



External Anatomy 101

Introduction

In Unit 1 you have discovered that insects have three body segments. Can you name them?

In this lab activity, we will learn a bit about the function of each of these body segments. We will discuss the each of these segments and will learn about the appendages and adaptations of each.

1. Head

Objectives:

- Name four functions of the head
- Identify the structures of the head
- Name and identify mouth types and components
- Describe different eye types
- State uses of the antennae and name and draw the different antennal types

2. Thorax

Objectives:

- Name the three parts of the thorax
- Identify major veins of the insect wing
- Describe different types of insect legs and identify the parts of the walking leg
- Identify modifications of the pronotum

3. Abdomen

Objectives:

- Identify segments of the abdomen
- Discuss modifications of the ovipositor
- Describe examples of cerci

Head

Why do animals have heads? Do you know of any animals without heads?
What do we use our heads for?



No, not that kind of head!

These are questions you have probably have never thought about. You may be surprised to find that insects use their heads in much the same way we do, but there are some pretty cool differences as well.

Generally a head has four functions:

1. for food ingestion
2. for sensory perception
3. to coordinate body activities
4. to protect coordination centers

Let's learn a bit about each of these functions.

First, we will discuss food ingestion.

Do you remember what type of mouthparts insects have? *Hint: It is an arthropod suborder.*



That's right, they have mandibles. Insects chew their food. But wait, how does a mosquito chew blood? Ok, ok , you got me. Let's back up just a bit.

Insects can have two types of mouthparts.

- Suctorial (sucking)
- Mandibulate (chewing)

The suctorial category can be further divided into categories.

- Suctorial
 - Non-piercing-sucking
 - Piercing-sucking

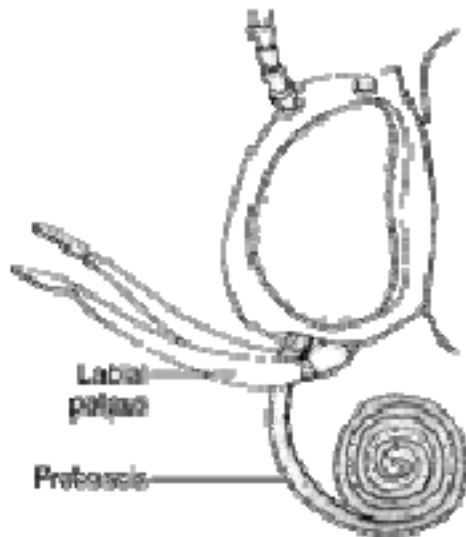
Let's take a look at some of these suctorial type of mouthparts.

a. Moth - mouthpart adapted for **siphoning** nectar.

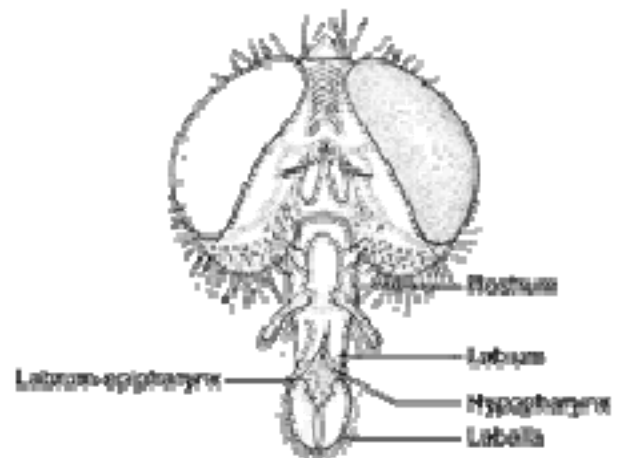
b. Fly - mouthpart adapted for **sponging**

c. Bee - mouthpart adapted for **lapping**

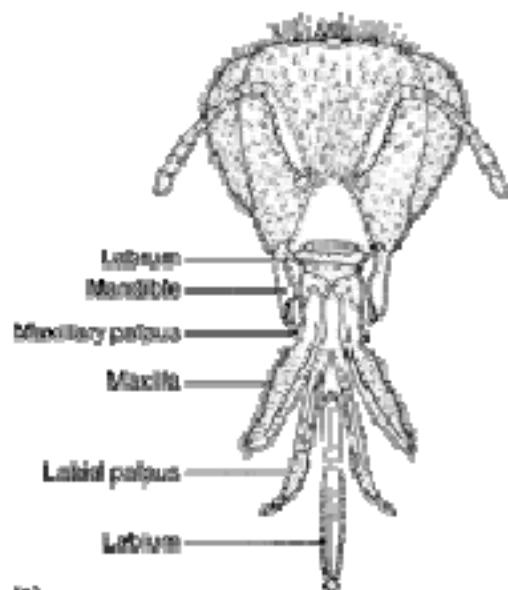
d. Bug - mouthpart adapted for **piercing-sucking** plant or animal juices



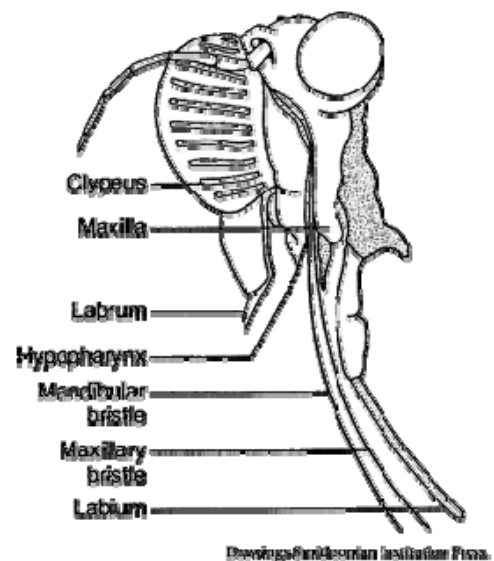
(a)



(b)



(c)



(d)

Order Hemiptera

By the way, as you are learning about the structures and types of insect mouths, I thought that I would mention that there are three head positions found in insects and they all have to do with the position of the mouthparts in relation to the head.

