

THE INCREDIBLE WORLD OF INSECTS

Educational Video
27 Minutes

Copyright, MMI
Rainbow Educational Media, Inc.

Distributed by:
United Learning
1560 Sherman Ave., Suite 100
Evanston, IL. 60201
800-323-9084
www.unitedlearning.com |
www.unitedstreaming.com



PRINCIPLE CREDITS

Producer, Writer &
Director:

Peter Matulavich

Consultants:

Greg Walker, Ph.D.,
Dept. of Entomology,
University of California,
Riverside

Michael Worosz, M.A.,
Curriculum Consultant

Videography, Animation &
Editing:

Peter Matulavich

Special Thanks To:

Arthur V. Evans, D.Sc.,
Los Angeles Insect Zoo

Bill Lewis,
Bill's Bees

Kirk Visscher, Ph.D.,
Dept. of Entomology,
University of California,
Riverside

Howard Topoff, Ph.D.

Portal Research Station,
American Museum of
Natural History

Video and Teacher's Guide produced for
Rainbow Educational Media
by Peter Matulavich Productions
San Dimas, California

TABLE OF CONTENTS

Introduction	2
Objectives	3
Summary	4
Review Questions	7
Discussion Questions	10
Activities	12
Glossary	14
Bibliography	18
Websites	20
Script	22

Purchase of this program gives the user the right to reproduce or duplicate, in whole or in part, this teacher's guide for the purpose of teaching in conjunction with this video. This right is restricted for use only with this video program. Any reproduction or duplication in whole or in part of this guide for any purpose other than for use with this video is prohibited

INTRODUCTION

This video is designed to introduce students to the world's most remarkable organisms, insects. Adapting to nearly every known habitat, insects are the most successful life forms. There are more than one million different species, and new ones are discovered nearly every day.

Students will learn that insects belong to a large group of animals called arthropods which include organisms that are sometimes confused with insects such as spiders, centipedes, millipedes, and scorpions. Insects share a number of things in common with other arthropods. They are all invertebrates, have jointed legs, and possess hard outer coverings. But insects differ from most other arthropods in a number of important ways. Insects are among the few arthropods with three body parts and six legs.

Much of the video is devoted to featuring each of the insect's three body parts and the important organs found there. Students will be awed by the many mar-velous adaptations various species have taken.

Also featured are two important social insects (bees and ants), camouflage, migration, and other fascinating behaviors.

The video concludes with a discussion of how insects can be both helpful and harmful to humans.

After viewing this video, students will be left with a greater appreciation for these remarkable creatures and their incredible world.

OBJECTIVES

After viewing this video, students should know:

- how insects are similar to other arthropods
- how insects differ from most other arthropods
- an insect can be identified by its three body parts (head, thorax and abdomen), and six legs
- every insect has a pair of antennae
- insects have both simple and compound eyes
- insects have different types of mouthparts
- palps are used for tasting, smelling and manipulating food
- most adult insects have two pairs of wings
- an insect's reproductive organs are located on its abdomen
- some insects, like ants and bees, are called social insects, and live and work together in colonies
- some insects defend themselves by blending into their surroundings
- insects can be both harmful and helpful
- scientists study insects to learn more about them

SUMMARY

The video opens with a fast-paced sequence featuring a variety of fascinating insects. The narrator then states that insects are the most successful life forms, and have adapted to nearly every known habitat. There are more than one million kinds of insects and they can be found just about everywhere in the world.

Students will learn that some animals look like insects but they are not. These include spiders, centipedes, millipedes, and scorpions. While they aren't insects, these animals belong to large group of animals to which insects belong, called arthropods, and have many things in common. They are all invertebrates, have jointed legs, and possess a hard outer covering.

Insects differ from most other arthropods in several important ways. Insects are among die few arthropods which have three body parts and six legs. The three body parts are called the head, the thorax, and the abdomen.

The head of an insect contains many of its most important organs, and these include the insect's antennae, eyes and mouthparts. Every insect has a pair of antennae and they are used for sensing the world around them. Insects also sense their world through their eyes, both compound eyes and simple eyes. Insects eat in a lot of different ways according to the type of mouthparts they have. Some insects are chewers, while others suck their food through tubes, and others lap food up. Many chewers possess palps, which are used for tasting and smelling, and which are sometimes used like fingers to help manipulate food.

