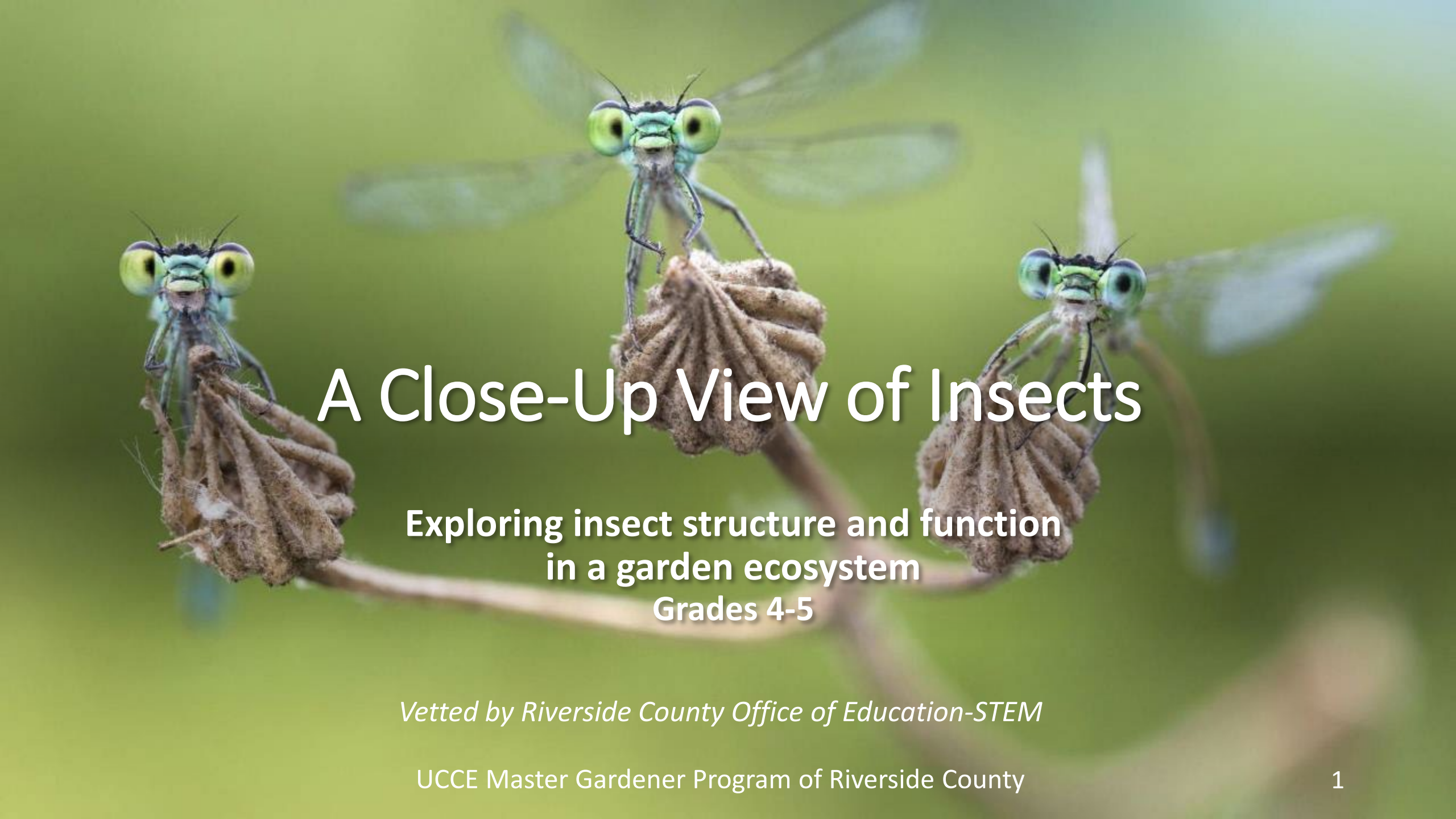


A Close-Up View of Insects

Exploring insect structure and function in a garden ecosystem

Grades 4-5

Vetted by Riverside County Office of Education-STEM

Why Is This Important?

