

The Grasshopper

Pre-Lab Discussion

Grasshoppers are members of the phylum Arthropoda and the class Insecta. The class Insecta contains more than 900,000 species, which is about five times as many species as in all the other animal groups combined. Insects are mainly land animals and occupy almost every environmental habitat on land. The development of wings gave insects such distinct advantages over other land invertebrates as greater dispersal, access to more food supplies, and more efficient methods of escape from predators.

Insects have an exoskeleton composed of chitin. They have three pairs of jointed legs and three distinct body regions. These regions are the head, thorax, and abdomen. Usually two pairs of wings are attached to the thorax. As members of the class Insecta, grasshoppers have one pair of antennae and one pair of large compound eyes. They also have a tracheal tube-spiracle system for gas exchange. The efficient respiratory system of insects provides oxygen for the rapid movement of muscles. The high reproductive capacity and relatively short reproductive cycle of grasshoppers enables them to increase their populations at a rapid rate.


In this investigation, you will observe the behavior and movement of a live grasshopper. You also will examine the external features of the grasshopper and identify parts of its anatomy.

Problem

What are the parts of a grasshopper?

Materials (per group)

- Live grasshopper in glass jar
- Preserved grasshopper
- Paper towels
- Dissecting tray
- Probe
- Scalpel
- Hand lens
- Lettuce
- Dissecting microscope
- Glass slide
- Medicine dropper

Safety 

Put on a laboratory apron if one is available. Handle all glassware carefully. Always handle the microscope with extreme care. You are responsible for its proper care and use. Use caution when handling glass slides as they can break easily and cut you. Be careful when handling sharp instruments. Always use special caution when working with laboratory chemicals, as they may irritate the skin or cause staining of the skin or clothing. Never touch or taste any chemical unless instructed to do so. Follow your teacher's directions and all appropriate safety procedures when handling live animals. Note all safety alert symbols next to the steps in the Procedure and review the meanings of each symbol by referring to the symbol guide on page 10.

Procedure

Part A. Observing the Reactions of a Live Grasshopper

1. Referring to Figure 1, locate the head, thorax, abdomen, three pairs of legs, and two pairs of wings of a live grasshopper in a glass jar. Observe the grasshopper for several minutes without disturbing it. Notice how the grasshopper moves and note which legs it uses when walking. Gently tap the side of the jar to make the grasshopper jump. Observe which legs are used in jumping. Answer questions 1 and 2 in Observations.

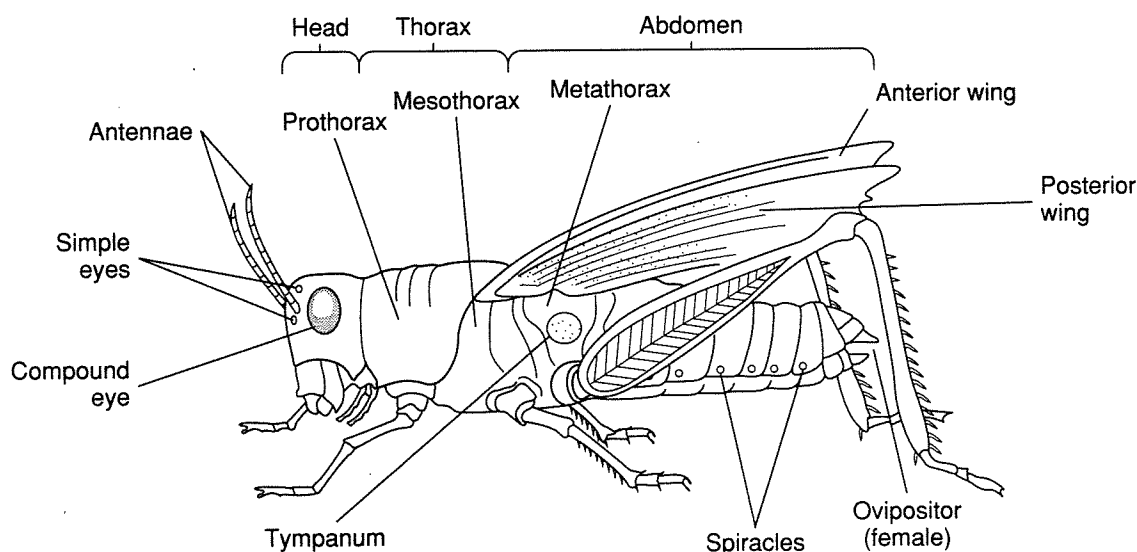


Figure 1

2. Observe the position and movements of the grasshopper when it is at rest. Use the hand lens to observe the movements of the abdomen that are associated with respiration. Answer question 3 in Observations.
3. Tear off a small piece of lettuce and offer it to the grasshopper. Notice how the animal eats. Closely observe the movement of the mouthparts. Answer question 4 in Observations.
4. Return the grasshopper to your teacher when you have completed your observations.

