

BIOLOGY 1101
LAB 9: ANIMAL DIVERSITY, FORM AND FUNCTION

READING: Please read chapter 17 in your text.

INTRODUCTION: The evolution of animal life (**Kingdom Animalia**) began about 700 million years ago, in the sea, and today exhibits a diversity of forms. Before we begin our survey of animal phyla in this lab, we should review some basic terminology. There are three types of body symmetry in animals: (1) **asymmetrical**, meaning there is no plane of body symmetry; (2) **radial**, meaning the body parts radiate from the center; and (3) **bilateral**, meaning the organism has a left and right side, in addition to an anterior and posterior end. A **coelom** is a body cavity, a fluid-filled space located between the digestive tract and the outer body wall. A true body cavity is completely lined by **mesoderm** tissue, the “middle” layer of embryonic tissue. Animals may be **acoelomate** (lacking a body cavity), **pseudocoelomate** (having a body cavity only partially lined by mesoderm), or **coelomate** (having a true body cavity lined by mesoderm).

Modern day sponges (**Phylum Porifera**) represent the descendants of the most ancient animals. Animals in this phylum are asymmetrical and lack true tissues. As new groups of animals evolved, different forms of body symmetry arose, true tissues (e.g. skin, muscle, and nerves) formed, body cavities evolved to cushion internal organs, and nervous and digestive systems became more complex. A jellyfish (**Phylum Cnidaria**) is a relatively simple animal, with radial symmetry and a **gastrovascular cavity** (a digestive compartment with a single opening serving as both mouth and anus). Bilateral symmetry arose later, with the flatworms (**Phylum Platyhelminthes**). Later still, a primitive coelom and a complete digestive tract appeared in the mollusks (**Phylum Mollusca**) and roundworms (**Phylum Nematoda**). Animal bodies eventually became segmented, as seen in **Phylum Annelida**, which includes the familiar earthworm. Annelid body segments are relatively simple and all very similar to each other. Animal body segments eventually became fused into fewer, but more specialized, segments, as seen in the **Phylum Arthropoda**. Arthropods comprise approximately 2/3 of all species on the planet and include the familiar **Class Insecta** (arthropods with three-part bodies and three pairs of walking legs, such as butterflies and beetles) and **Class Chelicerata** (arthropods with two-part bodies and four pairs of walking legs, like spiders and ticks). Arthropod success on land depended in large part on their tough, water-proof exoskeletons. Invertebrates, like the ones mentioned here, dominated life on earth until the Silurian Period (about 439 million years ago). The first vertebrates (**Phylum Chordata**, **Subphylum Vertebrata**) were small, fish-like organisms. Fish diversified in the oceans, giving rise to **Class Myxini** and **Class Cephalaspidomorphi** (jawless fishes), **Class Chondrichthyes** (sharks and rays), and **Class Osteichthyes** (bony fishes). Bony fishes gave rise to the first land vertebrates, the amphibians (**Class Amphibia**) with their moist skins and gelatinous eggs. Reptiles and birds (**Class Reptilomorpha**, formerly **Reptilia** and **Aves**, respectively) later arose, with their water-tight scales (modified as feathers in birds) and amniotic eggs, giving them an advantage in terrestrial habitats. Later still, mammals (**Class Mammalia**) evolved from reptilian ancestors, developing fur from ancestral scales.

LABORATORY OBJECTIVES: The goals of this lab activity are for you to learn to identify members of the major animal Phyla and Classes, and to become familiar with the characteristics of each. Further, you will dissect two invertebrate animals, comparing and contrasting their internal and external anatomies.

EXERCISES:

A. Animal Diversity

Materials:

- A selection of four preserved animals
- A dissecting microscope
- Latex gloves (trust me, you'll want these)

Procedure: A variety of animals are on display. Working in groups of 3-4, choose four animals that belong to four different phyla. For each animal, describe the characteristics that are diagnostic of the Phylum and/or Class (i.e. body symmetry, complete or incomplete digestive systems, body segmentation, presence of special structures such as shells, jointed appendages, etc.). Draw and label each specimen. One of your specimens must be a mollusc, one must be an arthropod, and one must be a chordate; the remaining specimen may be from any other Phylum. For molluscs, arthropods, and chordates, you must also classify the organism to Class.