1. **Hypognathous** – mouthparts directed downward (grasshoppers, roaches, etc.).
2. **Prognathous** – mouthparts directed forward (some beetles).
3. **Opisthognathous** – sucking beak directed toward rear, under the thorax (Hemiptera and Homoptera)

Can you match the insect photos below with the suctorial mouth type?



1. _____

2. _____

What head position does this insect have? (Hint: this is a Reduviidae in the order Hemiptera)

2A. _____





3. _____

It's pretty cool that insects have adapted to be able to feed on different juices with all these different types of suctorial mouthparts. Remember that these mouthparts all suck! (Hey now, you know what I mean.)

Ok, now let's take a look at the chewers, the mandibulates. These insects have a complete set of utensils built in to their mouth. Remember, they don't have hands to manipulate their dinner, so they must use their mouthparts. Let's look at these "utensils". (Hint: You will want to know these parts. Chomp Chomp)

Let's eat!

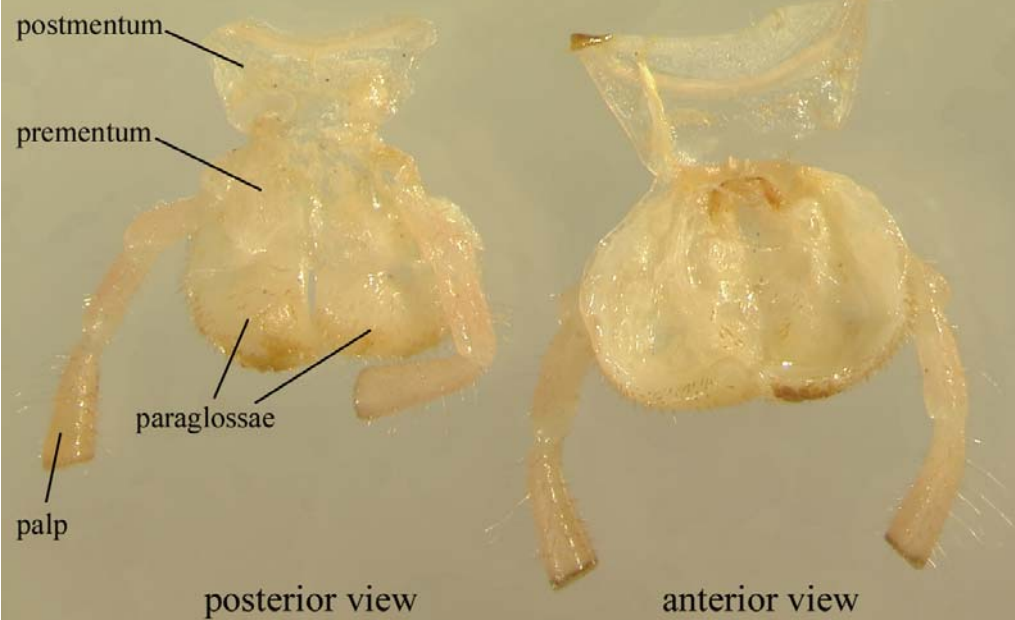


AMERICAN GRASSHOPPER MOUTHPARTS

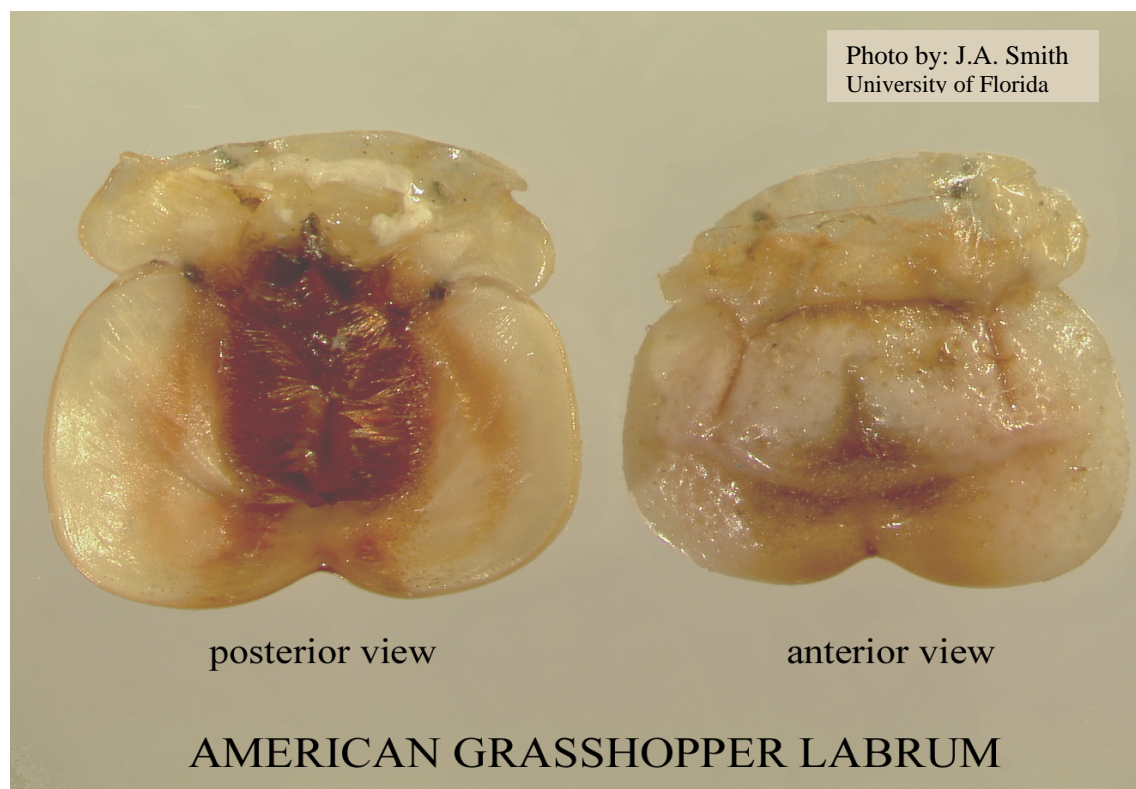
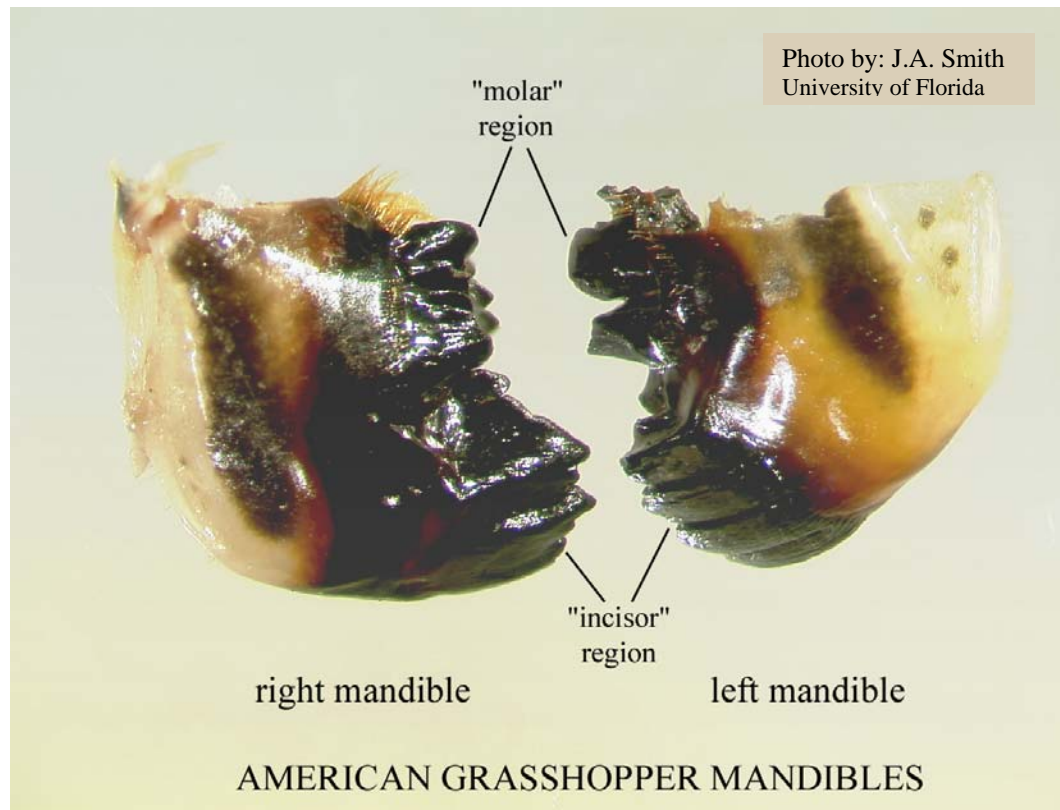
Photo by: J.A. Smith
University of Florida

