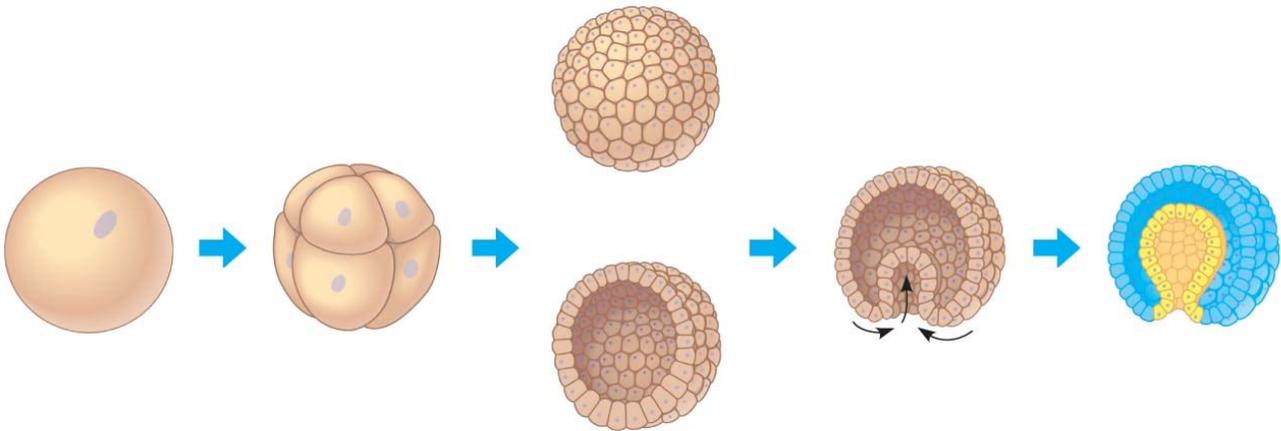


Name _____ Period _____

Chapter 32: An Introduction to Animal Diversity

Concept 32.1 Animals are multicellular, heterotrophic eukaryotes with tissues that develop from embryonic layers

1. Like the fungi, animals are multicellular heterotrophs. How do they feed?
2. What two types of specialized cells do only animals have?
3. Most animals reproduce _____, and the _____ stage dominates the life cycle.
4. Animal development requires its own vocabulary to describe the stages that are seen in all developing embryos. To help learn them, label each stage shown in this figure.



5. Your sketch labels should include the following terms. Define each one:

zygote

blastula

gastrula

blastopore

6. Explain these terms:

cleavage

gastrulation

metamorphosis

7. All eukaryotes have sets of regulatory genes containing common sets of DNA sequences called *homeoboxes*. What are the unique homeobox genes of animals called?

Concept 32.3 Animals can be characterized by “body plans”

8. Which animal group lacks symmetry? _____

9. Two types of symmetry are seen in all other animal groups. Name and describe them in words or with a sketch.

10. What is the symmetry of a jellyfish? _____ of a worm? _____ of a dog?

11. Animals that have *bilateral symmetry* have a front and rear. Draw a sketch of a cat, and label these regions: *anterior*, *posterior*, *dorsal*, and *ventral*.

12. Does your cat have whiskers, eyes, and ears? With *bilateral symmetry*, major sensory structures and the “brain” are concentrated in the head region. What is this area called?

13. Many animals with radial symmetry are *sessile*. What does this mean?

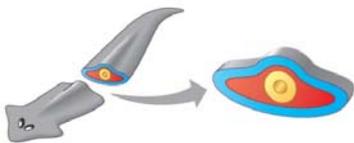
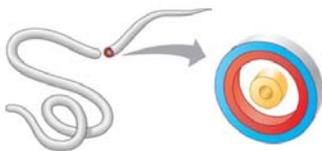
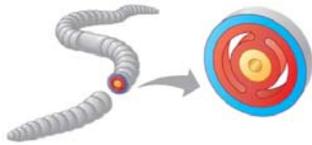
14. How is radial symmetry an advantage to *sessile* or *planktonic* animals?