The insect's thorax is where you will find its legs and wings. Insect legs are varied according to how they

are used. Most insects have wings, and of those who do, most have two pairs of wings.

An insect's abdomen is where you find a number of important glands and organs, including its reproductive organs. Most insects mate by connecting themselves at the abdomen.

Some insects are called social insects which means they live and work together. Honeybees live in hives and everything they do is dedicated to the well-being of the hive. Worker bees are constantly coming and going, flying off to find pollen and nectar, the bees' favorite foods. Their job is not only to bring the pollen and nectar back, but also to tell the other bees where they found them. One of the most remarkable ways they do this is by wagging. This resembles a little dance where a bee will circle in one direction and then another.

Each hive is begun by a single queen who lays all the eggs. Queens can be identified by their larger size. Worker bees tend to the queen's every need, feeding it and cleaning it. They also tend to the queen's eggs and larvae. Larvae are the second stage in the lives of most insects. They hatch from eggs and grow entirely within a single honeycomb cell. They have neither eyes nor legs and must rely on adult bees to feed them. When a larva is about a week old, the bees will seal its cell with beeswax to allow it to grow into an adult. After another couple of weeks, the adult bee will eat its way out of the cell.

Bees are extremely protective of their hive and that's why some workers serve as guards to keep an eye out for intruders. Featured in the video is a fight to the death between a guard bee and a yellow jacket intruder.

Ants are social insects too, and the video features an

exciting raid conducted by slave-making ants on another colony. The raiders find an entrance to a nest beneath a rock, and the members of the other colony come out to meet them. The fighting is fierce, but this raid isn't about killing. The raiders are here to steal the other ants' brood and take them back to their own colony where they will serve as slaves.

While ants are some of the world's fiercest insects, they are also known to cooperate with other insects. Ants will not harm aphids because these tiny insects produce a sweet nectar from their abdomens which the ants love. In a sense, the aphids defend themselves by producing the nectar.

Other insects defend themselves by blending into their surroundings, and a variety of camouflage techniques are featured. When monarch butterflies congregate, they often resemble dead leaves. Tens of thousands of monarchs are featured congregating at a site in California to which they migrate each winter from as far away as Canada.

Insects can be both harmful and helpful to humans. They help pollinate most of the world's plants, and they provide us with important products. But many insects are harmful, destroying plants and crops, and carrying disease.

The video concludes with the observation of whether they are good or bad, insects are the most incredible creatures on earth.

REVIEW QUESTIONS

1. Why are insects considered successful?

There are more than one million kinds and they have adapted to nearly every known habitat.

2. What organisms are frequently confused with insects?

Spiders, centipedes, millipedes and scorpions.

3. How are insects and other arthropods alike?

They are invertebrates, have jointed legs, and possess a hard outer covering.

4. How do insects differ from most other arthropods?

Insects have three body parts and six legs.

5. How are antennae used?

They are used mostly for touching and smelling.

6. What two types of eyes do most insects possess?

Compound and simple eyes.

7. How are simple eyes used?

They are used to detect light and dark.

8. How are palps used?

They are used for tasting, smelling and manipulating food.

9. How do insects use their legs?

They are used for climbing, clinging, running, swimming, and grasping.

10. In what other special ways do some insects use their legs?

Bees use their legs to gather pollen. Crickets use their legs to hear, and butterflies can taste with theirs.

11. How many pairs of wings do most insects have?

Two.

12. Other than for flying, how do some insects use their wings?

The katydid makes its distinctive sound by rubbing its wings together. Honeybees cool their hives and pass odors by fanning their wings.

13. Where do you find an insect's reproductive organs?

At the ends of its abdomen.

14. What are cerci?

They are sensing organs extending from the abdomens of some insects.

15. What are social insects?

They are insects, like bees and ants, which live and work together in colonies.

16. What are the favorite foods of bees?

Pollen and nectar.

17. How do bees communicate?

They communicate by touching antennae, passing nectar from one to another, fanning their odors, and by wagging.

