25.2 Animal Body Plans and Evolution

Lesson Objectives

- Discuss some trends in animal evolution.
- Explain the differences among the animal phyla.

Lesson Summary

Features of Body Plans Each animal phylum has a unique organization of body structures called its “body plan.” The features of a body plan include

- levels of organization: cells, tissues, organs, organ systems
- body symmetry:
  - radial symmetry: body parts extend from a central point
  - bilateral symmetry: left and right sides are mirror images, with front and back ends
- differentiation of germ layers:
  - endoderm, the innermost layer
  - mesoderm, the middle layer
  - ectoderm, the outermost layer
- formation of a cavity, or fluid-filled space between the digestive tract and the body wall:
  - a true coelom (found in most complex animal phyla) develops in the mesoderm and is lined with tissue derived from the mesoderm
  - a pseudocoelom is only partially lined with mesoderm
  - Some invertebrates lack a body cavity and some have only a primitive, jellylike layer between the ectoderm and endoderm.
- patterns of embryological development
  - Sexually reproducing animals begin life as a zygote, or fertilized egg.
  - The zygote develops into a hollow ball of cells, the blastula.
  - The blastula folds in on itself and creates a tube that becomes the digestive tract; the tube has a single opening, the blastopore:
    - In protostomes (most invertebrates), the blastopore becomes the mouth.
    - In deuterostomes (chordates and echinoderms), the blastopore becomes the anus.
- segmentation: repeated parts, such as the segments of worms
- cephalization: the concentration of sense organs and nerves near the anterior (head) end
- limb formation: external appendages such as legs, flippers, and wings

The Cladogram of Animals The features of body plans provide the evidence needed to build a cladogram, or phylogenetic tree, of all animals. Animal phyla are usually defined by their adult body plans and patterns of embryological development.

- The characteristics of animals vary within each phylum.
- Each phylum may be thought of as an “evolutionary experiment.” Phyla with successful body plans have survived.
## Features of Body Plans

1. Complete the table of main ideas and details about animal body plans. Use the boxes to list and summarize the features of animal body plans.

<table>
<thead>
<tr>
<th>Main Idea: Feature of Body Plan</th>
<th>Details: Important structures or patterns of development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levels of organization</td>
<td>Cells, tissues, organs, organ systems</td>
</tr>
<tr>
<td><strong>Body symmetry</strong></td>
<td>None, radial, or bilateral</td>
</tr>
<tr>
<td>Germ layers</td>
<td>Endoderm, mesoderm, ectoderm</td>
</tr>
<tr>
<td>Body cavity</td>
<td>None, pseudocoelom, or true coelom</td>
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<tr>
<td>Patterns of embryological</td>
<td>The zygote develops into a hollow ball of cells, the</td>
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<td>development</td>
<td>blastula.</td>
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<td></td>
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</tr>
</tbody>
</table>

2. **THINK VISUALLY** Sketch two common objects that show the difference between radial symmetry and bilateral symmetry. Label your sketches and explain them.

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One sketch (bilateral) should show and explain an object that can be divided into two matching halves along one axis. The other (radial) should show an object that can be divided into equivalent segments by drawing a line through its center.
3. **THINK VISUALLY** Label each of these organisms with the kind of symmetry it exhibits.

- [Image] bilateral symmetry
- [Image] radial symmetry

4. **THINK VISUALLY** Draw three sketches that show the difference between acoelomate, pseudocoelomate, and coelomate animals. Label ectoderm, mesoderm, and endoderm in your sketches.

*The acoelomate sketch should show mesoderm and a digestive cavity, as in a flatworm. The pseudocoelomate sketch should show a pseudocoelom and a digestive tract, as in a roundworm. The coelomate sketch should have a coelom and a digestive tract, as in an earthworm.*
5. Label the diagram showing the difference between deuterostomes and protostomes. Label the following structures: blastula, blastopore, ectoderm, endoderm, mesoderm, mouth, protostome.

5. a. Blastula
b. Mesoderm
c. Blastopore
d. Ectoderm
e. Endoderm
f. Protostome
g. Mouth

For Questions 6–14, complete each statement by writing the correct word or words.

6. Deuterostomes that show radial symmetry in their adult form are called **echinoderms**.

7. **Flatworms** are bilaterally symmetrical animals with three germ layers and no coelom.

8. **Mollusks** are protostomes with a true coelom and cephalization without segmentation.

9. Members of the **sponge** phylum have no body symmetry.

10. Animals in the **cnidarian** phylum have specialized cells and tissues, but no organs.

11. Both **annelids** and **arthropods** are segmented protostomes with bilateral symmetry.

12. In addition to echinoderms, **chordates** are also deuterostomes.

13. An important way in which the body plan of mollusks differs from that of arthropods is that mollusks lack **segmentation**.

14. Only members of the **roundworm** phylum have a pseudocoelom.
The Cladogram of Animals

Use the cladogram to answer Questions 15–17.

