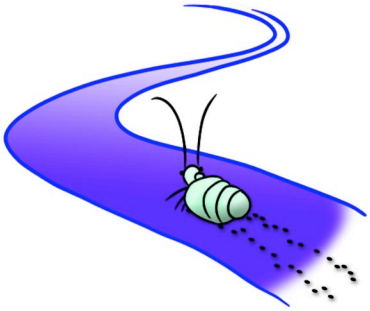
"How does a bug taste?"

What insect sense organs tell us about insects

All animals need information about their environment in order to survive. Most animals, including people, use their senses to find out what is going on around them. However, there are many different ways to get survival information. We can study insects to see how some animals use their senses in the same ways as us and in different ways. *The overarching theme of this lesson is that insects use sensory information to survive and that while they share many of the same senses with us, often their sense organs are different than ours. These differences tell us something about what is important to the insect.*



Grade level: 4-6 +

Presentation time: 50 minutes

Lesson plan organization:

Each lesson plan is divided into three sections: *Introducing the lesson*, *Conducting the lesson*, and *Concluding the lesson*. Each lesson has specific principles with associated figures, class discussion (D), and learning activities (A).

Materials:

"**Bug Sense" Trivia Sheet** (pg. 5)
Insects (have students bring in their own)
Activity sheets: "How do you compare to a bug?" (pg. 9), "Bug-O-Vision" (pg. 7)
"Termites Catch the Scent!" Kit: Carolina Biological Supply,
www.carolina.com, catalog #14-3722, $35.50
Male and female Saturniid moths: Rear from cocoons. (You just leave them in a cool, dry place for a few weeks. Adult moths cannot eat; you can keep them in a Tupperware with holes in the lid or any large container for a few days, or freeze them before they beat up their wings. Store dead moths in a cardboard box, preferably with a mothball.)
Carolina Biological Supply,
www.carolina.com, catalog #14-3940, $27.25 for six

This lesson plan is provided by the Neurobiology and Behavior Community Outreach Team at the University of Washington: http://students.washington.edu/watari/neuroscience/k12/LessonPlans.html

Introducing the lesson

D: Five senses
Ask students to think about their senses and the important information they provide. The following sequence of questions and discussion is a guide:

1. What senses do you have? What **sense organs** do you use for each one? (*Seeing/eyes, hearing/ears, touch/skin, taste/tongue, smell/nose, [pain and joint sense/proprioception])*

2. Why is it important to have these senses? *(They help us to gather information about our world and respond correctly; for example, seeing can help us avoid running into objects, taste can help us avoid eating poisonous foods.)*

3. Most living things use their senses to survive. What are some other examples of animals using their senses? *(This could range from a pet dog following a scent to a worm burrowing down into the ground. If the examples are all mammals, try to broaden the discussion by suggesting other animals, like octopi (which see very well) or sharks (which can smell a blood trail miles away)).*

4. Do all these animals use their senses in the same way? *(No; you can point out that animals adapt to their environment through evolution, including how they use their senses. Example: Night hunters need to find food in a dark environment. Some, such as cats and owls, have excellent night vision, while others, such as bats, rely on other senses like hearing to compensate.)*

5. Insects are animals too. Do you think they have the same senses as we do? *(Yes and no: they still see/hear/feel/taste/smell, but many of their sense organs are very different from ours. They also have some additional senses with which students may or may not be familiar – see **Bug Sense Trivia Sheet**, pg. 5.)*

6. Tell the students that today we will learn about how some insects sense the world around them. We will discuss how some of their sense organs are different than ours and what this tells us about how the insect lives.

Conducting the lesson

***Principle 1:* Insects and people use many of the same senses**

D: Insect senses are similar to ours

1. Even though an insect is very different from, say, a dog, they still need to do the same basic things to survive. What are some of the things they need to do? *(Avoid predators/enemies, find food and water, find a mate.)* Are these the same as us?

2. Can you think of an example of an insect using its sense of seeing/hearing/touch/smell/taste? *(See **Bug Sense Trivia Sheet** for examples, pg. 5.)*

Principle 2: **Insects have evolved different sensory organs to do the same job as ours**

D: Some insects have different sensory organs

1. So insects use the same senses as we do, but do they have the same sensory organs? *(Yes and no.)*

2. Students may not know much about that question; when they run out of ideas, present this **anatomy slide (**pg. 6**).**

3. Eyes -- People and insects both see with their eyes. But unlike people, insects have **compound eyes.** Do you know how a computer screen works? *(Explain the concept of pixels – asking them to envision a blocky old computer game might help. A single pixel can only show a square of a certain color, but on a screen with many pixels in a grid, you can generate a blocky image.)* Our eyes work like the lens of a (non-digital) camera, taking in an entire scene. But insects have compound eyes made up of many little lenses; they work more like a computer screen. However, an insect's brain handles information from the eyes in a way very similar to your brain and your eyes. In the end, insect vision is kind of like being in an old video game, where everything is a little blocky.