18. Who lays all the eggs in a hive?

The queen.

19. What is the name for ants which steal the brood of other ants in order to raise them as slaves?

Slave-making ants.

20. How do aphids protect themselves from ants?

They secrete a sweet liquid which ants like.

21. How do other insects protect themselves? One

way is by blending into their surroundings.

22. In what way are insects helpful?

They pollinate most of the world's plants.

23. In what ways are insects harmful?

They destroy plants and carry disease.

DISCUSSION QUESTIONS

1. **The video mentions how insects are considered successful because there are more than one million kinds and they have adapted to nearly every known habitat**

How successful are other kinds of animals?

By comparison, few other animals, including humans, are anywhere near as successful. There is only one species of human, and we have not adapted to nearly as many habitats as insects have.

2. **It is mentioned how insects possess an exoskeleton.**

What are some of the advantages and disadvantages of an exoskeleton?

The chief advantage is that it helps protect an insect. A disadvantage is that it can't expand and must be shed (molted) as insects grow, during which time the insect is highly vulnerable.

3. **Insects, along with spiders, centipedes, millipedes, and scorpions, are mentioned as being part of the arthropod group.**

What other animals are arthropods?

About 84 percent of all the animals on earth are members of the arthropod phylum, and include, in addition to the above, lobsters, crabs, shrimp, ticks, mites, and many others.

4. **Many insects shown in the video have multi-faceted eyes.**

What sort of image are insects likely to see through multi-faceted eyes?

Some scientists think insects see an image consisting of series of tiles something like a mosaic. Other scientists aren't so sure. They feel it is possible for an insect's brain, although primitive, to interpret the mosaic as a single image.

5. The video features a number of insects being eaten alive by other insects.

Do insects feel pain?

An insect's nervous system is quite primitive compared to ours, so it is unlikely they would experience pain in the same way or to the same degree we do.

6. An ant is featured dragging a fly many times larger than itself.

Are insects strong?

Incredibly so. By comparison, if humans were as strong as some insects, relatively speaking, they would easily be able to lift a car above their heads. Similarly, if humans could jump as high as some insects, they would be able to leap over a tall building.

7. The video features insects defending themselves through camouflage.

How else do insects defend themselves?

Some insects spray a foul-smelling liquid to ward off predators. Some caterpillars have scary-looking horns and other appendages. Other insects play dead, and some build shelters.

ACTIVITIES

These activities are designed to encourage students to learn more about some of the things covered in the video.

1. The video features a variety of interesting looking insects.

Activity: Have students draw and then color an insect of their choosing.

2. Insects are known to destroy crops and carry disease.

Activity: Have students research and report on a catastrophic famine, plague, or similar disaster caused by insects.

3. Humans have been using products produced by insects for thousands of years.

Activity: Have students research and report on important insect products which could include honey, beeswax, silk, shellac and some dyes.

4. The video features activities in a beehive.

Activity: Have students visit a local beekeeper to learn more about bees. Ask them to bring back some honey to share with the class.

5. The video features activities in an ant colony.

Activity: Have students maintain their own ant colony as a class project, using a plastic ant "farm".

6. Scientists are featured in the video as they study insects.

Activity: Have students conduct their own study using insects. They might try to find out how far ants may forage from their nest by observing them over an extended period, or what plants are favored by which caterpillars, or whether some insects are more active during different times of the day, etc.

7. Many insects are easy to keep.

Activity: Have students find insects that are harmless and easy to maintain. These include: praying mantises, walkingsticks, ladybugs, aphids, bessbugs, lightning bugs, Japanese beetles, and others. Insects should be kept in a small container with air vents along with a damp paper towel or sponge. Mantises eat crickets and other insects. Various walkingsticks eat the leaves of black cherry, oak, hickory, walnut, or locust trees. Ladybugs eat aphids. Aphids suck the juices from a wide variety of plants. Bessbugs feed on damp, rotting wood. Some adult lightning bugs never eat. Others eat smaller insects. Japanese beetles feed on a wide variety of plants.

