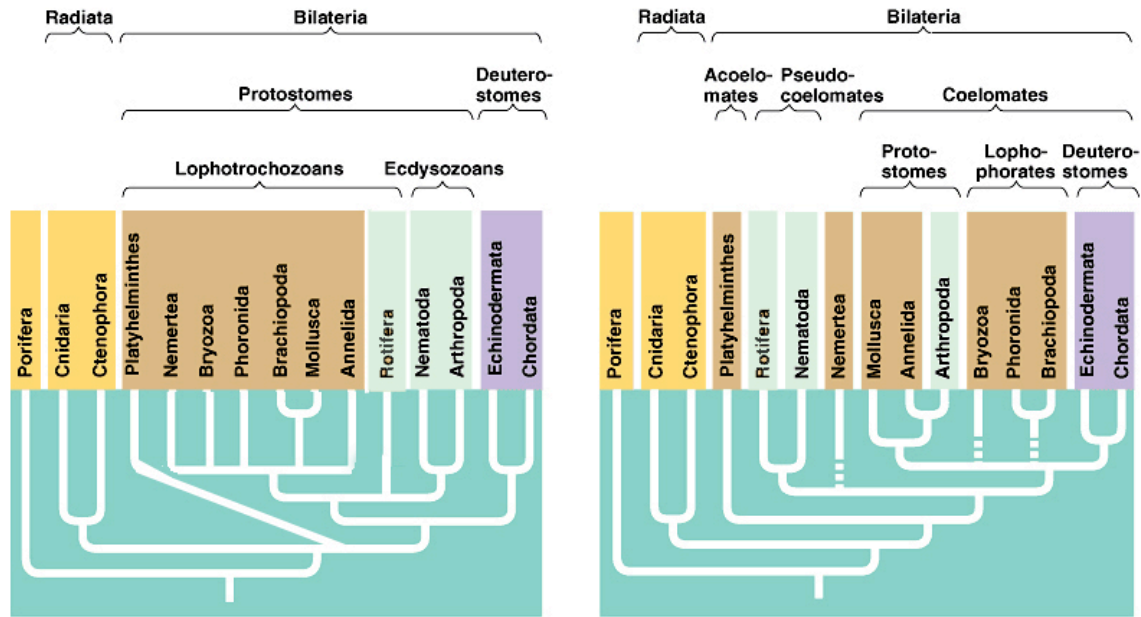
**B. Ancestry, Form and Function**

1. Describe the probable appearance of the most recent common ancestor of protostomes and deuterostomes.
2. Judging from the description you just made, which organ system(s) in these animals are most primitive?
3. Describe the appearance and developmental characteristics of a reasonable hypothetical ancestor of the Ecdysozoans.
4. Describe the appearance and developmental characteristics of a reasonable hypothetical ancestor of the Lophotrochozoans.
5. What synapomorphies are exhibited by each of the previous phyla that sets them apart from the hypothetical common ancestor and from each other.
  - a. Phylum Mollusca
  - b. Phylum Annelida
  - c. Phylum Arthropoda
6. Both Mollusks and Arthropods have an open circulatory system and a coelom reduced in size and function to form the pericardium and gonocoel. If the hypothetical relationships in the tree above are correct, what does this suggest about these two characters in these two phyla?
7. Describe the appearance and characteristics of a reasonable hypothetical ancestor of Echinodermata, Hemichordata, and Chordata.

8. What synapomorphies are exhibited by each of the previous three phyla that sets them apart from the hypothetical common ancestor and from each other.
  - a. Phylum Echinodermata
  - b. Phylum Hemichordata
  - c. Phylum Chordata

### **C. Practical Applications**

1. A drug called lufenuron (Program) interferes with the activity of an enzyme known as chitinase, which is involved in the normal formation of chitin. Lufenuron prevents normal maturation of animals that use chitin as structural support. Which of the following do you think would *most likely* be adversely affected by medicating an infected host mammal with lufenuron?
  - a. fleas
  - b. ear mites
  - c. leeches
  - d. heartworm (a nematode)
  - e. ringworm fungus
  - f. liver flukes
  - e. tapeworms
  - f. ticks
  - g. caterpillars
2. It turns out that although lufenuron is effective against insects, it will not kill ticks. What could be a possible reason for this?
3. Animal phyla have long been classified into putatively monophyletic assemblages on the basis of their body plans. Unfortunately, as we are now discovering with more sophisticated identification techniques such as DNA sequencing and metabolic studies, this can sometimes create artificial taxa that are para- or polyphyletic. Consider the following phylogenetic trees. The one on the left shows a classification based upon molecular (DNA sequencing) data. The one on the right shows a "traditional" classification based upon body plans and morphology.



(a) Tree based on molecular comparisons

(b) Tree based on body-plan grades

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**Now consider the following:**

Ivermectin is a macrolide antibiotic produced from a fungus (*Streptomyces avermitilis*) first isolated from a soil sample in Japan. Ivermectin is an agonist for the neurotransmitter gamma-aminobutyric acid (GABA), a major inhibitory neurotransmitter.

In mammals, GABA-containing neurons and receptors are found in the Central Nervous System, while in arthropods and nematodes GABA is found primarily in the Peripheral Nervous System (neuromuscular junction). This difference in location of GABA receptors may be the reason why ivermectin can be safely administered to mammals for treatment of arthropod and nematode parasites.

The binding of ivermectin to a neuronal membrane increases the release of GABA, which binds to the GABA receptor-chloride channel complex of postsynaptic neuronal membranes. This causes an influx of chloride ions that hyperpolarize the neuronal membrane making them less excitatory and decreasing nerve transmission.

The hyperpolarization of neuronal membranes (at the NMJ) mediate a flaccid paralysis in arthropods and nematodes.

Discuss the implications of this characteristic in arthropods and nematodes. Do you believe it is evidence of convergent evolution, or of homology? Support your answer.

**Discussion**

Can you think of other examples of characteristics used to devise phylogenies that might also have relevance in treatment of disease, solution of environmental problems, or other practical applications? Discuss! And discuss some more!