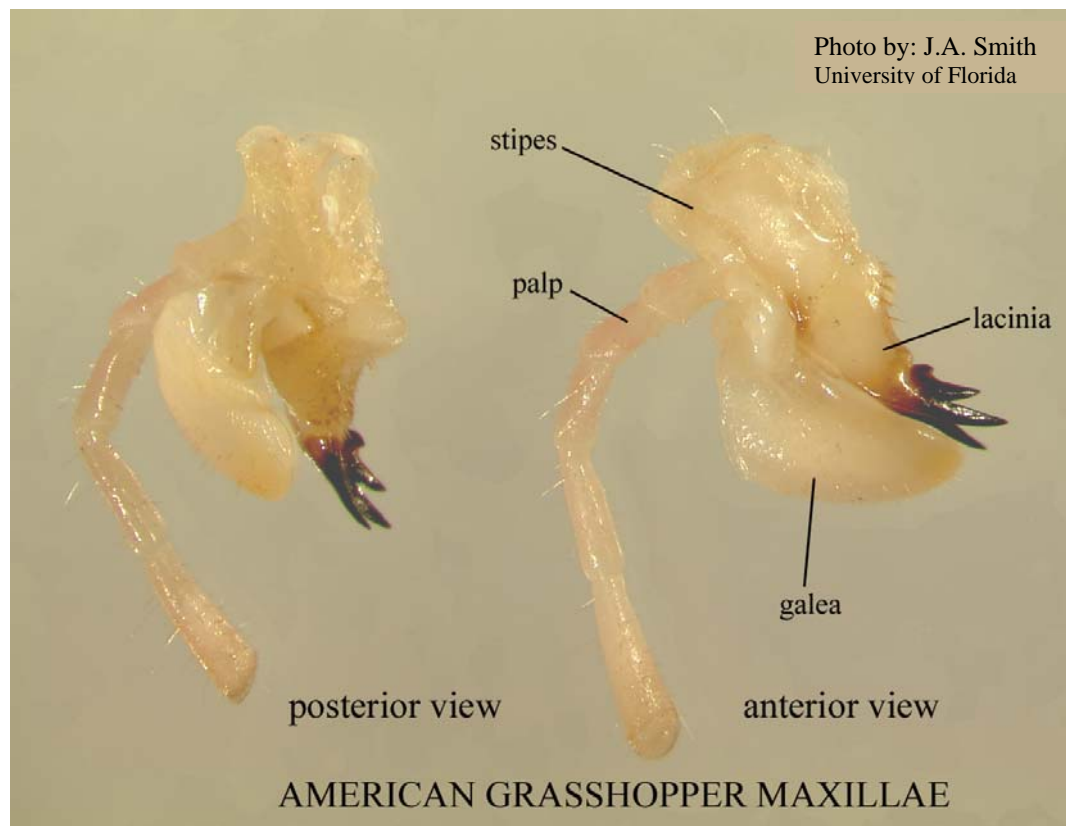


Photo by: J.A. Smith
University of Florida



AMERICAN GRASSHOPPER LABIUM





Is your head spinning with the new terminology? Are you wondering what those tooth like things are? Instead of mandibles, why can't they just call them jaws and how in the world do insects use them to chew? They're sideways for goodness sakes. Yeah, and how about all those little hairs on the palp, what are they for?

Hmmm. Well let's find out.



Read in your textbook pages 31-38 and answer the questions below.

Understanding

1. What is the function of the labrum?
2. How would you describe the motion of the mandibles?
3. Which part of the mouth is used to taste and feel the food?
4. What are **entognathous** mouthparts and what are some examples of organisms that have them? Are insects entognathous or ectognathous?
5. What are three functions of the mandibles, besides food ingestion?
6. Name one insect order that has mandibulate mouthparts as an immature and suctorial mouthparts as an adult.

7. Name a household item that you could use to demonstrate how piercing-sucking mouthparts work. How about something that represents the fly mouthparts?
8. If male mosquitoes (Culicidae) and Horse flies (Tabanidae) do not suck blood like the females, what do they feed on?

Watch the cockroach feeding video from the link on the E-Learning website. This video was taken of a cockroach in the UF/ IFAS Urban Entomology Lab. The cockroach is feeding on bread soaked in beer (typical college meal huh?). Notice how the cockroach uses it's palps to manipulate the food.



Next we are going to discuss sensory perception.



Have you ever seen an insect's nose?

Well, as you may have guessed, insects don't have a nose, but they do have a remarkable sense of smell. How, you may ask? They have antennae!

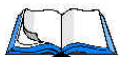
Can you think of uses of the antennae besides smell?

You may be surprised to find out that antennae contain chemoreceptors for smell, mechanoreceptors for touch, thermoreceptors for temperature, and hygromoreceptors for humidity. Insects can also use their antennae for hearing.

Wow, talk about your all in one tool.

Later in the semester, you will learn more about how the antennae function. I know you are restless with anticipation, but you will have to wait until lecture unit 7, Looking good, smelling good and sounding sweet. You can't wait can you?

Anyway, in this section, we will go over the different types of antennae and their parts. Just like the mouthparts were modified for the type of food eaten by the insect, the antennae are modified for the types of chemicals received and for the lifestyle of the insect.



Let's take a look at some of the antennae types. Turn in your text to page 30 and read the section about the antennae. Also, take a few minutes to become familiar with the drawings of the antennae types and then answer the questions below.

Filiform. The flagellomeres, normally numerous, are narrow, cylindrical, and of a similar size. It is the most common type in insects.

Moniliform. Flagellomeres are more or less spherical and look like rosary beads.

Capitate. The last flagellomeres are of greater diameter than the ones before, forming a 'club' or 'mace.'

Clavate. The flagellomeres increase in diameter gradually toward the apex.

Setaceous. Flagellomeres are extremely fine and gradually diminish in diameter toward the tip; the antenna thus acquires an appearance of seta or hair.

Serrate. The flagellomeres display pointed, lateral prolongations on one side or both.

Pectinate. The flagellomeres project laterally, forming a fine and more or less elongated projection. When it is produced over two sides of each flagellum, the antennae are called **bipeccintate**.