GLOSSARY

abdomen: the rear part of an insect's body which contains its reproductive organs

ant: a small insect that lives in large groups called colonies

antennae: the pair of organs on an insect's head that is used primarily for touching and smelling

aphid: a tiny green or brownish insect that feeds on the juices of plants

arthropod: a large group of invertebrate animals with jointed legs and a hard outer covering

assassin bug: an insect that has a short, curved powerful beak used to prey on other insects or to suck blood from mammals

backswimmer: an aquatic insect that swims on its back using legs that resemble oars

beeswax: the wax produced from the glands in a bee's abdomen

beetle: a usually oval-shaped insect with biting mouthparts and usually two pairs of wings

brood: the young of insects and some other animals

butterfly: a usually brightly-colored insect with a slender body and four broad wings

caterpillar: the wormlike form of a butterfly or moth

centipede: a wormlike animal with more than a dozen legs

cerci: a pair of sensory organs at the ends of some insects' abdomens

colony: a group of insects which live together

compound eyes: the large, faceted eyes of insects

cricket: a leaping insect, with a long pair of antennae, that is related to the grasshopper

damselfly: a usually brightly-colored insect with a long slender body and long wings

darkling beetle: a brown or black beetle that feeds on plants and decaying vegetation

dragonfly: a large insect with a long slender body and long wings

exoskeleton: the hard outer covering of an insect

facet: one of the lenslike units of an insect's compound eye

fly: a small insect with a single pair of wings

groom: to clean

hissing roach: a large cockroach which hisses when alarmed

hive: a place where bees live

honeybee: a bee that lives in a hive with other bees and which makes honey

insect: a tiny animal with three major body parts, six legs, and usually two pairs of wings

katydid: a green insect related to grasshoppers that produces a high-pitched sound by rubbing its wings together

larva: the wormlike second stage of most insects' lives

mate: to join as a pair to produce offspring

migrate: to move from one area to another

millipede: a wormlike animal which can have more than a hundred legs

mosquito: a slender flying insect with a proboscis for sucking blood from mammals

mouthparts: the parts of an insect's mouth used for eating

nectar: the sweet liquid in many flowers, made into honey by bees

odor: a smell

palps: the long fingerlike organs found near the mouths of many insects, used for tasting, smelling and manipulating food

planthopper: an insect that sometimes resembles a leaf and which flits from plant to plant

pollen: the yellow powder, that is found on the stamens of flowers, used by bees to make food

praying mantis: a green or brownish insect that eats other insects and which holds its front pair of legs as if it were praying

predator: an animal that lives by hunting and eating other animals

queen bee: the largest bee in a colony, which is responsible for laying all the eggs

reproductive organs: those body parts which are used during mating

simple eyes: the small eyes in the middle of some insects' heads, that are thought to be used to detect light and dark

social insects: insects that live and work together

spider: a small animal with eight legs and two major body parts

tarantula: a large hairy spider with a painful bite

thorax: the second or middle part of an insect's body to which its legs and wings are attached

tropics: a region of the world near the equator marked by hot temperatures and often high humidity

wagging: the short quick movements of a bee which are performed as a means of communication

walkingstick: an insect that resembles a stick

yellow jacket: a wasp with yellow and black markings

BIBLIOGRAPHY

- Arnett, Ross H. and Jacques, Richard L. *Simon & Schuster's Guide to Insects*, Simon & Schuster, NY 1981
- Borror, Donald J. and Johnson, Norman F. and Triplehorn, Charles A. *An Introduction to the Study of Insects*, Harcourt Brace College Publishers, 1992
- Headstrom, Richard. *Adventures with Insects*, Dover Publications, NY 1982
- Holldobler, Bert and Wilson, Edward O. *Journey to the Ants*, Belknap Press, Cambridge, MA 1994
- Klots, Alexander B. and Elsie B. *1001 Questions Answered About Insects*, Dover Publications, NY 1977
- McGavin, George C. *The Pocket Guide to Insects of the Northern Hemisphere*, Parkgate Books, London 1992
- Milne, Lorus and Margery. *National Audubon Society Field Guide to North American Insects and Spiders*, Alfred A. Knopf, Inc. New York 1980
- Mound, Laurence. *Insect*, Alfred A. Knopf, NY 1990
- O'Toole, Christopher. *The Encyclopedia of Insects*, Facts on File, NY 1993
- Russo, Monica. *The Insect Almanac*, Sterling Publishing Co., Inc., NY 1991

Wemer, Floyd and Olson, Carl. *Insects of the Southwest*, Fisher Books, Tucson 1994

WEBSITES

The following list includes some of the best websites devoted to insects.

bugbios

(<http://www.insects.org>)

This beautifully-designed site is devoted to the "shameless promotion of insect appreciation" and includes content-rich articles and impressive insect images.