"Insects occupy virtually all habitats on earth except the open ocean. Insects live in or on animals, plants, soil, wood structures and furniture, streams, lakes, ocean shores, and stored grain and other foods.

Insects are the most abundant animal on the planet. About one million different kinds, or species, are known to exist, and the final count may be greater."

--California Master Gardener Handbook

Learning Goals

Students will learn:

- The basic structure of an insect,
- and how this structure helps an insect to function within an ecosystem.

Anchor Phenomena:

Microscopic View of Insect Structure

Develop a Model To Describe the Phenomena

Draw a diagram showing the structure of an insect and how it helps the insect to function in its environment. Include both observable and unobservable details.

- Label all important parts of the diagram.
- Use arrows to show how all parts interact.
- Write a paragraph describing how the structure of an insect helps it to function in its environment.

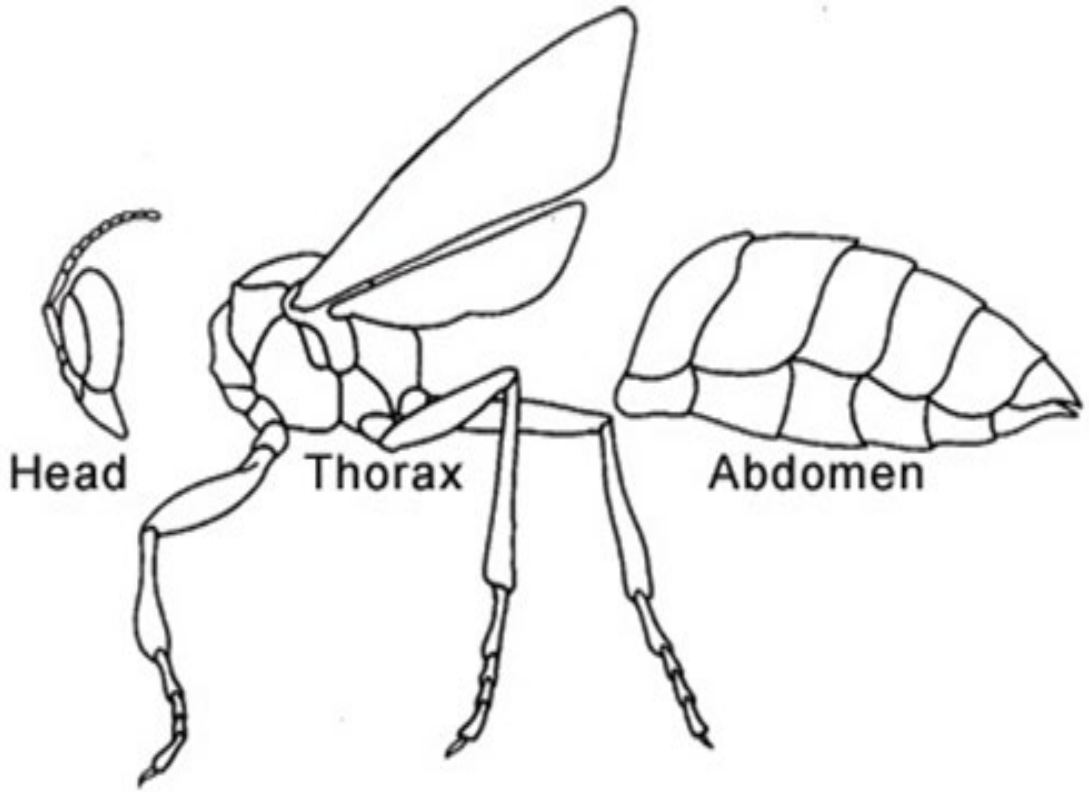
Following each *Quick Check*, consider updating your model to show what you have learned.

Examine the structure of an insect

Insects are the largest group of animals on Earth!

How is the structure of an insect:

- like other animals?
- different from other animals?