4. Complete "Bug-o-Vision" worksheet (pg. 7).

5. What about hearing? Do insects have ears? *(?)* Their ears don't look like ours, but insects can have ears all over their bodies! Our ears have an **ear drum** inside that looks like the top of a drum: it's a thin sheet of skin inside of your ear. (If it breaks, you can't hear.) Insects don't have ears like we do, but they do have thin sheets of their skin (exoskeleton/cuticle) that work the same way, to pick up sounds. *(Show pg. 8**,** of where the ears are on different insects.)*

6. What about touch? Do you think insects "feel" the same way we do? *(Basically, yes. Students may suggest that insects use their antennae to feel – if they do, segue into the next section.)* Insects do use their antennae to feel around, but antennae actually have a more important function…

7. How does a bug taste? Not if you eat one, but rather, how does an insect taste its food? I'll give you a hint: did you ever notice how flies like to come to a picnic, or if they're inside, how they hang out on the dinner table? What do they do? *(They walk on the food.)* Insects have their taste buds in their feet! Why might this be useful? *(They can walk around on your picnic; they can find out if a food is good before they put it in their mouth; since some are too small to see a chunk of food, they may not know it's food until they land on it and taste it.*)

8. Smell! An insect's antennae are a lot like your nose – in fact, an insect's brain and a person's brain process smells almost exactly the same way.

A: Moths and smell

1. Let me tell you a story. When a female moth is looking for a mate, she releases a special smell, called a pheromone, that tells male moths she is waiting. Male moths can track this smell for *miles* to find a female. They have a great sense of smell. So using what we just learned, can you guess which moth is the male, and which is the female? *(If*

the Saturniid moths are alive, have students approach two or three at a time to look at them in a clear container, such as a Tupperware. If they are dead, pass them around in a cardboard box – tell students to look, but don't touch.) [Answer: Males have much bigger, bushier antennae than females do.]

Principle 3: **Sense Detectives solve the case!**

A: What sense do termites use to look for food?

1. So now that you've learned all about insect senses, let's see if we can figure out what sense **termites** use to look for food! What do termites eat? *(Wood, houses.)* That's right. In a moment, I'm going to show you some live termites. You can move them with a paintbrush, but it's very important that you be gentle with them! Also, don't let them escape. [Have the **Termites Catch the Scent** kit prepared according to kit instructions.]

2. I'm going to draw an arrow pointing the way to food on this paper. Let's see if the termite can figure it out. [Draw a long arrow on a piece of white paper with a blue Bic pen (included in the kit). Use a paintbrush to deposit a termite at one end of the arrow – within a few seconds, it should pick up the trail and start walking along the line.]

3. Ask students if they really believe the termite knows to go the direction of the arrow (*probably not*). What other explanation might there be? Let's be Sense Detectives and try to figure it out! (*In the past, students have suggested that they like the color blue, that they can feel the divot left by the pen, that they like to walk on the dark, etc.*) [Encourage students to think of ways to test these ideas – e.g., if it's the color blue, why not see if the termite will follow blue marker? The kit comes with additional ideas.] Eventually, hopefully, someone will suggest that they can *smell* the ink. [Hints: they sometimes lose the trail, then circle around until they find it again – probably not seeing or feeling it. Hard to see, but they also brush the trail with their antennae – remember, antennae are used primarily for smell.] Termites use their sense of *smell* to find food; Bic makes a component its blue ink out of wood, so the ink smells like the chemical that the termites follow in the wild. Good work, Sense Detectives – you solved the mystery!

Concluding the lesson

D: Recap

So today we learned about how animals use their senses in different ways, using some of the same **sense organs** and some different ones. Who can tell me one of the senses that's the same in you and an insect? One that's different? How about in other animals – what are some senses that are the same? Different? (*I'm sure they'll come up with something.*) You used your Sense Detective skills to discover how termites find their food – who can explain what happened? That was some good detective work, everybody! If you liked that, maybe someday you could be a biologist, and figure out how other animals work!

A: Bug comparisons

Complete the activity sheet **"How do you compare to a bug?"** (pg. 9).