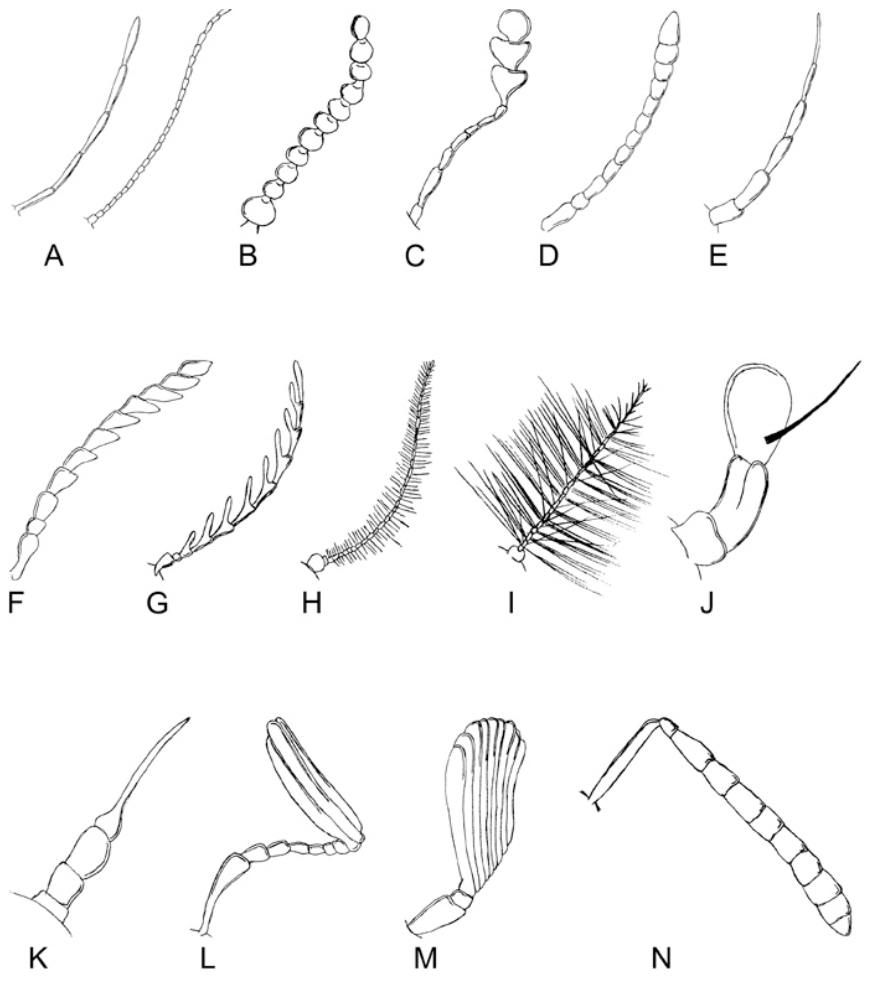
Plumose. Flagellomeres with numerous long hairs are arranged in a feather-like or whorled form.

Stylate. The last flagellomere is prolonged apically in a fine and elongated process named the style.

Lamellate. Only the last flagellomeres display long, lateral expansions.

Flabellate. The flagellum displays long, flattened or more or less cylindrical expansions.

Geniculate. The scape is relatively long, forming clear angles with the rest of the antenna (pedicel plus flagellum).



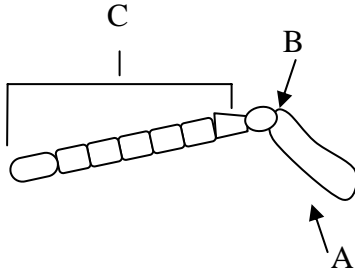
A. filiform; **B,** moniliform; **C,** capitate; **D,** clavate; **E,** setaceous; **F,** serrate; **G,** pectinate; **H,** bipectinate; **I,** plumose; **J,** aristate; **K,** stylate; **L,** lamellate; **M,** flabellate; **N,** genticulate.

Understanding

1. What type of antennae does this insect have?

2. Why do you think they are shaped like this?





3. What type of antennae is represented here? _____

4. Can you think of an insect that has this type of antennae?
(Hint: see page 331 figure 16.5 a) _____

5. Name the antennal parts
A. _____

B. _____

C. _____

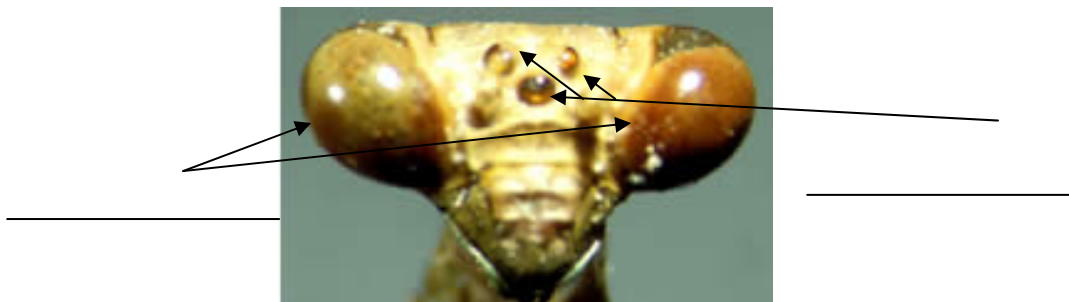
On with sensory perception.

Insects have three types of eyes, **ocelli**, **stemmata**, and the **compound eye**. These types of eyes will be covered in detail in unit 6, Reception and Integration, so stay tuned.