Did you know that insects have some body organs like humans?

This includes:

- Brain
- Eyes
- Heart

➢ **However, they do not have lungs or a stomach!.**

Let's take a closer look at insects.

Insect shapes have evolved around a basic pattern: **An armored three-part body**

All adult insects have:

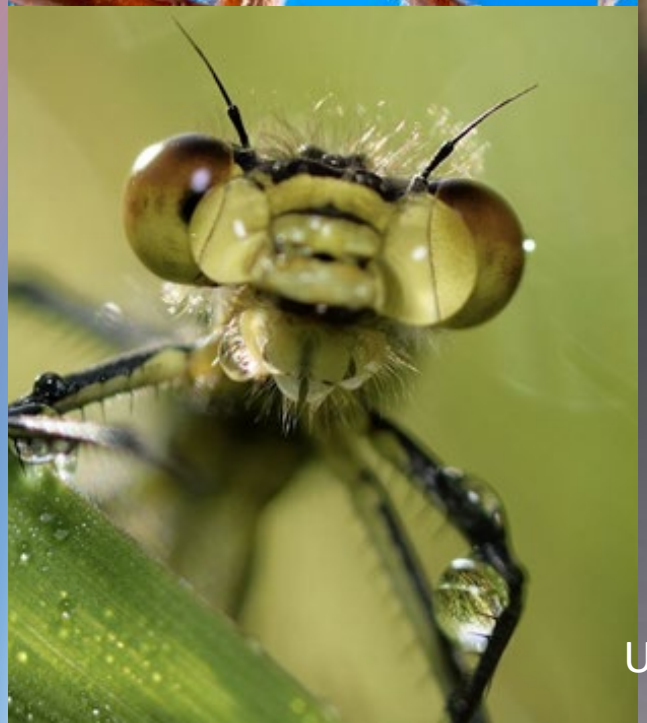
- A **head** section with eyes, antennae and appendages for eating.
- The midsection, called the **thorax**, has six legs for walking and, for most insects, a set of wings for flying.
- The rear section, called the **abdomen**, has the guts and glands for digesting food and mating.

What is insect armor?

Insects have an outer skeleton called an exoskeleton.

- The exoskeleton is formed by the hardening of skin secretions as the insect develops.
- These secretions consist mainly of *chiton* which is flexible, lightweight and strong. Even the wings are made of chiton.

➢ Compare this to your finger and toenails which are also made of chiton.



A closer look at an insect's head

The head has most of an insect's sense receptors:

- Antennae
- Compound eyes and/or simple eyes called ocelli
- Mouthparts vary depending on what the insect eats.

Antennae are essential to insect survival

Antennae are a critical sense organ for most insects and are constantly in motion. Antennae provide information on:

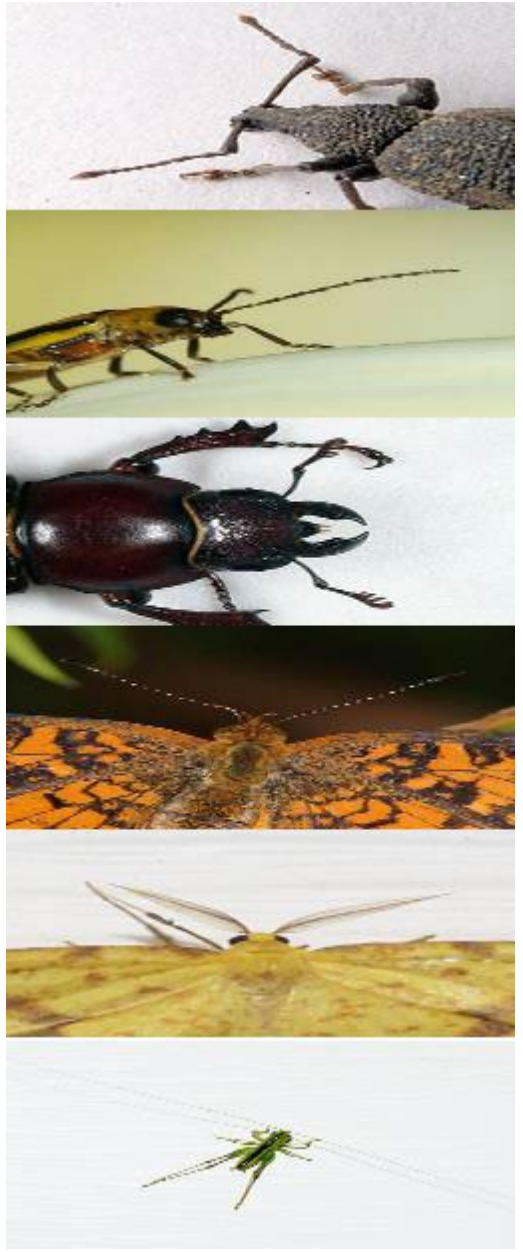
Smell: Antennae have numerous little pegs which can detect chemicals (odors) in the air. This helps insects locate nearby food and potential mates.