15. The process of *gastrulation* results in concentric layers in the embryo and the development of a body tube called the *archenteron*, which becomes the gut. Return to the figure in question 4, and label the *archenteron* and the three tissue layers: *endoderm*, *ectoderm*, and *mesoderm*. If this diagram is not printed in color, use pencils to color the ectoderm blue, the mesoderm red, and the endoderm yellow. These colors are used by convention for each tissue type.
16. Which animal groups have only two tissue layers and are said to be *diploblastic*?
17. For a *triploblastic* animal, give at least two organs or organ systems that arise from each tissue layer (also called *germ layer*).

| Germ Layer | Organ or Organ System |
|-------------------|------------------------------|
| <i>endoderm</i> | |
| <i>mesoderm</i> | |
| <i>ectoderm</i> | |

18. Now we are going to move into a discussion that many students find confusing. Pay close attention! What is a *coelom*?
19. The definition you have written should say the body cavity is surrounded by mesoderm on *both* sides. What do we call the animal groups that have a body cavity with mesoderm on only *one* side?
20. And what are the animal groups called that have *no* body cavity?

21. Here's the point our students find confusing: the *gut* or *digestive tube* is not a *coelom*! All the animals sketched below have a digestive tube, but only one has a true coelom. Using the colors described in question 15, color the germ layers, and label these representative animals *coelomate*, *pseudocoelomate*, and *acoelomate*. Indicate the body cavity and gut in the pictures. Also give the common names of the animals shown.

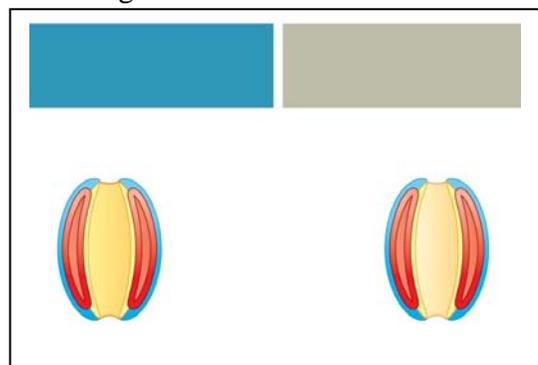


22. What are three functions of the body cavity?

Protostome and Deuterostome Development

This concept is one our students often find difficult, but it is important to help you understand the major features that are used to organize the animal groups. Stick with it until you know what is meant by being a *protostome* or *deuterostome*. Let's begin with explaining the meaning of these words based on their roots:

stom- = mouth
proto- = first
deutero- = second



With a *protostome*, the *blastopore* (which is the opening into the archenteron) becomes the mouth (*first mouth*), and a second opening in the body tube will form the anus.

With a *deuterostome*, the blastopore will be the anus, and a second opening becomes the mouth (*second mouth*).

23. Label *protostome*, *deuterostome*, *mouth*, *anus*, and *digestive tube* on the figure above.
24. What forms the mouth in a *deuterostome*?
25. Now let's layer on another set of words based on the early mitotic divisions of the embryo called *cleavages*. Study the figure below. If the cells are lined up over each other in the eight-cell embryo, the cleavages are said to be *radial*. If the top layer is rotated relative to the lower layer, the cleavages are said to be *spiral*. Label the cleavages below.
26. If each cell in the early embryo has the capacity to develop into a complete embryo, what is this type of cleavage called?
27. What type of cleavage is it if the developmental fate of each embryonic cell is rigidly "determined" very early?
28. You will notice that most animals have *spiral* and _____ *cleavage* or *radial* and _____ *cleavage*.
29. Label the figure below with *protostome* and *deuterostome*, *spiral* and *determinate cleavage*, and *radial* and *indeterminate cleavage*.



30. Many times you have heard that taxonomy is in flux. Your text shows two different phylogenetic trees based on analysis of different criteria. Use the phylogenetic trees to answer these questions.

Animals in which phylum or phyla . . .

- lack symmetry and true tissues?
- show radial symmetry and are diploblastic?
- have three tissue layers, but lack a body cavity?
- show bilateral symmetry and have a pseudocoelom?
- have a true coelom and are protostomes?
- have a true coelom and are deuterostomes?
- are your closest relatives?

If you can group the animal phyla based on the characteristics above, you are ready for the most common type of animal questions you will see on the AP Biology exam!