Bug Sense Trivia

- Some **butterflies** have simple eyes on their ovipositor to help them know where to lay their eggs: they can see with their behind!

- A male **mosquito** can tell the difference between a female who is looking for a mate and one who has already laid her eggs by listening to her wingbeat!

- **Ticks**, **lice** and other bloodsuckers often locate their hosts by detecting CO2 – they can smell you breathing!

- Male **Cercropia moths** can smell a female from miles away, then track her in the dark of night!

- **Ants** can tell their relatives apart from intruders and workers apart from their queen by smell. They even detect dead ants by smell – if you paint dead-ant smell on a live worker, its nestmates will try to bury it!

- Have you ever been to a 3D movie? Some 3D movies, the ones with 3D goggles that look like sunglasses, take advantage of the fact that humans cannot see the polarization of light, but many insects can. This helps them navigate – but they wouldn't be able to watch "Bugs 3-D"!

- **Cockroaches** have special "tails" called cerci that are sensitive to the slightest touch. They can feel the puff of air from your foot about to stomp them and run away!

- The hand is quicker than the fly? Flies can see much faster movements than people can – that's why they're so hard to swat. Some species of **horsefly** can catch a beebee that's been fired out of a beebee gun!

- **Orb-weaving spiders** have an amazingly sensitive sense of touch. They use the vibrations from their webs to locate not only where an object is, but whether it's a twig, an intruder, or a meal, and what species it is! (*Note: spiders are not insects; they are arachnids.)

- Most insects and spiders taste with their feet. That is why **flies** like to walk around on your food. It also means spiders don't want to be on you – you taste too salty! So if a **spider** accidentally walks on you, don't squash her; help her off.

- Ever wonder why **butterflies** are so colorful? Many butterflies and moths can see far more colors than we can – up to five times as many!

- **Water striders** gliding on the surface of a pond use their sense of touch to detect ripples from predators or prey, much like a spider uses her web.

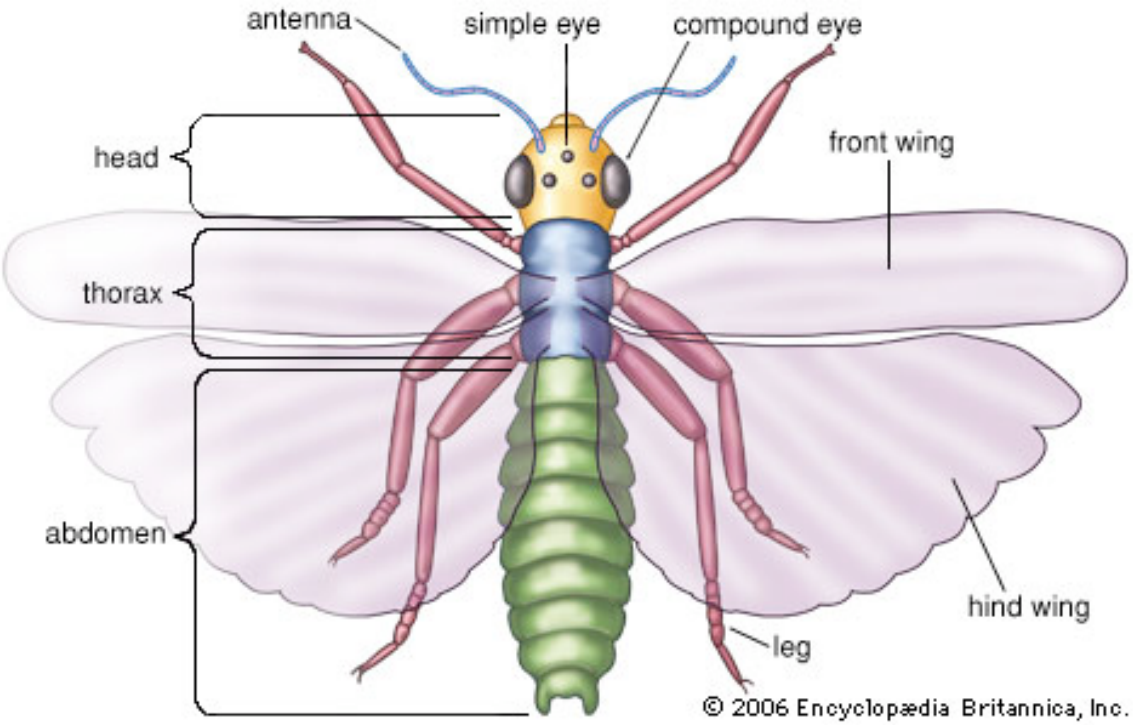
- Insects can use their antennae as feelers, but the main function of antennae is smell! Many insects also have olfactory receptors (a fancy word for "noses") on their feet.