Feel: To navigate and explore their surroundings, and to detect temperature and humidity (moisture level) in the air.

Taste: Several types of insects use their antennae to decide if something is good or bad before placing it in their mouths.

Sound: Detecting vibrations in the air.

- Only crickets, grasshoppers, locusts, cicadas and most moths have actual hearing organs. But these are *not* located on their heads. Instead, these are found on the abdomen or legs!



Most insects have both compound eyes and ocelli eyes

Compound eyes have many lenses on a curved surface. The view appears blurry compared to human vision.

However, this view helps an insect to function. This is because compound eyes provide:

- Wide angle views
- Ability to detect fast movement
- Many insects can also see ultraviolet light which means the insect can see more of the color spectrum than humans.

➢ ***Click on this short video to see like a bee!***

Ocelli eyes have one lens like human eyes. The lens may be shaped very differently depending on the insect. For example, in bees it is curved (see picture) and in cockroaches it is flat.

- Ocelli detect motion and light, but do not transmit images.
- Scientists believe ocelli help insects navigate (find their way) around in their environment.
- All flying insects have ocelli eyes.

Insect mouths have evolved to eat various foods

An insect's actual mouth is a round hole that has no jaws of its own. This is surrounded by mouthparts that have adapted for these basic types of feeding**:**

- **Biting and chewing:** A pair of mandibles that swing inward with food to a pair of maxillae which grasp the food. Behind these is another pair of maxillae which form a large underlip.
- **Piercing and sucking:** Most "biting" insects don't bite! They have a needle-like stylus that pierces to suck in food. Other insects that feed on liquids have mouthparts that form a hollow straw-like tube that can siphon liquid upward.
- **Sponging:** Some insects, like flies, liquify solid food using saliva, then soak it up into their mouth.

➢Hairs on the mouth parts help insects to taste.

Quick Check!

- What kind of skeleton does an insect have?
- Why are antennae constantly in motion?
- What is the difference between compound and ocelli eyes?
- Describe one way an insect eats.
- Give an example of how insects use one of their sense receptors to function in their environment.

➢ *Revise your model to show what you have learned.*

A closer look at an insect's thorax

The thorax is the *locomotion* center for the insect. It is packed with powerful muscles which operate an insect's:

- Six legs
- Wings: Most insects have wings. The fly has one pair of wings. All other insects have two pairs of wings for flying.