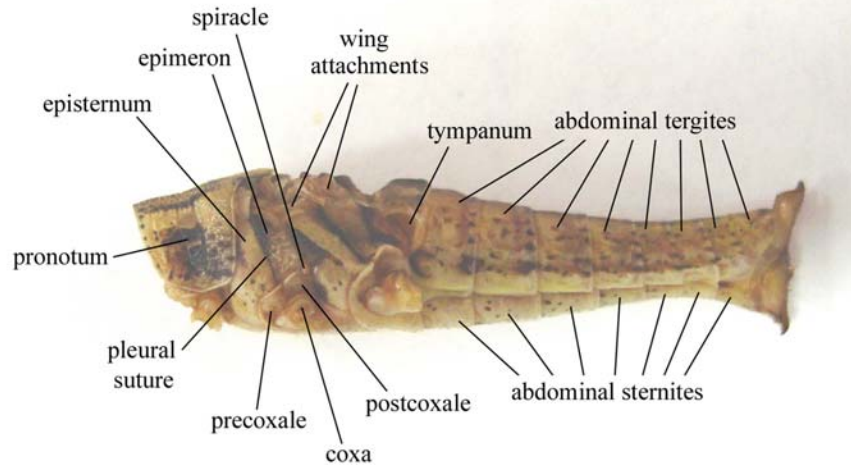
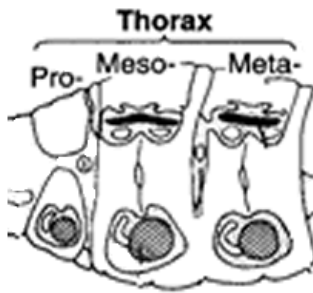
In the mean time, read pages 26-29 to see where the eyes are located on the head.

Can you locate the two compound eyes and the three ocelli on this mantid head? Label each on the photo below.



Great! Now you have mastered the insect head. Let's move on to the central region, the thorax.

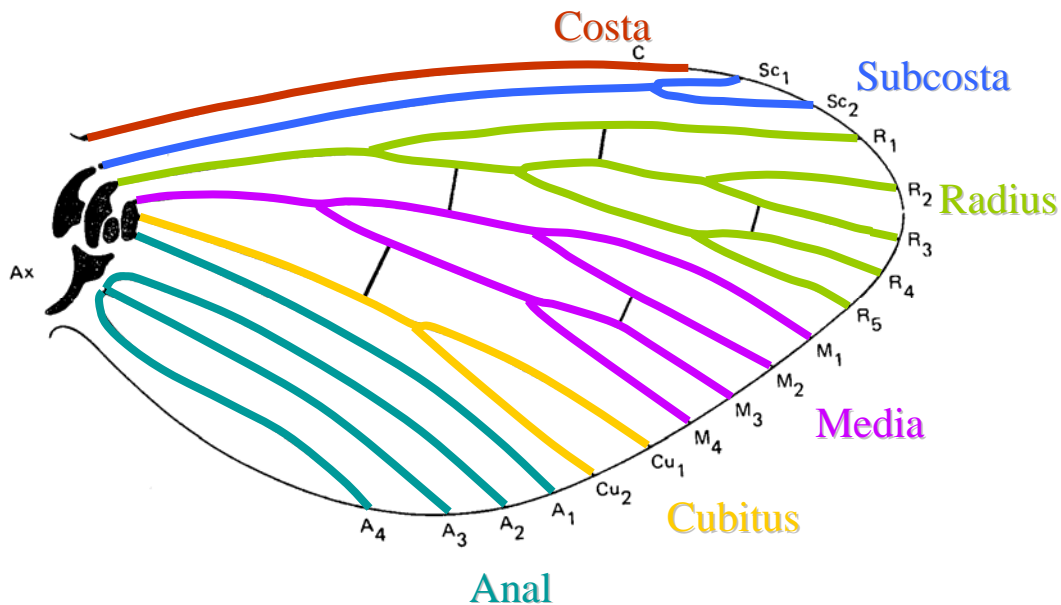
Thorax



The thorax is divided into three segments, the **prothorax**, which bears the **forelegs**, the mesothorax, which bears the **middle set of legs**, and the **metathorax**, which bears the **hind legs**.

Take a look at the photo and drawing and see if you can find these areas. Be sure to notice where the legs and wings attach. Imagine the muscles it takes in this area to work all those appendages. Whew.

Let's take a closer look at a general insect wing.





Please read pages 42-46 in your text and answer the questions below. Keep in mind that many insects are identified by the wing venation.

Understanding

1. Which wing veins are identified in the Comstock system as Cu?

2. What do the numbers next to the letter mean? Example R₅

3. What is an open cell?

4. Can you identify a closed cell in the generalized wing above?
Sketch it in the box below.



5. What are the forewings of beetles called and why are they different from other winged insects?

6. Why are Hemipterans called such? (Hint: What do their wings look like?)

7. Can you name an insect that is apterous?

8. What are the little hooks called that are found on the wings of bees and wasps?

9. Why do thrips have long hairs on their wings?

Insect Legs

Another helpful characteristic when identifying insects is the insect leg. There are many leg modifications and different numbers of tarsal segments.