The Wonderful World of Insects

(<http://www.earthlife.net/insects>) This site offers an easy to use interface that leads to impressive images and articles on a wide variety of insects, order by order. Also included are areas on insect identity, anatomy, arthropods, evolution, and insect care. This is a fun, content-rich site certain to appeal to most students.

Entomology Department at Iowa State University

(<http://www.ent.iastate.edu>) This searchable site offers a virtual insect zoo complete with a controllable webcam where you can view insects in real time (if your server is willing). There's also an insect image gallery and even a chat room.

The Minibeast World of Insects and Spiders

(<http://members.aol.com/YESedu/welcome.html>)

Sponsored by the Young Entomologists' Society, this site includes a minibeast museum and articles on classification and identification. The "Teacher's Tower" provides a variety of helpful teaching tools.

The Butterfly Website

<http://mgfx.com/butterfly>

Devoted exclusively to butterflies, this site includes a wide variety of articles and images.

Buginfo

(<http://www.si.edu/resource/faq/nrmnh/buginfo/>)

Sponsored by the Smithsonian Institution, this site provides "information sheets" on many common insects and topics. The site also provides links to other Smithsonian insect resources.

Yucky Bug World

(<http://www.yucky.com/roaches>) This site, while trying overly hard to be cool in order to appeal to a younger audience, provides a lot of roach facts and illustrations, but very few photos.

Myrmecology

(<http://www.myrmecology.org>) Devoted to the "scientific study of ants" this site has useful information and images, including scanning electron microscope images.

The Sonoran Arthropods Studies Institute

(<http://www.sasionline.org>)

Insects and other arthropods of the Sonoran Desert are featured at this site.

Dennis Kunkel's Microscopy

(<http://www.pbrc.hawaii.edu/~kunkel>) This site features impressive insect images photographed through a scanning electron microscope by the co-author of *MicroAliens - Dazzling Journeys with an Electron Microscope*.

Note: Some servers have difficulty reaching every site address. If you encounter troubles, try reaching the site by entering its name in a search engine.

SCRIPT

Insects are the most fascinating creatures on earth. They are also the most successful, adapting to nearly every known habitat. There are more than one million kinds of insects and they can be found just about everywhere in the world.

Let's find out more about the incredible world of insects.

A lot of animals look like insects, but they're not. Spiders, like this tarantula, aren't insects.

And neither are centipedes, although this one is eating an insect.

Millipedes aren't insects either. And

neither are scorpions.

All of these animals are related to insects. They're cousins. They belong to a group of animals to which insects belong, called arthropods. Let's see how all these creatures are similar.

First, insects, like this walkingstick, and all other arthropods are invertebrates. That means they don't have a backbone as you and I do.

Next, all insects, and all arthropods, have jointed legs. Look at the joints in this walkingstick's legs.

And finally, all insects, like this hissing roach, and all arthropods, have a hard outer covering. The reason an insect's body is hard is because its outer covering is actually its skeleton. That's right, the insect's skeleton is on the outside of its body, not on the inside, like it is

with you and me. That's part of the reason why many insects appear shiny, because of their hard outer covering.

The outer covering of an insect is called its exoskeleton. "Exo" means outside. The insect's exoskeleton is like a suit of armor and helps to protect the insect.

Insects have a lot in common with other arthropods, but they also have many differences. Let's examine an insect in much closer detail to see how it differs from most other arthropods.

Insects are among the few arthropods which have three body parts. The head. The thorax. And the abdomen.

It's easy to spot the three body parts on some insects, like this wasp. Here's its head. Its thorax. And its abdomen.