Part B. Observing the External Anatomy of the Grasshopper

1. Rinse the preserved grasshopper with water to remove excess preservative. Place the grasshopper in a dissecting tray. Touch the chitinous exoskeleton and apply gentle pressure. **CAUTION:** The preservative used on the grasshopper can irritate your skin. Avoid touching your eyes while working with the preserved grasshopper. Answer question 5 in Observations.

2. Locate the three body segments of the grasshopper: the head, the thorax, and the abdomen. Use the hand lens to examine the head. Notice two long antennae, the sensory organs for touch, located at the front top of the head. Closely examine the antennae with a hand lens. Three simple eyes, or ocelli, are located in the head—one at the base of each antenna and one in the center front of the head. The head also contains two compound eyes, one located on each side of the head. Simple and compound eyes are sensory organs for vision. Answer question 6 in Observations.
3. With a scalpel, carefully cut off a portion of the compound eye and place it on a clean glass slide with a drop of water. **CAUTION:** *When using a scalpel, cut in a direction away from your hand and body to avoid cutting yourself.* Observe the piece of the eye through low power of a dissecting microscope. The compound eye is made up of over 2000 facets, or surfaces, that allow the grasshopper to see almost all of its surroundings. In the appropriate place in Observations, sketch the compound eye as it appears through low power. Record the magnification of the microscope. Answer question 7 in Observations.
4. Closely examine the mouthparts with a hand lens. Identify the following parts as shown in Figure 2: the labrum (upper lip), the mandibles (jaws), the maxillae with sensory palps for tasting, the labium (lower lip) with sensory palps for tasting, and the hypopharynx, the tongue-like structure inside the mouth. Figure 2 also shows what each individual mouthpart looks like.