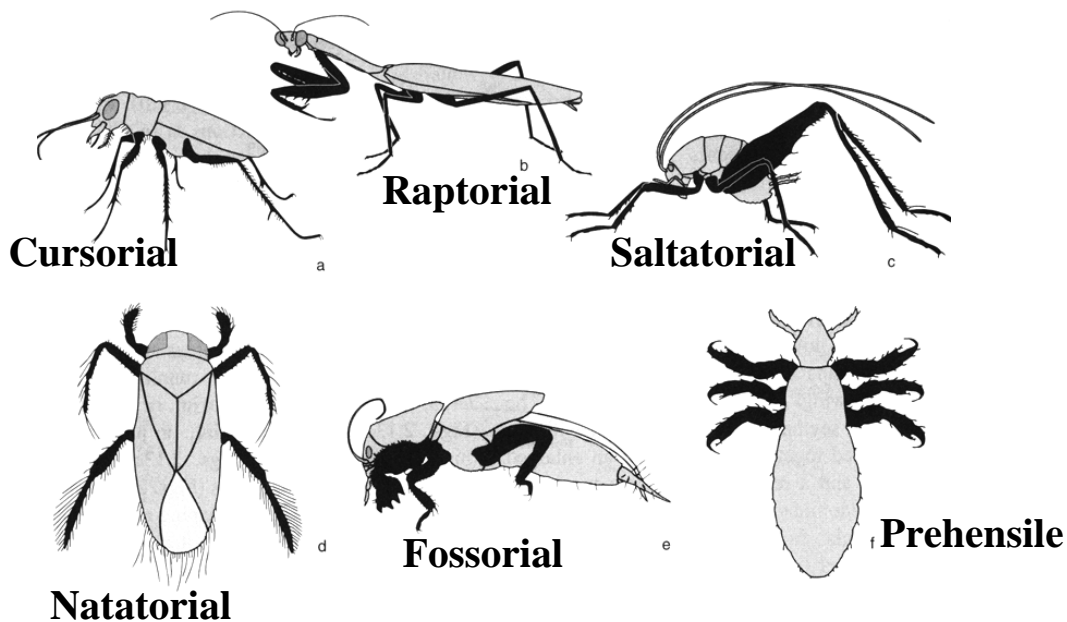


Think about insect legs. What kinds can you think of? Running, jumping. . .



Please read pages 41-42 in your text to learn about these modifications.

How many leg types did you think of? Did you think of all of these?



List the locomotion types associated with each of these modifications.

1. Cursorial = running
2. Raptorial = _____
3. Saltatorial = _____
4. Natatorial = _____
5. Fossorial = _____
6. Prehensile = _____

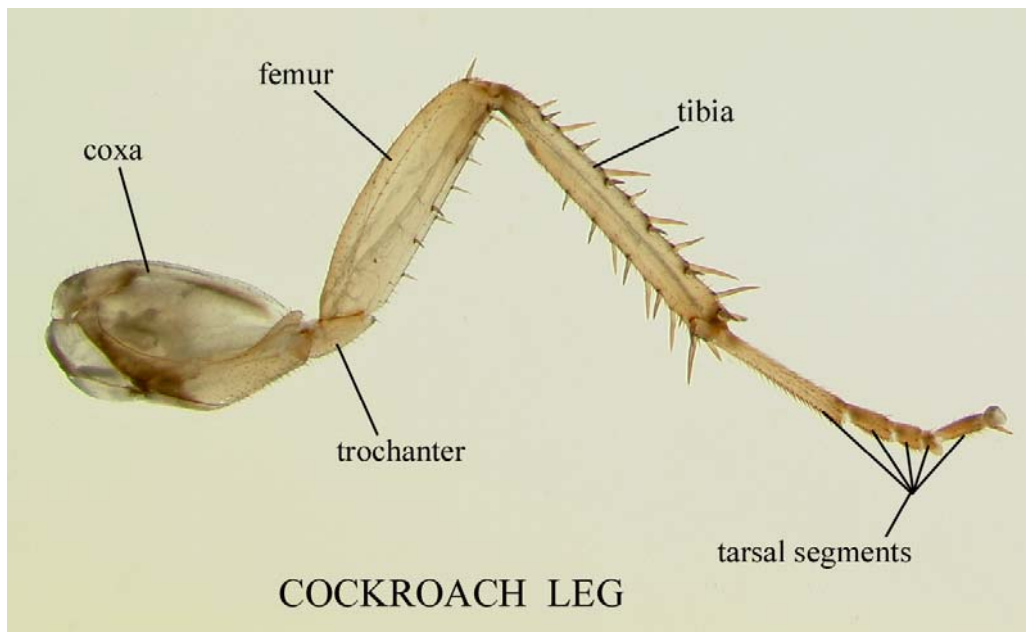
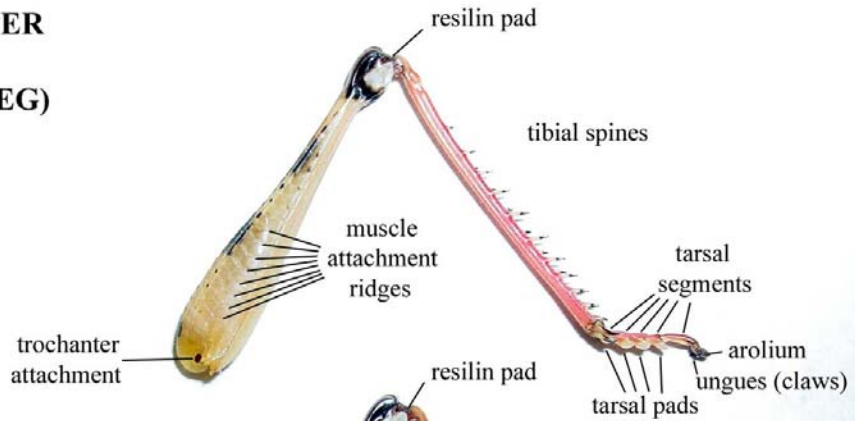


Photo: J.A. Smith UF/IFAS

Here we have a photo of a grasshopper leg. What is this leg modified for?
Take a look at all the muscle attachment ridges. No wonder why they need to eat so much!