15. On the lines provided, label the names of the animal phyla that correspond to the letters in the diagram.
   a. __________ Sponges __________  
   b. __________ Cnidarians __________  
   c. __________ Arthropods __________  
   d. __________ Roundworms __________  
   e. __________ Flatworms __________  
   f. __________ Annelids __________  
   g. __________ Mollusks __________  
   h. __________ Echinoderms __________  
   i. __________ Chordates __________

16. What characteristics define the branch of the cladogram that leads to the mollusks?
   The characteristics are organs, three germ layers, bilateral symmetry, cephalization, and protostome development.

17. Is a chordate a “better” animal than a sponge? Explain your answer.
   No, it simply has a different body plan that has made it well adapted to survive and reproduce in its environment.

18. Cows, hawks, and whales are all vertebrates. However, their forelimbs are noticeably different. Explain how “evolutionary experiments” that yield variations on a body plan have produced such diversity among vertebrates. Use forelimb structures as an example.
   Those variations that promoted survival and reproduction were maintained in what eventually became new classes of chordates. For example, the forelimb has evolved as a leg in the cow, while it is a wing on a bird. The whale’s forelimb is adapted for swimming in water; the bird’s is adapted for flying in air.
Chapter Vocabulary Review

Across

2. the concentration of nerves and sense organs in a head
5. a fertilized egg
8. the outermost germ layer
10. an embryo at the hollow ball of cells stage
12. A system in which a product of a process limits the process is ____________ inhibition.
15. the kind of symmetry exhibited by a sea anemone
16. a chordate with a backbone
17. a body cavity lined in mesoderm
18. animals in which the blastopore becomes the mouth

Down

1. the kind of symmetry exhibited by a horse
3. animals in which the blastopore becomes the anus
4. a body cavity only partially lined with mesoderm
6. an animal that lacks a vertebral column
7. a supporting rod just below the nerve cord in some animals
9. the middle germ layer
11. a kind of pouch found in the throat region of chordates
13. the innermost germ layer
14. an animal that has a notochord
Working with Animals

Some people who are interested in animals and love to be around them own pets or volunteer at local animal shelters. Other people, however, want to devote their careers to caring for or studying animals.

People who want to work with animals must decide what level of education and training they are willing to pursue to achieve their goal. Some jobs that involve caring for and understanding animals require extensive education or intensive training, such as that of the scientists in the Chapter Mystery. Other careers that involve working with animals require less experience and education. For example, animal control officers might be required to have a two-year degree, rather than a four-year degree or a graduate degree. Below is an example of a job description for an animal control officer.

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**County Animal Control Officer Job Opening**

**JOB DESCRIPTION**

Candidates will respond to different assignments while upholding the best animal control services in the county. Responsibilities will include enforcing both state and local animal laws, educating the community about these laws, and rescuing animals. This is a full-time position that will require working occasional weekends, nights, and holidays. Candidates will also be on-call at times. Continuing education provided on the job.

**QUALIFICATIONS**

Candidate must have excellent equipment, computer, and management skills. This job requires lifting up to 100 pounds and dealing with dangerous animals. Applicant must have a valid driver’s license. Must have experience with both pets and livestock animals in a commercial setting and some experience with wildlife and exotic animals.

**EDUCATION**

Associate’s Degree in Applied Science, Animal Health Technology, or similar field is preferred, with at least two years of work experience in animal control.

**STATUS**

Full-time

**SALARY**

Depends on qualifications and experience
1. What work experience should a candidate for this job opening have?

*Experience working with pets and livestock, as well as wildlife*

2. What might be a commercial setting in which a candidate worked with animals?

*Sample answer: Veterinary clinics, zoos, animal shelters, farms*

3. Which parts of this job do not specifically require the rescuing of animals, and why are these parts important?

*Animal control officers must educate the public about state and local animal laws and enforce those laws. These responsibilities are important because they help citizens become aware of the importance of treating animals well.*

4. This ad states that an Associate’s Degree is preferred. What do you think might be an alternative to this degree?

*Sample answer: An alternative might be more experience in the field of animal control and animal handling with a proven record of mastering the job qualifications and responsibilities.*

5. What danger might an animal control officer face when rescuing an animal?

*Sample answer: An animal control officer might have to deal with an aggressive and frightened animal or an animal with rabies, or might have to face angry citizens.*

**21st Century Skills**

**Investigate a Career**

The skills used in this activity include information and media literacy, critical thinking and systems thinking, creative and intellectual curiosity, and self-direction.

Work with a group to investigate how a person would become an animal control officer. Then create a chronological plan to become an animal control officer. Do an online search to identify community colleges, state colleges, and private institutions that offer courses and degrees that satisfy the job description on the previous page. (Alternatively, you could call local animal shelters to discuss the educational programs completed by its staff members.) In your group’s plan, identify the courses a person would need to complete the program. Include any high school experiences, internships, and summer jobs that would be helpful to secure a job after college graduation. Your group should also create a budget that includes tuition, room and board, application fees, meal plans, textbooks, and other supplies. Submit your group’s plan and budget to your teacher.

*Evaluate groups’ plans based on how realistic they are, and how complete they are in terms of taking all the factors involved in preparing for this career into account. Plans should be clear and chronological and presented in an easy-to-understand format.*