Insect wings are not like bat or bird wings

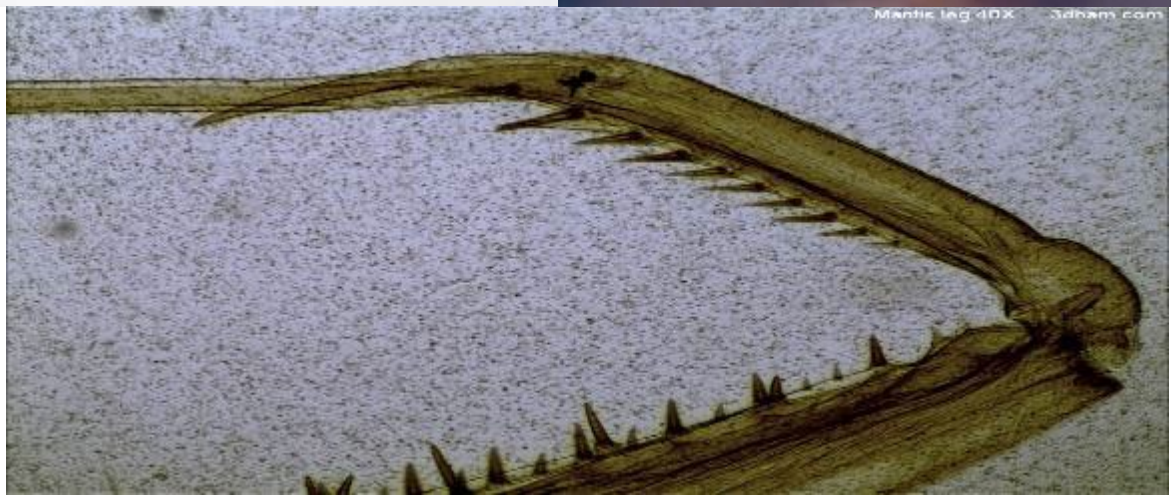
Instead, the wings are part of the insect's back –an outgrowth of the exoskeleton.

- The exoskeleton wings are structured for passage of air and blood.
- Wings give insects greater ability to search for food and places to live, escape danger and find a mate.

Insect legs are made for more than just walking

Insects have six legs that are adapted for walking, leaping, paddling, digging, cleaning and storage.

- The front legs of many insects have special notches which they use to clean their antennae.
- Most insect legs end in a pair of claws with a pad of hollow hairs between them. The claws and pads help insects climb sheer surfaces.



Observing Insect Wing and Leg Locomotion

- *Click on this short **video** to observe how a cockroach uses its legs and wings to function in its environment.*

Quick Check!

- What are insect wings made of?
- Which insect has just one pair of wings?
- Do all insects have wings?
- How many legs does an insect have?
- Give an example of how insects use their wings or legs to function in their environment.

➢ *Revise your model to show what you have learned.*

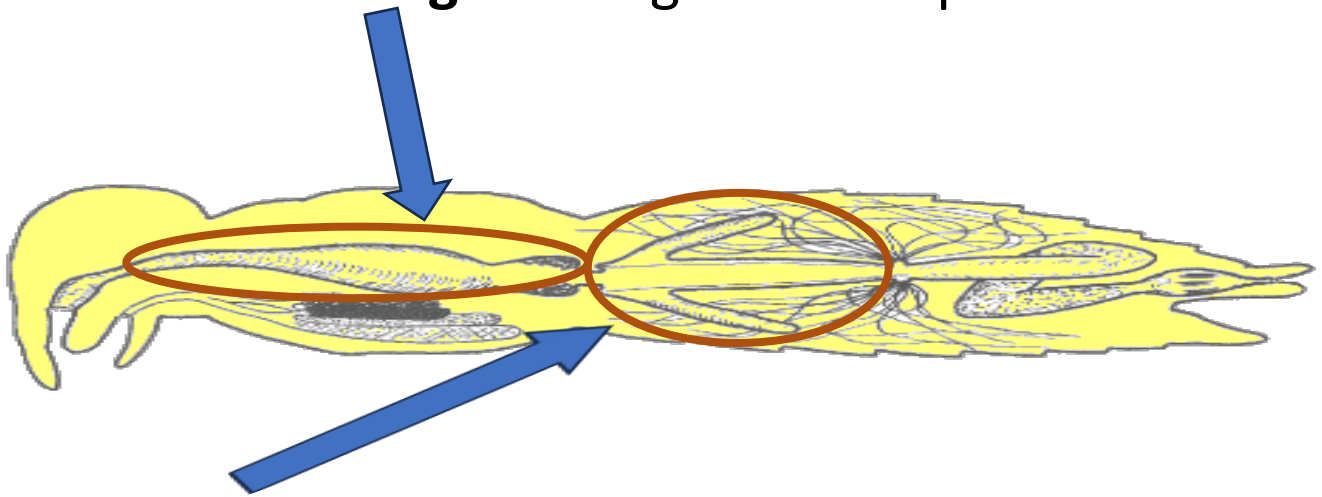
A closer look at an insect's abdomen

The abdomen is the largest body part of the insect. It contains several important systems:

- Digestive system--guts
- Breathing system-trachea
- Circulatory system-dorsal vessel

If insects don't have a stomach, how do they digest food?

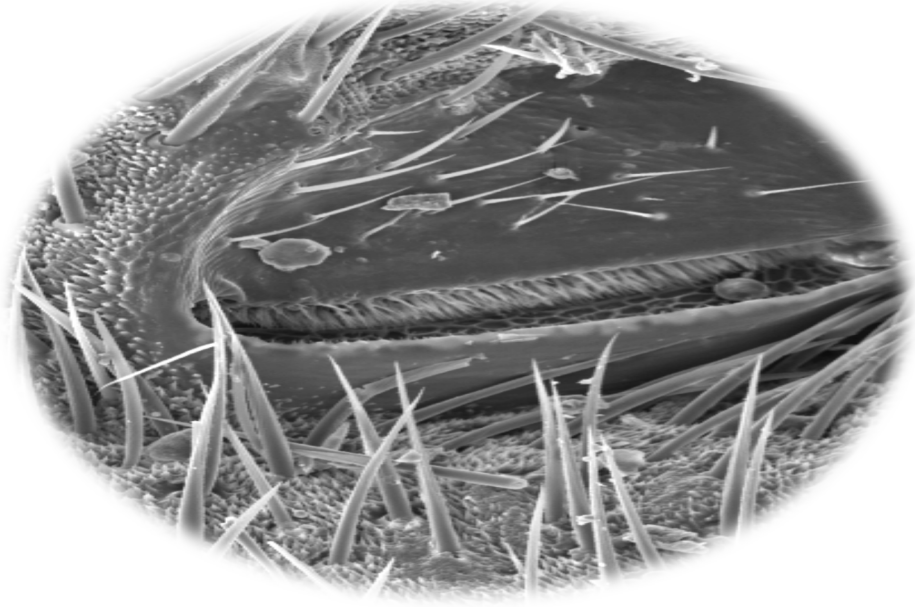
Insects have a **foregut** that grinds and pulverizes food particles.



- The **midgut** is where most of the food is digested, and nutrients are absorbed.

How do insects breathe without lungs?

- Air is taken in through tiny openings called **spiracles** located in the exoskeleton of the abdomen.



- These spiracles lead to the **trachea** which are hollow tubes that transport oxygen.

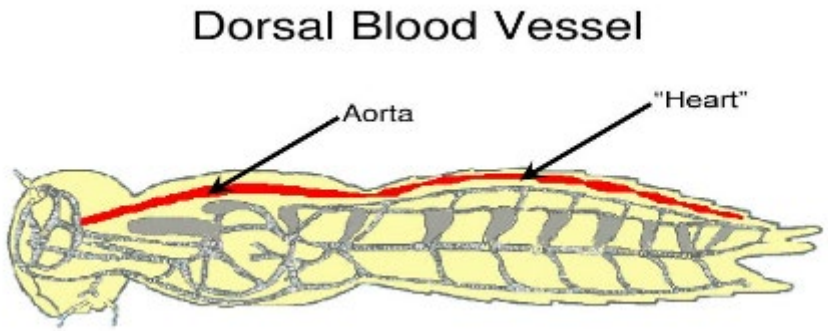
- These tubes get smaller and smaller as they branch to every part of the body.

An insect's heart is different from other animals

An insect's "heart" is a tube-like structure called the *dorsal vessel*.