GRASSHOPPER HIND LEG (JUMPING LEG)

Internal View



External View

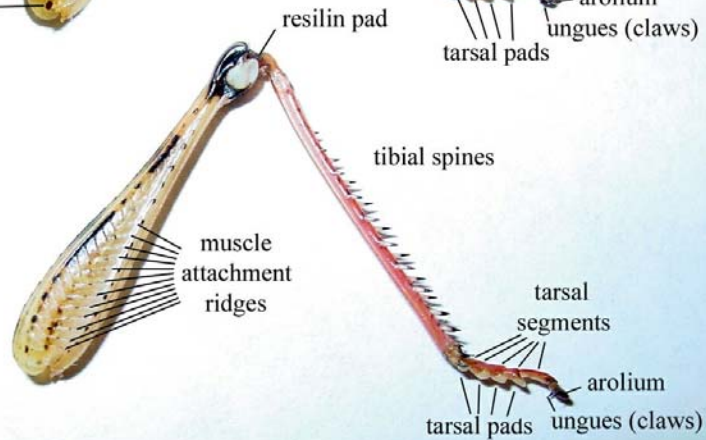
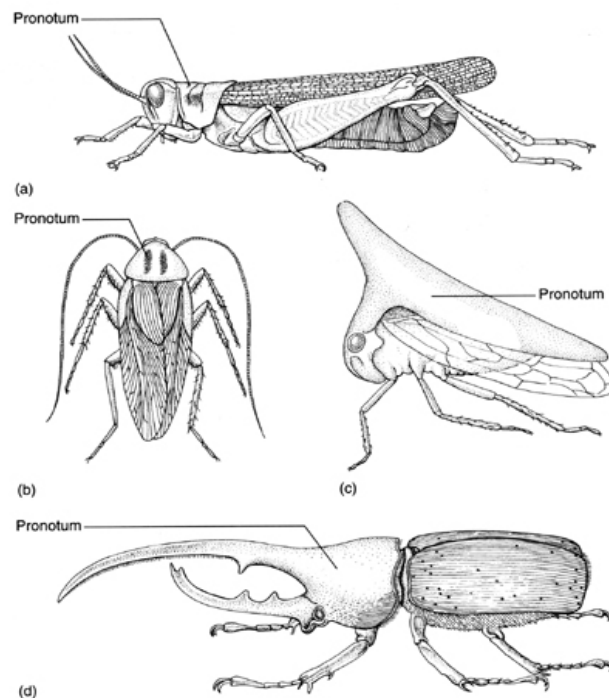


Photo: J.A. Smith UF/IFAS

Here are some modifications of the pronotum. Insects are very diverse. These are just some examples of how the same structure, in this case, the pronotum, can be modified into a variety of shapes for different functions.

Why do you think these are modified in this way? Hey, does that guy look like a thorn?



Abdomen

Well, the head was mainly for food ingestion, sensory perception, and coordination. The thorax was for locomotion. What do you think the function of the abdomen is?

The abdomen is where most of the guts are. Most of the digestive system, the fat body, the dorsal organ, and the reproductive organs are here. We will discuss internal anatomy later in the semester. For now, let's look at some external abdominal modifications.



Did she say dorsal organ?



Please read pages 46-50 in your text to learn about the modifications of the abdomen.

Take a look at these interesting ovipositors.



Understanding

1. What is an ovipositor? Why are some ovipositors modified for digging or piercing?

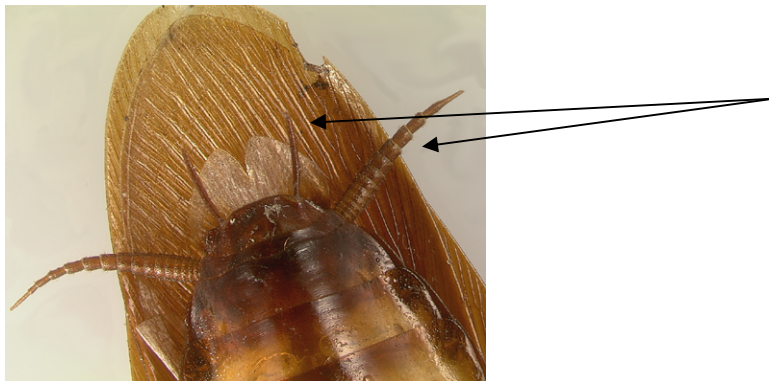
2. The ovipositor of many wasps, bees and ants has been modified into what?

3. What are cerci and where are they located?

4. Draw two representative kinds of cerci and identify which insect they represent.

5. How can you determine whether an American cockroach is male or female?

Answer: Male American cockroaches have two sets of cerci.



Well, this wraps up “External Anatomy 101”. When you are out collecting and observing insects, be sure to take a look at these external characteristics.

Oftentimes the behavior of the insect will give you a clue to why certain of its parts are shaped the way they are. You may want to jot down some information about your specimens as you find them. The information about your observations may help you in your identification.

Good Luck!