Organism (common name): _____

Phylum: **Chordata**

Class: _____

Characteristics:

Body Symmetry: _____

Acoelomate, pseudocoelomate, or coelomate? _____

Complete or incomplete digestive tract? _____

Body segmentation? _____

Special characteristics: _____

Organism (common name): _____

Phylum: _____

Characteristics:

Body Symmetry: _____

Acoelomate, pseudocoelomate, or coelomate? _____

Complete or incomplete digestive tract? _____

Body segmentation? _____

Special characteristics: _____



B. COMPARATIVE ANATOMY OF INVERTEBRATES

Materials:

- Dissecting tray
- Gloves
- Scalpel
- Scissors
- Forceps
- Pins
- A preserved earthworm
- A preserved grasshopper

Procedure:

1. “The Earthworm” - Kingdom Animalia, Phylum Annelida, Class Oligochaeta. Oligochaetes are often called “earthworms” (although there are also aquatic species in this group). There are over 6,000 species of oligochaetes, and they may occur in freshwater, marine, or terrestrial environments. Most feed on dead and decaying materials, but the earthworms you are familiar with finding in the ground actually digest the soil and feed on the microscopic organisms that live in the soil. Nightcrawlers feed on vegetation at the surface of the soil. Look closely at a preserved earthworm. Note that the body is ribbed. This is because the body of an earthworm is a series of uniform cylindrical segments. Many of the same body functions are performed in each segment. Do you see any appendages (**parapodia**)? No... although many annelids have parapodia, oligochaetes do not. They have lost their appendages over evolutionary time. However, they do have **setae**, which are little prickly projections... if you run your fingers along the sides of the earthworm, you will note it feels rough.
 - a. You can distinguish the head of the worm, because it is larger. The “head end” of the worm is called the **anterior** region. Conversely, the “tail end” is called the **posterior**. The “back” or “top” side of the animal is called the **dorsal** side, and the “belly” is called the **ventral** side. The ventral side of the worm will appear slightly flattened and lighter in color. Orient the worm on your dissecting tray with the anterior end pointing away from you, and the dorsal side up. When you have the worm oriented, raise your hand and your instructor will check to see if it is oriented correctly. _____
 - b. A prominent region of the earthworm is the swollen band posterior to the head, called the **clitellum**. (Yep, seriously, pronounced exactly the way you think. In fact the class is now called Clitellata “*clit-a-lot-a*” – if you don’t believe me, look it up.) The clitellum produces mucus during copulation which holds the two worms together and also aids in the movement of sperm. The clitellum also secretes a cocoon around fertilized eggs.

- c. The mouth of the worm is located on the ventral side of the first segment. The very first segment of the worm is called the **prostomium**. Counting posteriorly from the mouth, how many segments do you count before you get to the clitellum? _____
- d. Earthworms are hermaphrodites; that is, they possess both male and female sex organs, although they usually breed with other worms (Figure 1 below). Turn the worm so its ventral surface is facing up, and locate the **male genital pores**, which have a distinct swelling. They should be located at about segment 15. Also note that there is a pair of grooves running between the male genital pores and the clitellum. These are called **sperm grooves**. Sperm travels posteriorly along the sperm grooves to the female genital pores of the other worm.
- e. The **female genital pores** are located just anterior to the male genital pores, but are more difficult to see. Why do you think the female genital pores might be located anterior, and not posterior, to the male genital pores?
- _____
- _____
- _____
- _____
- _____