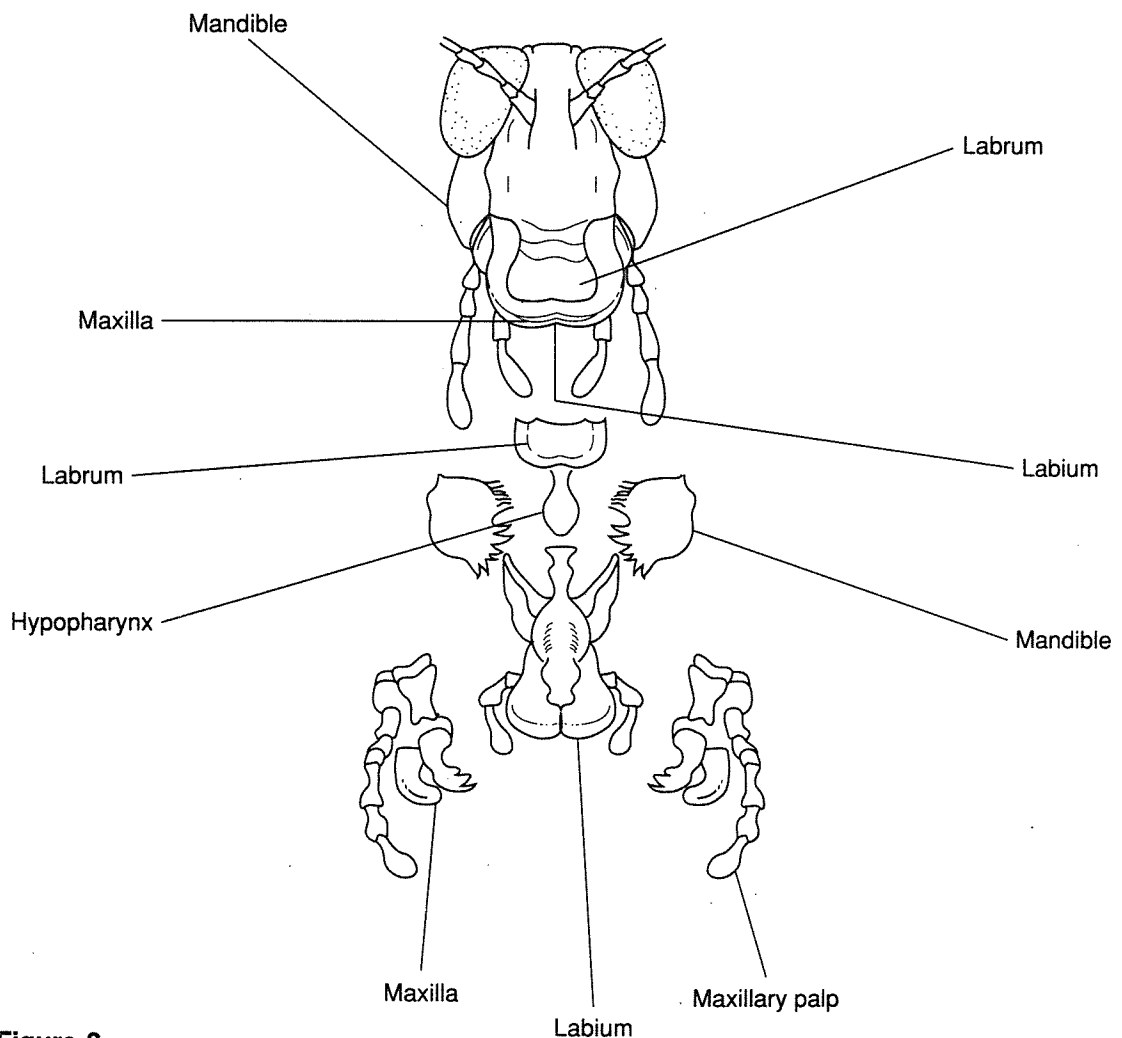


Figure 2

- (4)
5. Locate the thorax. Notice that the thorax is divided into three segments. One pair of legs is attached to each segment. Observe the two front legs, or forelegs, and the third and largest pair of legs, the jumping legs, or hindlegs. Notice that each leg is composed of the coxa, trochanter, femur, tibia, and tarsus, as shown in Figure 3. Answer question 8 in Observations.

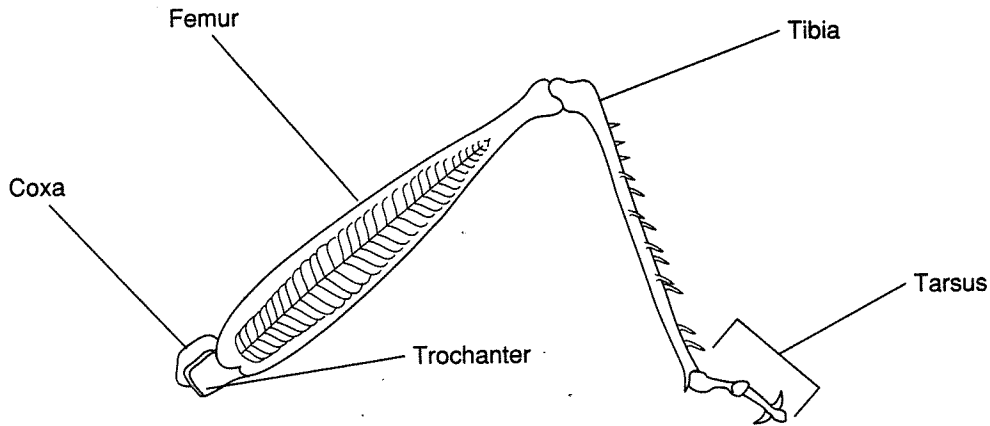


Figure 3

6. Observe the two pairs of wings, which also are located on the thorax. Use your fingers to gently spread open the wings. Notice the difference between the forewings and the hindwings. The leathery forewings protect the membranous and delicate hindwings, which are used for flying.
7. Locate the abdomen and notice its segments. On the first segment of the abdomen, locate the drum-shaped tympanum (eardrum). The tympanum is the sensory organ for sound. On the lateral surface of each segment of the abdomen, locate the small openings called spiracles. The spiracles are openings into the gas-exchange, or respiratory, system of the grasshopper. Note that the last segment of the abdomen is different in males and females. In females, the last segment, the ovipositor, is modified into a clawlike structure with four points used to dig a hole where eggs are laid. The female's abdomen is longer than the male's. In males, the last segment is blunt and curved upward. See Figure 4. Answer question 9 in Observations.