Testing Your Knowledge: Self-Quiz Answers

Now you should be ready to test your knowledge. Place your answers here:

1. _____ 2. _____ (you may omit #3) 4. _____

Name _____ Period _____

Chapter 33: Invertebrates

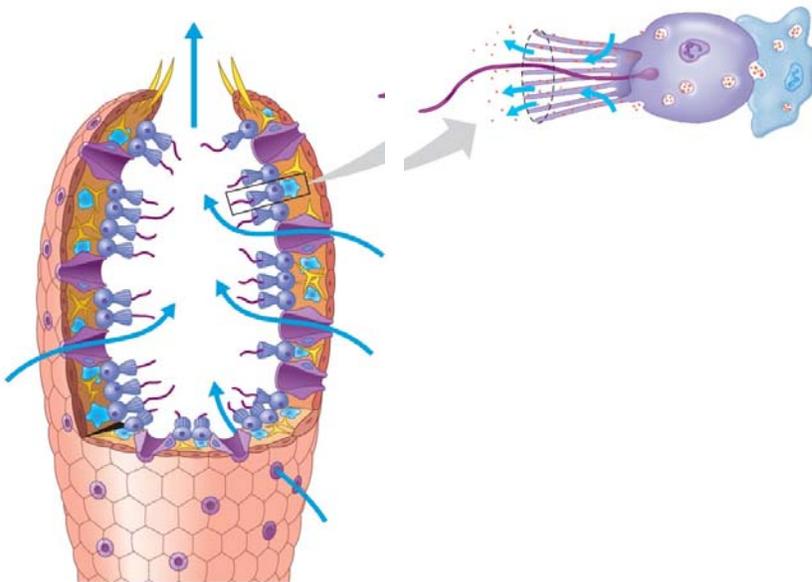
Chapters 31, 32, and 33 should be considered as a single unit, and you should try to put all of them together in a single conceptual framework. Due to the scope of our course, you are likely to see more general questions on individual phyla. For each of the phyla that we highlight in the questions that follow, try to know the characters that are unique to that group, and focus on the evolution of various systems. So they have time to teach the more difficult molecular concepts, many teachers choose to have students learn this unit on their own. Our goal here is to focus your time and energy on what we have seen to be commonly asked information. At the end of this *Reading Guide* chapter, you will find a chart that may help you to organize this knowledge.

Concept 33.1 Sponges are basal animals that lack true tissues

1. You may have learned in an earlier course that sponges are in the phylum *Porifera*. This group is now known to be polyphyletic, and all *sponges* belong to either phylum *Calcarea* or phylum *Silicea*. They are the simplest animals and lack true tissues.

Label the following: *pores*, *spongocoel*, *epidermis*, *amoebocytes*, *choanocyte*, *flagellum*, *spicules*, *epidermis*, and *mesohyl*.

On this sketch of a typical sponge, *explain* how water flows through the body of a sponge, and describe how it obtains food.

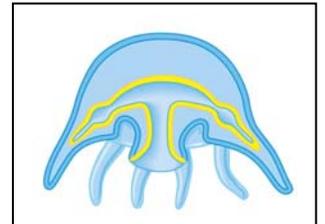


2. What is the feeding method of a sponge?

- Go back to the labels you applied to the figure above, and explain or define each term: *osculum*, *spongocoel*, *epidermis*, *pore*, *mesohyl*, *amoebocyte*, *choanocyte*, *spicules*.
- Most sponges are *hermaphrodites*. What does this mean?
- Go to the chart at the end of this *Reading Guide*. Consider that the sponges have only two cell layers, and both are in contact with the surrounding medium. They have no specialized tissues, and therefore no organs. This will help you explain how a sponge obtains oxygen or gets rid of wastes. Fill in the chart for sponges.

Concept 33.2 Cnidarians are an ancient phylum of eumetazoans

- Sketch the polyp form of a cnidarian and add these labels: *gastrovascular cavity*, *mouth/anus*, *epidermis*, *gastrodermis*, *tentacle*, *mesoglea*, and *gastrovascular cavity*.
- Cnidarians* are *diploblastic* and have *radial symmetry*. Use your sketch above to explain what this means.
- If you flip the polyp form, squish it a bit, and give it a floatation device, you will have the body form of a jellyfish. What is this body form called?
- What are *nematocysts*, and how do they help a cnidarian obtain its food?
- Read the rest of this concept carefully to complete the chart at the end. What is the nervous system of a cnidarian? Do they have a brain?
- What is the “skeleton” of a cnidarian? Check the glossary to explain how this type of skeleton works.