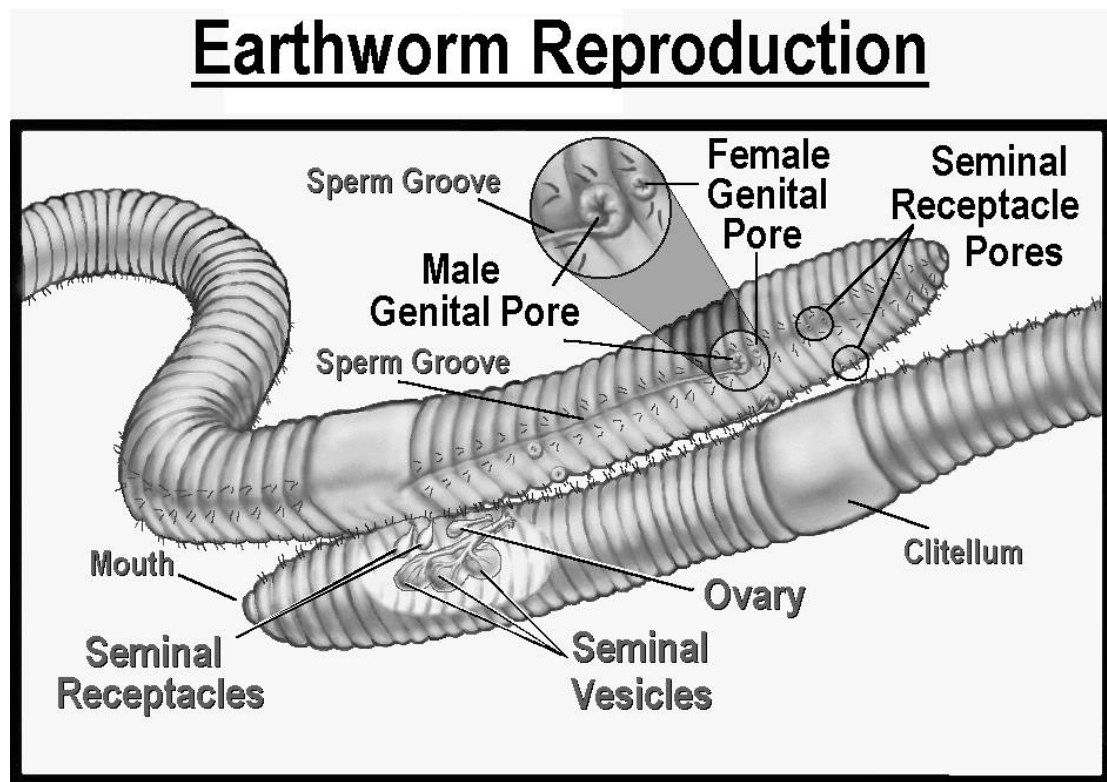


Figure 1. Earthworm reproduction and reproductive anatomy.

- f. Turn the worm so that it is dorsal side up again, with the anterior end is facing away from you (Figure 2). Place a pin at both ends, and use a razor blade or scalpel to make a shallow cut down the **dorsal side**. Cut until you are about 10 segments past the clitellum. Pull the body wall over laterally and pin it to the tray. Note the **septa** (walls) that divide the segments of the worm internally. The **coelom**, or body cavity, is found between each pair of septa.