But what about this giant water bug? Can you spot its three parts? Here's the head. The thorax. And the abdomen.

And what about this walkingstick? Here's the head. The thorax. And the abdomen.

Spiders, by the way, have only two body parts. The head and thorax, which are combined into one part. And the abdomen.

Insects are the only adult arthropods with six legs. One, two, three, four, five, six.

Can you count the legs on this darkling beetle?

And what about this ant?

Or this backswimmer? They all have six legs.

A spider has eight legs. It's not an insect.

The same with scorpions. Eight legs. It's not an insect.

Centipedes aren't insects. They have more than a dozen legs.

Millipedes aren't insects. They can have more than a hundred legs.

Let's take a closer look at each of the insect's body parts.

The head of an insect contains many of the insect's most important organs. And these include the insect's antennae. Its eyes. And its mouthparts.

One of the first things you notice when you look at an insect's head is its antennae. Every insect has a pair and they are used for sensing the world around them. That's why you often see an insect waving its antennae about as it explores its world.

Antennae are used mostly for touching and smelling. And this helps insects identify their own kind, and whether they're male or female.

Insects also communicate with their antennae. When two ants meet each other, you often see them touching antennae. They are actually passing chemical messages from one ant to another.

Antennae come in a variety of shapes and sizes. Some are short and fan like. Others are short and beaded. Some look like whips. While others are long and thin. And still others look like feathers. Each style of antenna is better at some things than others.

Insects also sense their world through their eyes. Here

a praying mantis grooms itself under a full moon. The mantis, like many insects, has a large pair of compound eyes, these are the most important for vision, and several simple eyes, which are probably sensitive to only light and dark. The mantis's three simple eyes are located here in the middle of its forehead.

Compound eyes are made up of tiny sections called facets. Each facet is a lens, and the more facets, the better the insect's vision. That's why dragonflies which have a lot of facets in their eyes, have such good vision.

And so do damselflies, which is probably why they respond so quickly to the slightest movement.

Beetles have poor vision. That's because their eyes are tiny and have few facets.

Insects eat in a lot of different ways. Some, like this grasshopper, are chewers. They chew the food they eat.

The mouthparts of many chewers, like this stick insect, include palps, or feelers, which are extremely sensitive and which give the insect information about the food it is eating, including taste and smell. Palps are also used like fingers to help manipulate food. After which, the insect spreads apart its palps so that it can chew the food with its jaws. Sticks are big eaters, and just a few of them can destroy a rose garden in a very short time.

Predators, like praying mantises, are chewers as well. This one is devouring a cricket it has just caught. Mantises have powerful jaws, and they can easily bite through the hard skeletons of most insects.

Can you spot the palps on this mantis? They're quite small compared to those on other insects. Many insects don't chew at all. The butterfly has a long

sucking tube which it uncoils to stick deep into flowers to obtain their sweet nectar. The tube is longer than its legs.

Bees eat mostly by lapping up nectar from flowers, but it's not easy to see. In this view you can clearly see the mouthpart that is used to lap up food, in this case, some honey.

The next insect body part is the thorax. This is where you find the insect's legs and wings.

Insect legs are varied according to how they are used. Some are used mostly for climbing and clinging. Some for running. Some for swimming. And some for grasping.

These threatening legs belong to the praying mantis, one of the great predators of the insect world. We've already seen how it uses its powerful jaws to devour insects. Before it can devour them, it has to catch them, which it does with lightning speed.

The strike is so fast, it's easy to miss, so we've slowed one down in order to see it more clearly. Here, a cricket passes in front of the mantis, jumps, and is caught in mid-air. There's a brief struggle, but once in the mantis's powerful legs, impaled on its spines, there is no escape for the cricket.

Insect legs are used in many ways. Bees use their hind legs for gathering pollen. Crickets can hear with their legs. And butterflies can taste with theirs.

Ants use their legs to carry and drag things. This ant is attempting to drag a dead fly many times larger than itself back to its colony. It's quite a struggle as the fly keeps getting caught up in grass and twigs. But ants are persistent and this one will eventually succeed, dragging the fly dozens of feet.