Concept 33.3 Lophotrochozoans, a clade identified by molecular data, have the widest range of animal body forms

You may breathe a sigh of relief to know that we are going to condense this section and look at only three phyla: *Platyhelminthes*, *Mollusca*, and *Annelida*.

12. *Platyhelminthes* means “flatworm,” which describes the shape of these worms. This is the first phylum we are studying that is *triploblastic*. This group is *acoelomate*, a term you learned in the last chapter. It is the only *acoelomate* group we will study, so be sure to know this. As you read this paragraph, complete the line on the chart for *Platyhelminthes* at the end of this *Reading Guide*. Remember that if there is no specialized system for gas exchange, for example, then it occurs by diffusion, and this is what you should write in the chart.
13. *Excretion* is not just a polite word for *defecation*; instead, it refers to the elimination of *nitrogenous waste*. Your primary nitrogenous waste is urine, produced by the kidneys. What specialized organ do flatworms have to manage water balance and nitrogenous wastes?

Include this information on the chart at the end of this *Reading Guide*.

14. Focus on the three classes of *Platyhelminthes* listed below to complete this chart.

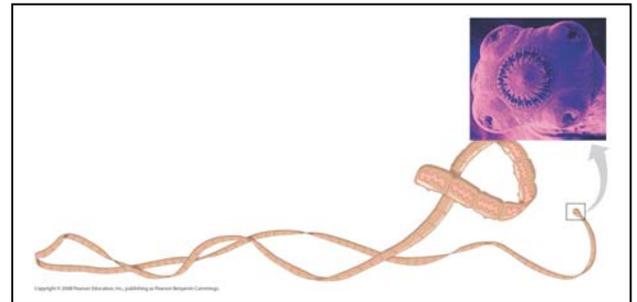
| Class | Example(s) | Features to Note |
|--------------------|------------|------------------|
| <i>Turbellaria</i> | | |
| <i>Trematoda</i> | | |
| <i>Cestoda</i> | | |

15. *Planaria* are the only free-living (not parasitic) examples from the chart above. Notice the presence of *eyespots* and *ganglia* in the *Planaria*. Label them. This is the first group we see with *bilateral symmetry* and sense organs concentrated at the anterior end. What is the term for this move toward having a “head” where sense organs and brain are concentrated? (See Chapter 32 if you have forgotten.)



16. Label the *mouth* in the *Planaria*. Where do wastes leave? The digestive system seen here is sometimes called two-way. Why?
17. Parasitic worms often have complex life cycles involving multiple hosts. Sketch the life cycle of a *blood fluke*.

18. Look at the evil head of a tapeworm! How do they attach to the gut of the host? This is another worm with a complex life cycle. How might *you* get a tapeworm?



19. Tapeworms have no digestive system. Why not?

20. Here are some important features of animals in the phylum *Mollusca*. Explain each one.

muscular foot

visceral mass

mantle

radula

21. You are familiar with many molluscs. Give the key features of each class, and provide an example.

| Class | Key Features | Example |
|-----------------------|--------------|---------|
| <i>Polyplacophora</i> | | |
| <i>Gastropoda</i> | | |
| <i>Bivalvia</i> | | |
| <i>Cephalopoda</i> | | |

22. The last phylum in this concept is *Annelida*. This group is sometimes called the segmented worms because of its visible rings. There are three classes. Give the information for each class in the chart that follows.

| Class | Key Features | Examples |
|--------------------|--------------|----------|
| <i>Oligochaeta</i> | | |
| <i>Polychaeta</i> | | |
| <i>Hirudinea</i> | | |

23. Many students dissect an earthworm in introductory biology, and all of us have seen living earthworms (much more interesting). Study the figure of an earthworm, and be familiar with these features:

clitellum

ventral nerve cord

crop/gizzard

metanephridia

chaetae

24. Both *molluscs* and *annelids* have a true *coelom*. Refer to Chapter 32, and define *coelom* again.

Concept 33.4 Ecdysozoans are the most species-rich animal group

25. What do the root words that name this group mean?

ecdypo-

-zoan

26. Phylum *Nematoda* includes the worms we often call roundworms. Their bodies are cylindrical, unlike those of the flatworms, and lack segmentation. What makes up the body covering of a nematode?