- Insect ears are all over the place! For example, **grasshoppers** have ears on their knees, **praying mantises** have them on their bellies, and **mosquitoes** have them at the base of their antennae.

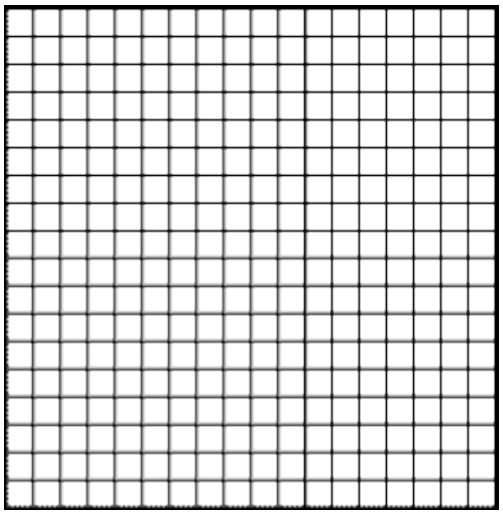
- An insect's eyes are called compound eyes. They are made up of many little lenses, instead of one big lens (like our eyes have). They cannot see detail as well as us, but they have some advantages: **butterflies** can see more colors than us, **bees** can see something called the *polarization* of light, and **horseflies** can respond to movements much, much faster than people can!

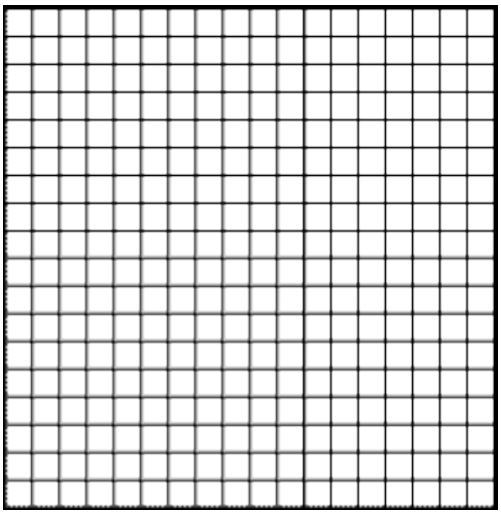
- Insects can taste with their mouth, just like us, but most also taste with their feet. Would you want to taste the inside of your shoes?!