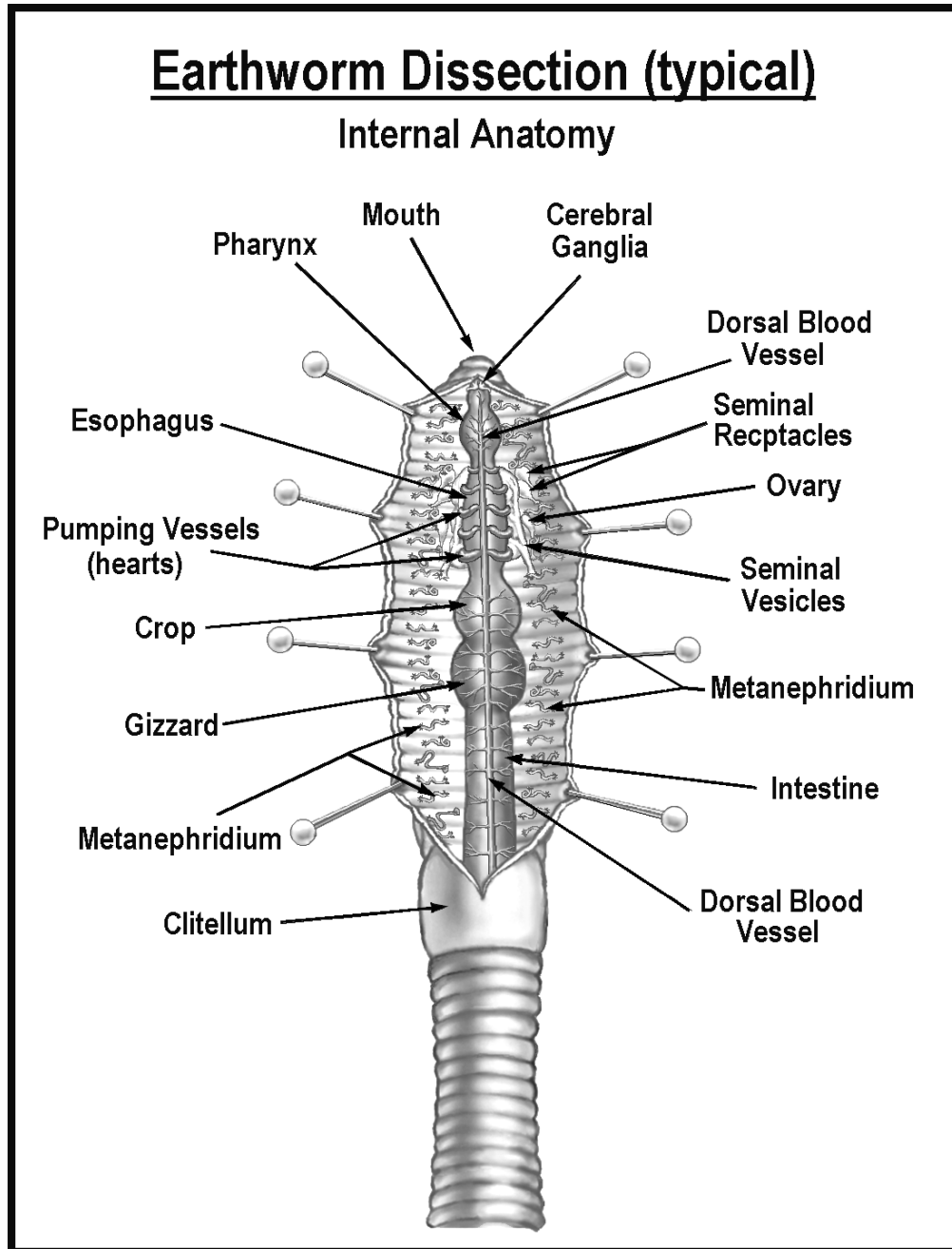


Figure 2. Internal anatomy of an earthworm.