27. *Caenorhabditis elegans* is a model research organism and is widely studied. It is an example of a free-living nematode. Some interesting parasitic nematodes include the human parasites pinworms, hookworms, and *Trichinella*. How does this last parasite work? Note that its life cycle involves more than one host.

28. What does the phylum name *Arthropoda* mean?

29. The *ecdysozoans* are a huge group, but members have some common features. What is the body covering? What molecule is it made of?

30. The only way an arthropod can grow is to shed its *chitinous exoskeleton*. What is this shedding process called?

31. Describe the circulatory system of arthropods. Note that most molluscs have a similar type of circulatory system.

32. Let's focus on some specific groups. How many legs do *arachnids* have?

33. What are three examples of *arachnids*?

34. *Millipedes* and *centipedes* are placed in the subphylum *Myriapoda*, which means "many legs." Complete the following chart.

| Class | Example | Legs per Segment | Diet |
|-------|------------|------------------|------|
| | Millipedes | | |
| | Centipedes | | |

35. For the class *Insecta*, how many legs do all members have?

36. What are the three body regions of insects?

37. Insects show two types of metamorphosis. Explain each type.

incomplete metamorphosis

complete metamorphosis

38. *Crustaceans* are primarily aquatic and have many pairs of appendages. How many appendages does a lobster have?

39. What specialized respiratory structures do many crustaceans have?

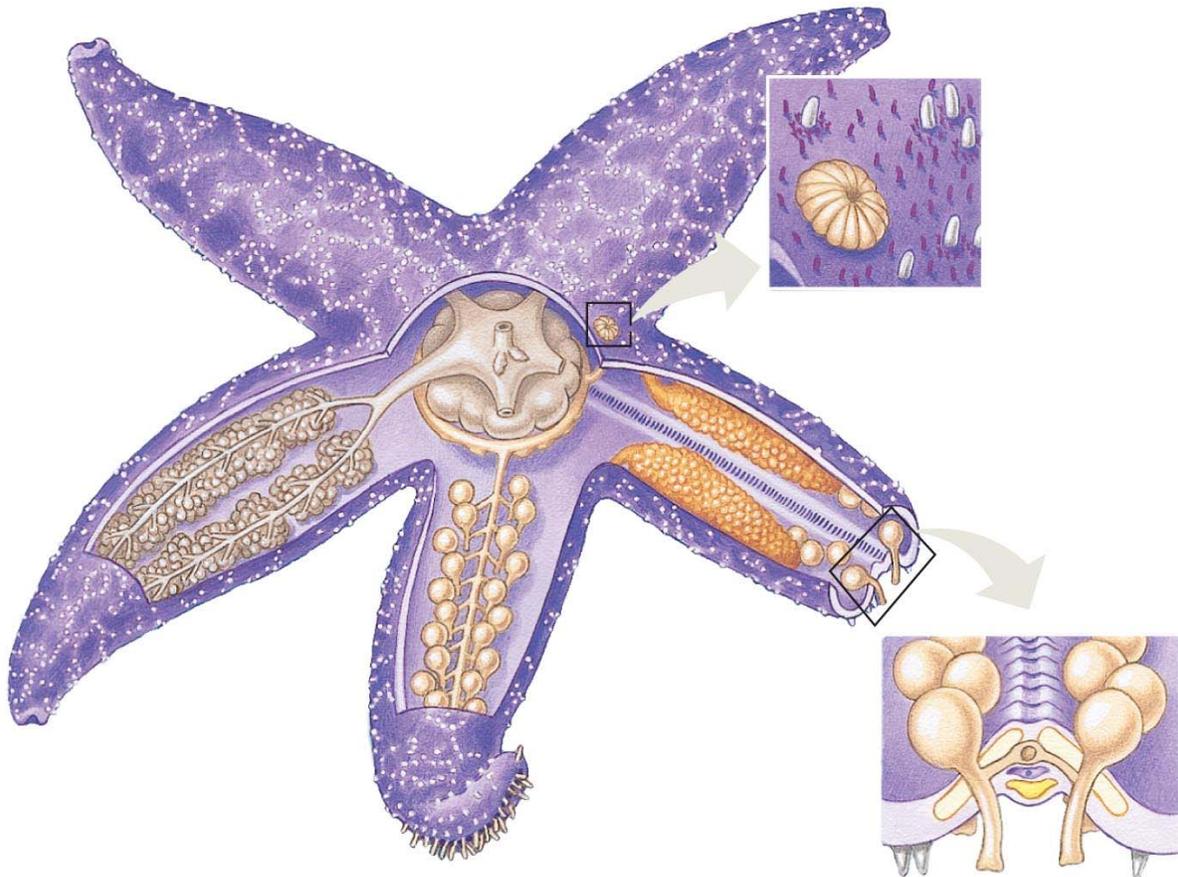
40. Complete this chart to summarize the different groups of arthropods.