One of the most remarkable abilities of insects, is their ability to fly. Most insects have wings, and of those who do, most have two pairs of wings. Can you spot the two pairs of wings on this butterfly?

What about this beetle? You say it doesn't have two pairs? Here they are. The first pair serves as a protective case and covers the second pair which is used for flying. Most beetles have two pairs of wings.

Insects don't develop wings until they become adults. Wings are just beginning to emerge on this young mantis. But in just a few weeks, they will be fully formed, and the mantis will become an even more effective predator.

Some insects use their wings for things in addition to flying. The katydid makes its distinctive sound by rubbing its wings together.

Honeybees cool their hives and pass odors by fanning their wings.

An insect's third body part is its abdomen. It is here that you find a number of important glands and organs, including its reproductive organs.

When you come upon insects, you will sometimes find them connected at the abdomen. This is how most insects mate.

In addition to their sex organs, some insects also have a pair of cerci extending from their abdomens. These are sensing organs.

Other insects have stings and some, like this earwig, have pincers which are used for defense.

Some insects can expand their abdomens, enabling them to squeeze into tight places.

The anal opening of an insect is found at the end of its abdomen, a very important organ as this is how insects get rid of their waste.

Some insects are called social insects. That means they live and work together.

Bees live in colonies in which they bring up their young.

Most honeybees today are domesticated. That means they live in artificial hives tended by beekeepers. But these bees still behave in pretty much the same way as they would if they were wild.

Everything the bees do is dedicated to the well-being of the hive.

Worker bees are constantly coming and going, flying off to find pollen and nectar, the bees' favorite foods. They may have to fly a long distance to find them. When they return, their stomachs are full of nectar and their legs are loaded down with pollen. Their job is not only to bring the nectar and pollen back, but also to tell the other bees where they found them. They do this in several ways. One way is by touching antennae. They also pass nectar from one to another. And they fan their odor to other members in the hive. But one of the most remarkable ways they communicate is by wagging. These little dances where they first circle in one direction, then another, tell the other bees where to go to find pollen and nectar.

Each hive is begun by a single queen ~ she's the one in the middle — who lays all the eggs. Queens are larger than the other bees in the colony. There is no king bee.

Worker bees tend to the queen's every need. Feeding it and cleaning it. They also tend to the queen's eggs and larvae. The larvae are the white forms you can see at

the bottom of some of the cells. Larvae are the second stage in the lives of most insects. They hatch from eggs. The larvae get nearly constant attention. It is important that they grow into adult bees. You will often see adults reaching deep into cells to feed the larvae.

After about a week, the bees will seal the cells with beeswax to allow the larvae to grow into adults.

After another couple of weeks, the bee will begin to eat its way out of the cell. It'll take several efforts, but in a few minutes, a newly formed bee will emerge, identical to an adult in every way, except for its light color and its inability to sting. It'll be greeted by the other bees, and be given a few minutes for its wings to dry out, but there's no time to waste and the bee will be hard at work in a very short time.

Bees are extremely protective of their hive. That's why some workers serve as guards to keep an eye out for intruders. It isn't long until one is discovered, a yellow jacket inside the hive itself, trying to steal the bees' honey. It is overpowered by dozens of workers. They expel the yellow jacket, but one bee wants to finish the job and engages in a life and death struggle with the more powerful yellow jacket. The bee is left dazed and confused, but the fight is hot over. The yellow jacket returns to finish the bee off, biting the bee over and over with its powerful jaws. The bee, exhausted, is helpless now and the yellow jacket is able to bite it in half. Incredibly, a second yellow jacket enters the scene and steals the lower half of the bee. The first yellow jacket grabs the rest of the bee and flies off.

Ants are social insects too. They live in a colony. They tend to the queen. They bring up their young. And when a colony is disturbed, the ants will always attempt to take their brood to safety.

Sometimes you will see ants scurrying about, seemingly confused. Some ants behave this way before they start a raid. They are passing on instructions, making sure each ant gets the right chemical message. Then they are off, in search of an enemy to raid.

They travel in columns like soldiers, being led by a scout. Little can stop them. They stop at a tree stump. From their excited actions, it appears there is a rival colony under the trunk. But the colony appears to have blocked the entranceways. The ants are unable to get in and this raid ends in failure.