- The dorsal vessel has chambers made up of muscles that expand or contract to control the flow of insect blood.

➢Click on this short video to learn more.



A closer look at insect blood called *hemolymph*

Insect blood does not circulate through veins. It flows freely throughout the insect's body.

- Like human blood, hemolymph carries important nutrients to the insect's organs.
- Unlike human blood, it does not contain hemoglobin (red blood cells.) This means insect blood is clear or tinged with yellow or green.

➢ *Have you ever squished an insect and seen what looks like red blood? That is actually pigment (color) from the insect's eyes!*

Quick Check!

- What part of an insect's body digests food?
- How do insects breathe without lungs?
- How is an insect's dorsal vessel different from a human heart?
- Give an example of how one of these systems in the abdomen helps an insect function in its environment.

➢ *Revise your model to show what you have learned*

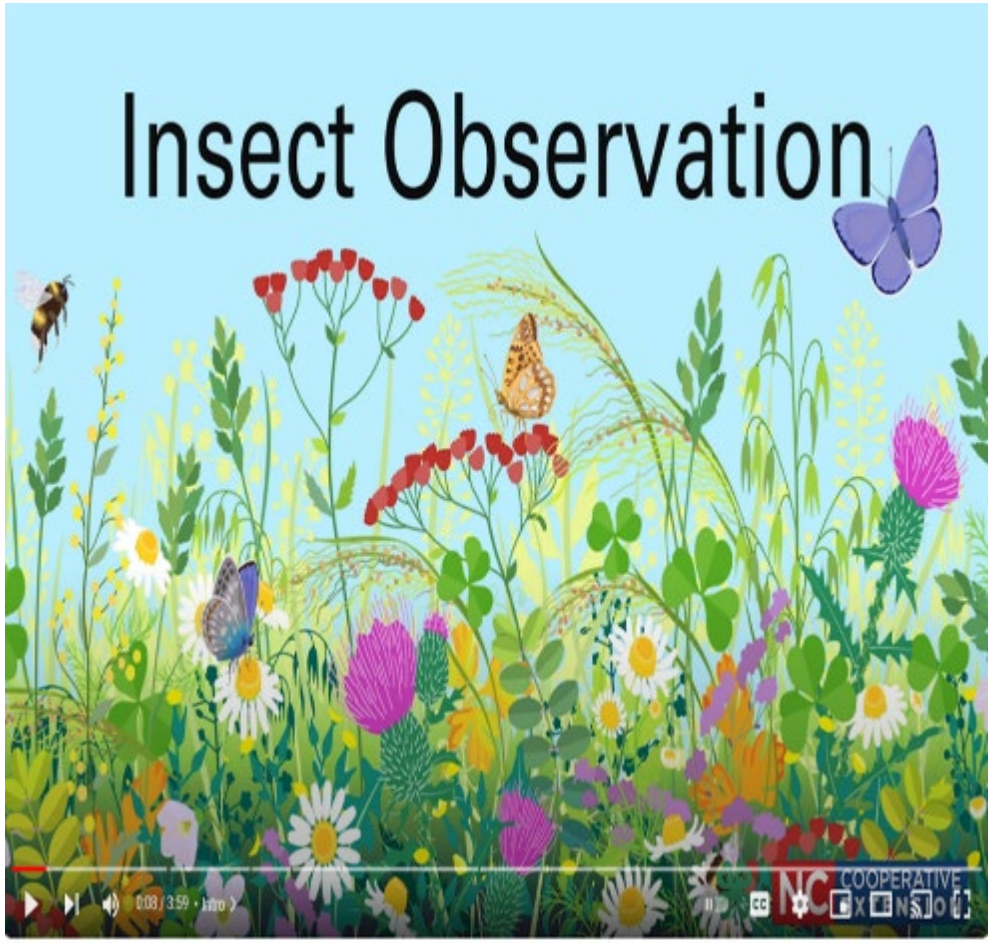
Phenomena in the Garden:

Exploring temperature's affect on insect function

Insects are cold-blooded animals, which means that they cannot control their body temperature. An insect's body temperature will be similar to the current temperature of their environment. As a result, most insects are active during warmer weather.