| Group | # of Appendages | Respiratory Organs | Examples |
|--------------------|------------------------|---------------------------|-----------------|
| <i>Arachnids</i> | | | |
| <i>Insects</i> | | | |
| <i>Crustaceans</i> | | | |

Concept 33.5 Echinoderms and chordates are deuterostomes

41. What does the phylum name, *Echinodermata*, mean?

42. Besides a spiny skin, *echinoderms* have a *water vascular system* with *tube feet*. Label the features of the water vascular system on the following sketch, and explain how the system works.



43. As adults, many echinoderms appear to have radial symmetry, but *their larval stage is bilateral*. This is an important feature to note. As you read this section, what other interesting facts do you find about members of this group?

44. Let's go back and look at phylogeny. Use the chart copied below from Chapter 32 to explain the *key feature* that separates each of the following groups:

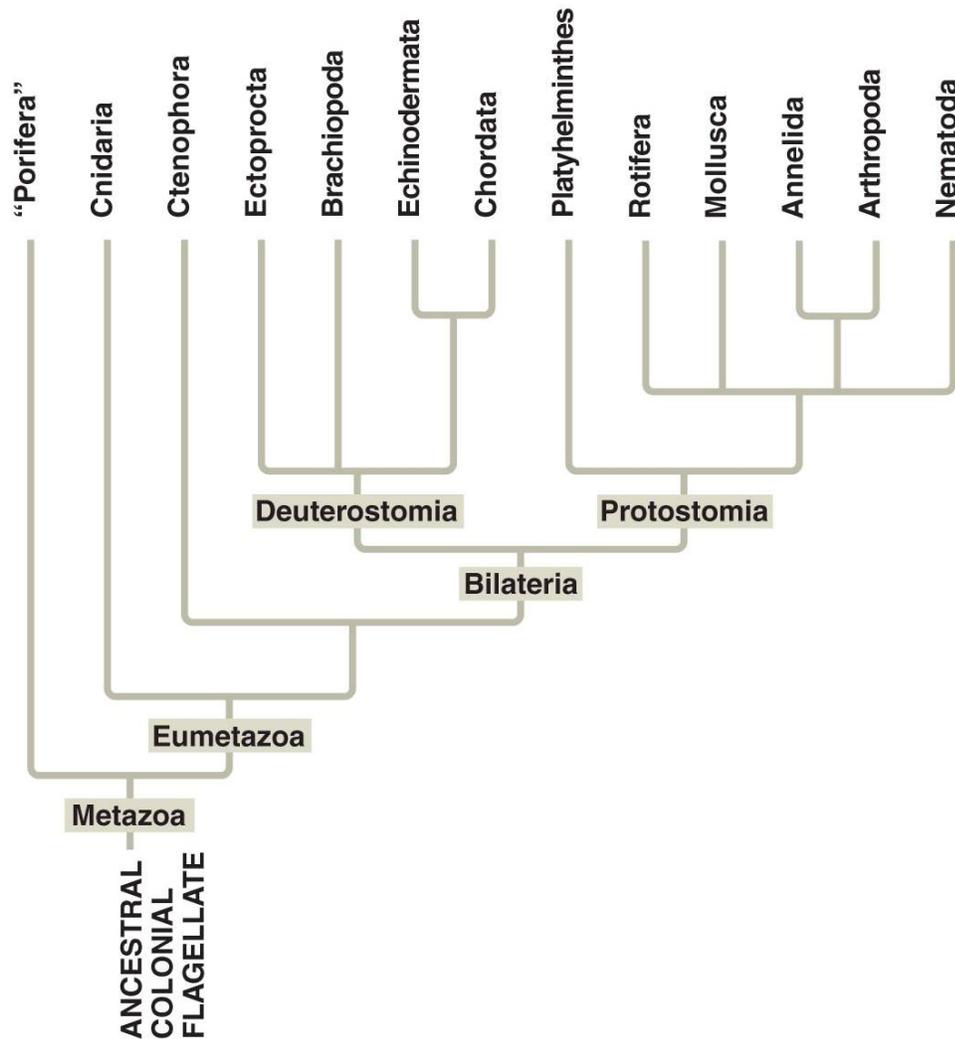
“Porifera” from all other groups

Cnidaria from all other groups

Protostomes from *deuterostomes* (Which are the only two deuterostome groups?)