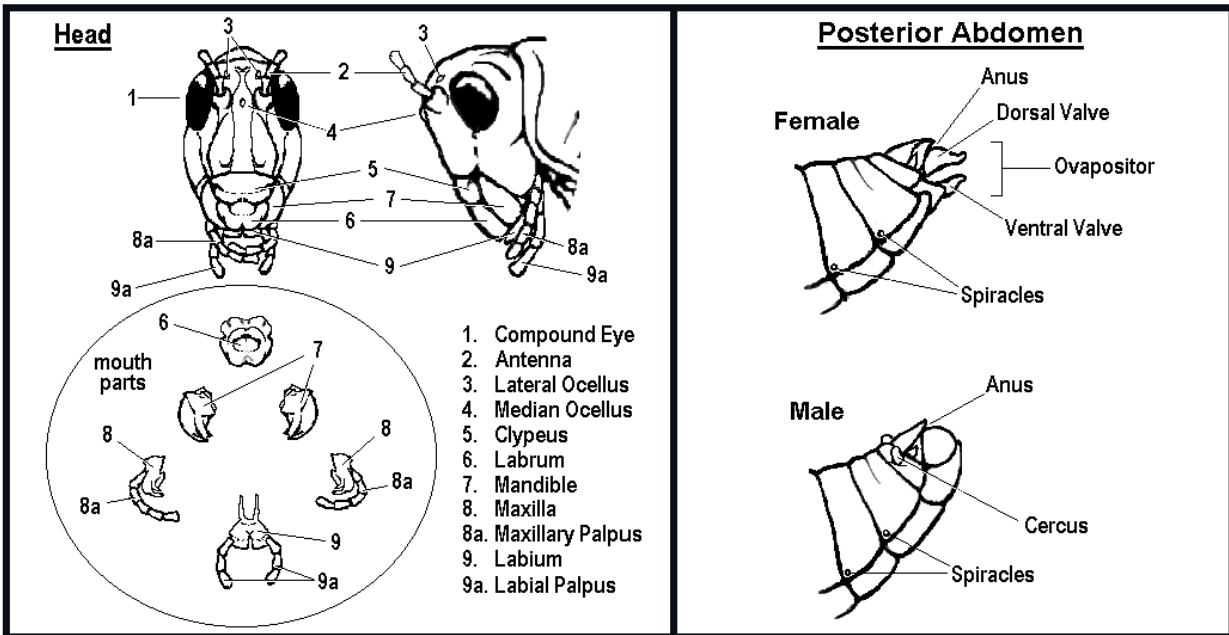
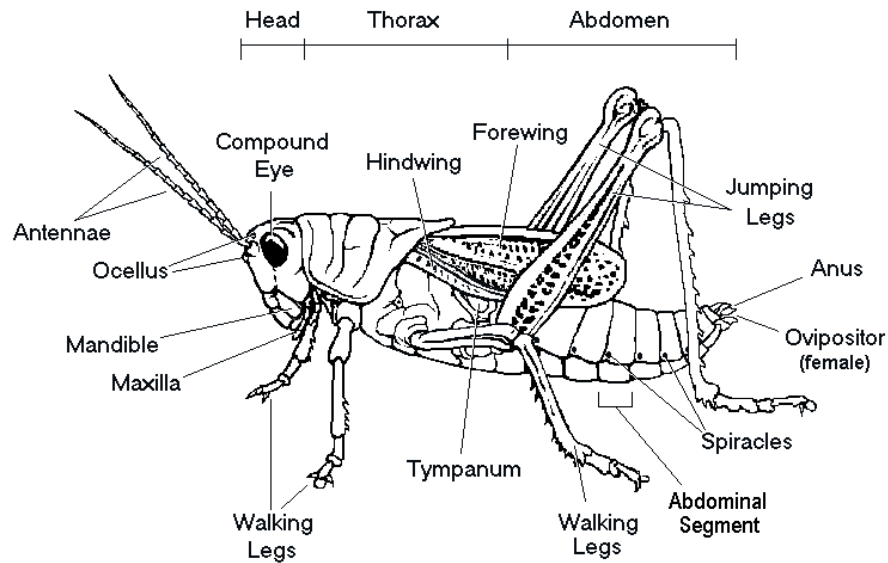
- g. Using Figure 2 as a guide, locate the internal organs of the earthworm. The **mouth** opens into the **pharynx** of the worm; posterior to the pharynx is a tube

called the **esophagus**, which carries food to the **crop**; the **crop** and **gizzard** store and grind food; posterior to the gizzard, food continues down the **intestine** until it exits the body through the **anus**. A **dorsal blood vessel** is located on the dorsal surface of the gut. In segments 7 to 14, there are 5 pairs of **hearts** that wrap around the esophagus. Near the hearts, there are 3 pairs of large, light-colored structures. These are the **seminal vesicles**, which contribute to the production of semen. Each segment of the worm contains a pair of little tubes called **metanephridia**, which is the earthworm equivalent of kidneys (you may need to view your worm under a dissecting microscope to see the metanephridia).

2. The “Lubber Grasshopper” - Kingdom Animalia, Phylum Arthropoda, Class Insecta. Grasshoppers are plant-eating insects common in many parts of the world. The specimens you will be dissecting are Eastern Lubber Grasshoppers, a particularly large species that makes dissection and observation of internal organs easier. You may be thinking “*Where in the world do they grow these giant grasshoppers?!*” Eastern Lubbers are found in the south-eastern United States (parts of Texas, Louisiana, Florida, Mississippi, Alabama, Georgia, and South Carolina). In fact, these grasshoppers are so large that their wings are of little use in flight, and they move principally by crawling.
 - a. Obtain a large grasshopper, and observe its external anatomy. Note that the grasshopper is a segmented animal, as was the earthworm. However, the segments of the grasshopper are much more specialized than the segments of the earthworm. Refer to Figure 3 and observe the external anatomy of your grasshopper. Locate the **head**, **thorax**, **abdomen**, **eyes**, **legs**, **wings**, and **antennae**.
 - b. Note that, as in all insects, the grasshopper has six legs. It also has a protective, nonliving covering called the exoskeleton. Note that, along the sides of the abdomen, there are small pores in the exoskeleton called **spiracles**, which allow the grasshopper to breathe.
 - c. Female grasshoppers tend to be larger than males, and have a forked structure at the end of their abdomen called the ovipositor. They use the ovipositor to dig into soil and deposit their eggs. Internally, you can distinguish a female from a male because the female will be full of rows of rice-shaped eggs. Orient the grasshopper on your tray so that its **anterior end** is facing away from you and its **dorsal side** is up. Using a razor blade or scissors, remove the head and legs. Then make a cut from the anterior to the posterior end, and pull the body wall back laterally. Do you have a male or female?
Sex: _____ Have your instructor initial here: _____