The next day, the ants are on the march again. This time they surround a colony which has built its nest under a rock. Members of the other colony, who are darker in color, come out to fight the invaders, but they have little success. There are too many of them and they are too powerful. The raiders find an entrance to the nest beneath the rock and the fighting continues. But this raid isn't about killing. The raiders are after just one thing, the unborn brood of the rival ants. The raiders are called slave-making ants. They are here to steal the brood and take them back to their own colony where they will serve as slaves. While many types of ants go on raids, only a few capture slaves.

Ants are among the fiercest fighters in the insect world. You wouldn't expect them to cooperate with other insects, but they do. These tiny green and brown insects are called aphids. They're found just about everywhere and feed on the juices of plant stems, leaves, and flowers. Ants could easily kill them, but they don't. That's because the aphids secrete a sweet liquid from their abdomens which the ants are just crazy about. In a sense, the aphids defend themselves by producing the liquid for the ants.

Insects defend themselves in a number of ways. One way is by blending into their surroundings. You can

see how difficult it would be for a predator to spot this insect.

And look at how this cricket seems to almost disappear.

Are you able to spot the insect in this scene? It's a walkingstick. One of the great masters of disguise in the insect world. It even shakes a little as if it were being blown by the wind.

The same for this insect from the tropics. It shakes as if it were a leaf being blown by the wind.

If you think these are dead leaves drooping from this tree, look again. They're all butterflies. Tens of thousands of monarch butterflies that have migrated to this site in California from as far away as Canada. They come here every winter, and how they find their way to the same small grove of trees is a mystery. Unlike migrating birds, they've never made this trip before. These butterflies will die before the next migration. There won't be any left to show the next group where to come. But they'll get here just the same, just as they've always done.

Each morning, they warm themselves in the sun, and by mid-day, they're practically all in flight, numbering more than a hundred thousand, creating one of the most remarkable scenes in the insect world.

Insects can be both helpful and harmful. When an insect flits from plant to plant, it carries pollen from one flower to another, which enable those plants to reproduce. Without insects, especially bees, most of the plants we're familiar with would not exist today.

Insects also produce important products. Bees are kept by beekeepers in artificial hives, so that the honey and wax the bees produce can be gathered and sold. And

who doesn't like honey?

But many insects are harmful. This beautiful beetle is actually a pest and infests many plants and food crops, damaging their leaves.

Aphids reproduce in such great numbers that they can suck most of the sap out of a plant and kill it.

Caterpillars are nonstop eating machines and are responsible for destroying countless plants.

And some insects, like flies, mosquitos, and assassin bugs are carriers of disease.

These are just a few of the reasons why insects are so important and why scientists throughout the world study them, so that they can learn even more about these fascinating creatures and their incredible world.

In this program we have seen how insects belong to a group of animals called arthropods which include spiders, centipedes, millipedes, scorpions and many others.

Insects and all other arthropods are invertebrates, have jointed legs, and have a hard outer covering, called an exoskeleton.

While insects have much in common with other arthropods, they have many differences. Insects are among the few arthropods with three body parts. The head, thorax, and abdomen. Most other arthropods have two body parts.

An insect can also be identified by the number of its legs. Insects have six legs.

The head of an insect contains many of the insect's most important organs, and these include the insect's

antennae, its eyes, and its mouthparts.

Insect antennae are used for sensing the world around them and for communicating.

Insects also sense their world through their eyes, both compound eyes, and simple eyes.

Insects eat in a number of different ways, including chewing, and sucking.

The insect's thorax is where you find its legs and wings.

Insect legs are varied according to how they are used.

Most adult insects have two pairs of wings.

The insect's abdomen is where you find a number of important organs, including its reproductive organs.

Most insects mate by attaching themselves at the abdomen.

Some insects are called social insects, and they live and work together in colonies.

Some insects defend themselves from predators by blending into their surroundings.

Insects can be both helpful and harmful. They help pollinate most of the world's plants, and they produce some important products.

But some insects carry disease and destroy countless plants and crops.

Good or bad, we think you'll agree, insects are the most incredible creatures on earth.