Platyhelminthes from other *protostomes*

Annelids and *arthropods* from *nematodes*



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Now you should be ready to test your knowledge. Place your answers here:

Testing Your Knowledge: Self-Quiz Answers

1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____

A COMPARISON OF IMPORTANT FEATURES OF SELECTED ANIMAL PHYLA

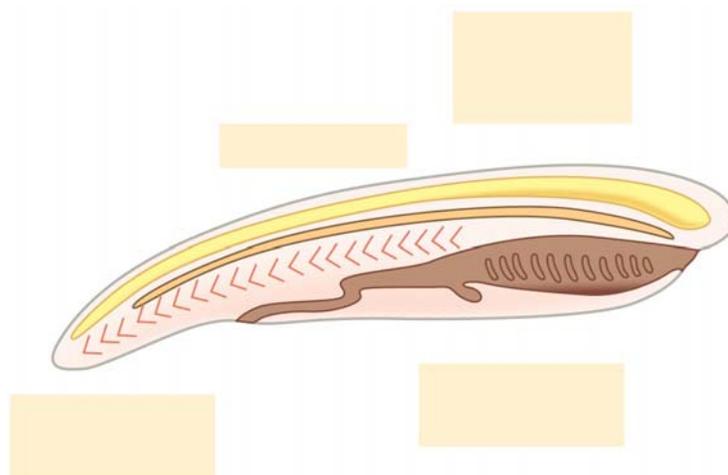
| PHYLUM | Examples | Unique Features | Circulatory | Respiratory | Nervous | Excretory | Digestive |
|------------------------------|-----------------|------------------------|--------------------|--------------------|----------------|------------------|------------------|
| Calcarea/ Silicea | | | | | | | |
| Cnidaria | | | | | | | |
| Platyhelminthes | | | | | | | |
| Nematoda | | | | | | | |
| Mollusca | | | | | | | |
| Annelida | | | | | | | |
| Arthropoda | | | | | | | |
| Echinodermata | | | | | | | |
| Chordata | | | | | | | |

Name _____ Period _____

Chapter 34: Vertebrates

Concept 34.1 Chordates have a notochord and a dorsal, hollow nerve cord

1. We are *vertebrates*. What phylum do we belong to?
2. What other phylum might be considered our close relatives? Why?
3. Here is a figure showing the four key chordate characteristics. Label and explain each one.

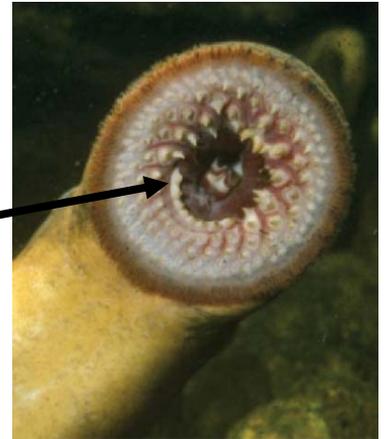


4. One of the important characteristics is a *notochord*. What is a *notochord*?
5. For us, as vertebrates, what remains of the *notochord*?
6. Chordates are the first group to show a *dorsal nerve cord*. Which embryonic layer forms the nerve cord?

7. *Pharyngeal gill slits* develop into what structures in the fishes?
8. In tetrapods, what do the *gill slits* become?
9. Vertebrates are not the only chordates. The *lancet* displays a number of chordate characteristics, and the ancestral chordate may have resembled a lancet. Describe a *lancet*.

Concept 34.2 Vertebrates are craniates that have a backbone

10. What is the oldest lineage of vertebrates? _____
They are *jawless* parasitic fish with a skeleton made of _____.
Look at the mouth! Lampreys have invaded the Great Lakes and damaged the fishing industry there.