Insect Anatomy



Bug-O-Vision

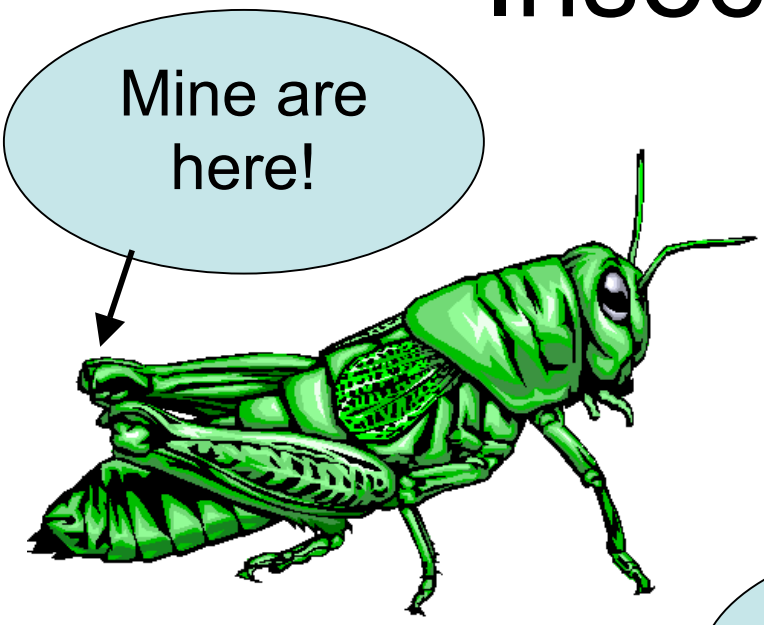


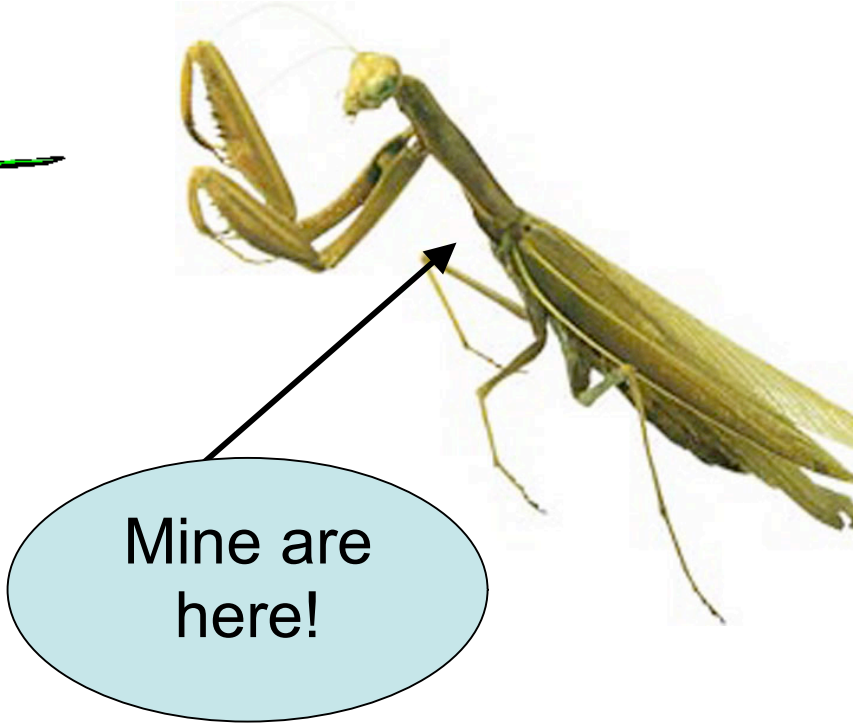


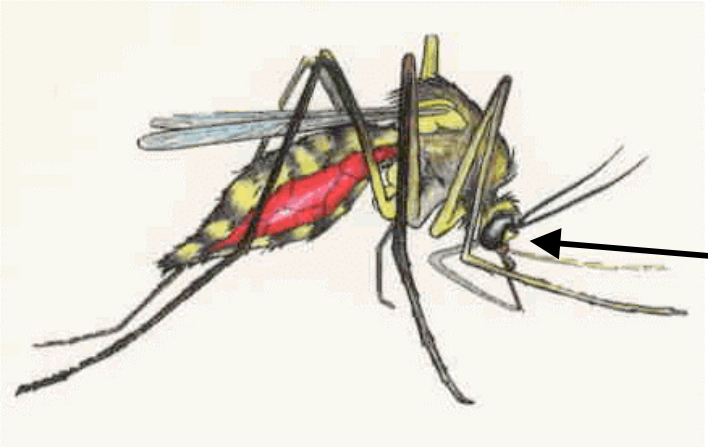
Instructions:
Make a line drawing of anything you want in the grid on the left. (It helps to draw big!) Then convert to Bug-O-Vision: in the grid on the right, fill in the WHOLE square anywhere there's a line going through that same square on the left.

Humans see smooth images, because our eye works like the lens of a camera. Insects have compound eyes, broken into many little lenses. Their eye works more like a digital camera, where each little lens records a small part of the image as light or dark and a color. This means they see blocky images, like in an old video game.

Insect Ears







How do you compare to a bug?

Match the human sense to the insect sense

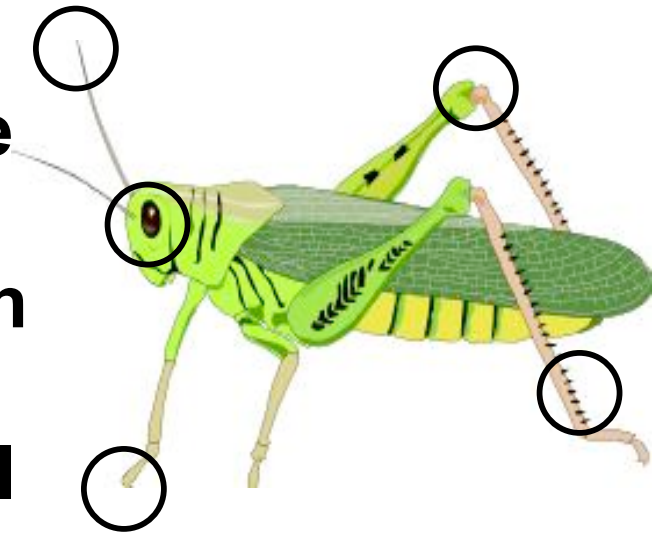
Vision

Taste

Touch

Smell

Hearing



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