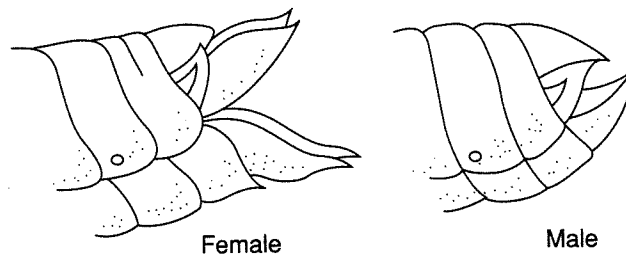
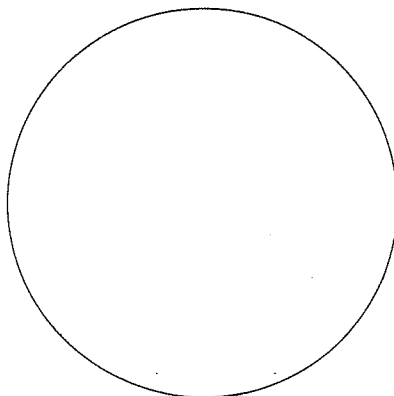


Figure 4

8. In the appropriate place in Observations label the external anatomy of the grasshopper.

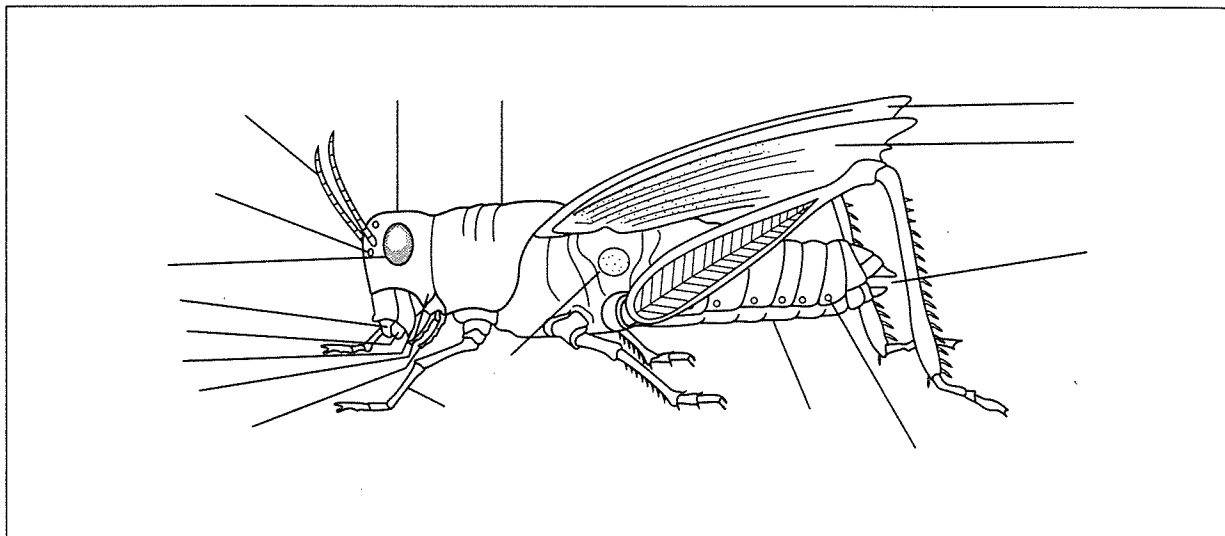
Observations

Magnification _____



Grasshopper Compound Eye

Grasshopper



1. Describe the color of the grasshopper. _____

2. Which legs are used for walking or crawling? For jumping? _____

3. Describe the movements of the grasshopper's abdomen associated with respiration.

4. Compare the movement of the grasshopper's jaws to those of humans.

5. Describe the texture of the grasshopper's exoskeleton.

6. Describe the appearance of the antennae as seen through a hand lens.

7. How do simple and compound eyes differ?

8. Compare the forelegs and the jumping legs in terms of structure and size.

9. What sex is your grasshopper? How can you tell?

Analysis and Conclusions

1. How is the color of a grasshopper an adaptation to where it lives?

2. List two characteristics of chitin that make it a good material for the exoskeleton and wings of arthropods.

3. How is the grasshopper adapted to detect moving objects in the environment?

4. What are the mouthparts of a grasshopper adapted to do? _____

5. Of the three body regions of the grasshopper, which one is specialized for locomotion?

6. What do you think is the function of the spinelike structures found on the tibia and tarsus?

Critical Thinking and Application

1. How can a grasshopper's exoskeleton be both an advantage and a disadvantage?

2. List three structures of the grasshopper that are adaptations for life on dry land.

3. Most insects are small as compared to most vertebrates. Do you think being small is more of an advantage or a disadvantage to insects? Give evidence to support your answer.

4. Can you drown a grasshopper by holding its head under water? Explain your answer.