Concept 34.3 Gnathostomes are vertebrates that have jaws

11. *Gnatho-* means “jaw,” and *-stome* means “mouth.” This group includes the sharks, fishes, amphibians, and reptiles. From what structure is it believed that jaws evolved?
12. What animals are in the clade *Chondrichthyes*?
13. What does the name *Chondrichthyes* mean? What material makes up their skeleton?
14. Why do sharks have to swim continuously?
15. The “fishes” with a bone skeleton are aquatic *Osteichthyes*. How do they breathe?

16. What is the function of a swim bladder?

Concept 34.4 Tetrapods are gnathostomes that have limbs

17. What does *tetrapod* mean?

18. What animals are in the class *Amphibia*?

19. What does the class name *Amphibia* mean?

20. Frogs have a life cycle with an aquatic larval stage, the *tadpole*. How do *tadpoles* breathe?

21. How do adult frogs breathe? (two ways)

22. Fertilization in amphibians is _____. The eggs lack a shell, and mortality is very high.

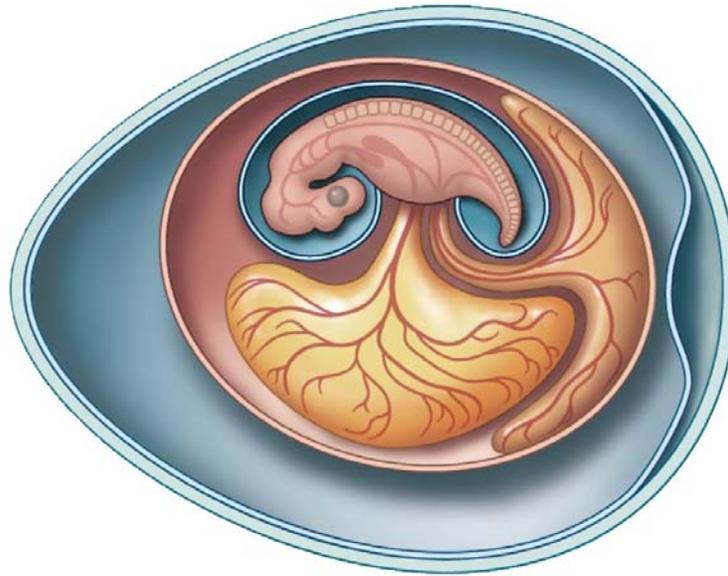
23. What factors tie *amphibians* to a life near water?

Concept 34.5 Amniotes are tetrapods that have a terrestrially adapted egg

24. What is an *amniotic egg*? How has it enabled animals to occupy a wider range of terrestrial habitats than amphibians can?

25. What groups have an *amniote egg*?

26. Label the four *extraembryonic membranes* seen in an *amniotic egg*, and explain the role of each one.



27. What animals are in the *reptile clade*?
28. Read the second paragraph about reptiles carefully, and then make a list of five characteristics of reptiles.

| Reptile Characteristics |
|--------------------------------|
| |
| |
| |
| |
| |

29. What is the body covering of a reptile? How does this enable it to live a more terrestrial life?

30. What is *internal fertilization*? How does this enable reptiles to reproduce on land?
31. Fishes, amphibians, and reptiles are *ectothermic*. What does this mean?
32. Birds are in the reptile clade. Which extinct group included their closest relatives?
33. Here is a short list of some reptiles. For each group on the list, give some important features that make them unique.

snakes

lizards

turtles

alligators and crocodiles

birds

34. What are four avian adaptations for flight?

| Adaptations for Flight |
|-------------------------------|
| |
| |
| |
| |

Concept 34.6 Mammals are amniotes that have hair and produce milk

35. Make a list of at least five traits of mammals, including the two in the concept heading. Put an asterisk (*) next to the traits unique to mammals.
36. There are three groups of mammals. Contrast the groups based on how they bear young, and give an example.

| Mammalian Group | Reproduction | Example |
|------------------------|---------------------|----------------|
| <i>Monotremes</i> | | |
| <i>Marsupials</i> | | |
| <i>Eutherians</i> | | |

37. As a human, you are in the class *Mammalia* and the order *Primates*. What features are unique to *primates* only?

Now you should be ready to test your knowledge. Place your answers here:
Testing Your Knowledge: Self-Quiz Answers

1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____