Grasshopper (typical)

External Anatomy



© 2006 by S.L.Weyrauch

Figure 3. External anatomy of a grasshopper.

- d. The internal anatomy of a grasshopper can be a little difficult to distinguish, but compare your specimen to Figure 4, paying particular attention to the crop, gastric caecum, Malpighian tubules, and intestine.

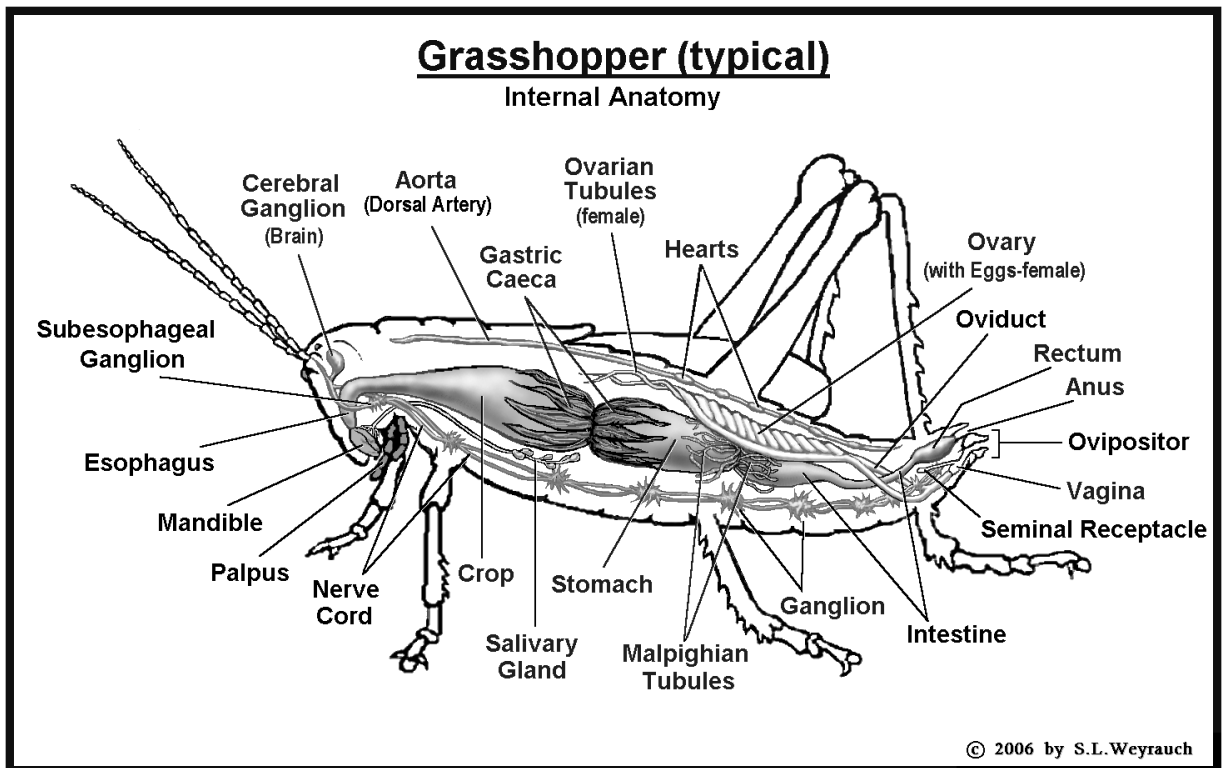


Figure 4. Internal anatomy of a grasshopper.

Discussion Questions:

1. How do the internal and external anatomies of the earthworm and grasshopper compare? In what ways are they similar, and in what ways different?

2. What adaptations do earthworms and grasshoppers have to a terrestrial existence?

This page intentionally left blank.