1. Watch this video to learn more about observing insects in warmer weather.
2. Apply what you have learned by touring your school or home garden and completing the insect identification chart.

   (Teachers: Chart is on the next slide.)



Warm Weather Insect Observation Chart

Location: Date:

Insect Observed: *Describe by name and/or as adult, larva, cocoon, eggs*	**Location:** *Flower, stem, leaf, lawn, soil, bark, leaf litter*	**Tally:** *How many of this adult insect, larva, cocoon or eggs did you observe?*

Develop a Model To Describe the Phenomena

Make final revisions or draw a new diagram showing the structure of an insect and how it helps the insect to function in its environment. Include both observable and unobservable details.

- Label all important parts of the diagram.
- Use arrows to show how all parts interact.
- Write a paragraph describing how the structure of an insect helps it to function in its environment.

Extend Your Thinking:

Explore how some insects survive in cold temperatures

This video explores three ways some insects survive cold weather:

- Migration
- Hibernation
- Dormant eggs or larvae

➢ Watch the video, then select one of these strategies and an example of an insect that uses this strategy.

➢ Update your model to reflect what you have learned about how this insect survives cold weather.

Teachers: Please Provide Your Input!

Master Gardeners would appreciate your feedback on this lesson. The survey is anonymous but does require a Gmail account to access.

➢Please click on the link to complete a brief survey.

MG Lesson Survey

University of California
Agriculture and Natural Resources
UCCE Master Gardener Program

California Next Generation Science Standards

LS1.A: Structure and Function
Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)

LS1.D: Information Processing

Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions. (4-LS1-2)

LS2.A: Interdependent Relationships in Ecosystems
A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. (5-LS2-1)

California Next Generation Science Standards

Science and Engineering Practices:

- Use a model to test interactions concerning the functioning of a natural system. (4-LS1-2)
- Develop a model to describe phenomena. (5-LS2-1)

Cross-Cutting Concepts:

A system can be described in terms of its components and their interactions. (4-LS1-1),(4-LS1-2); (5-LS2-1)

Resources

- Do Insects Really See Hundreds of Tiny Identical Images? Ask a Biologist, Arizona State University
- How to Know Insects: Youth and Entomology; Perdue University Extension
- Insects: Chapter 12 of the Missouri Master Gardener Handbook; University of Missouri Extension
- Insect Breathing: Ask a Biologist, Arizona State University
- Insect Flight: Smithsonian
- Insect Mouthparts: Camille Goodwin; Problem Solver Guide for Gardeners; Extension Horticulture Texas A & M University
- Insects Taste More Than Food and With More Than Mouths: Panchalie B. Gunathunga, Entomology Today
- California Master Gardener Handbook
- The Eye of the Fly; Saukville Field Station, University of Wisconsin, Milwaukee
- The exoskeleton: the good, the bad and the creepy crawly; UC Museum of Paleontology, Berkley
- **Videos:** The Kid Should See This; Edinburgh Honey Co.; Palansoft; A Moment of Science, PBS; Liz Driscoll; Sci Show
- **Images:** Creative Commons; Stock; Kiddle; Wikipedia

Master Gardeners

The University of California Cooperative Extension (UCCE) Master Gardener Program (MGP) is an educational program designed to teach and effectively extend information to address home gardening and non-commercial horticulture needs in California.

UCCE is the outreach arm of UC's division of Agriculture and Natural Resources (ANR). Master Gardener volunteers (MG volunteers) promote the application of basic environmentally appropriate horticultural practices through UCCE-organized educational programs that transfer research-based knowledge and information.

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Agriculture and Natural Resources
UCCE Master Gardener Program

Gardening Questions?

UCCE Master Gardeners of Riverside County Contact Information

Email Helpline: anrmgriverside@ucanr.edu

Website: Riverside County Master Gardeners

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