NATIONAL MUSEUM of NATURAL HISTORY
Smithsonian

Insect Zoo Audio Description Tour Full Script

Introduction

Welcome to the O. Orkin Insect Zoo at the Smithsonian Institution's National Museum of Natural History. Visitors get to observe, learn about and possibly even handle insects and other arthropods. The zoo has displays of live insects, preserved specimens, illustrations and a few tactile and interactive elements. The Insect Zoo is on the second floor of the Museum, and this tour begins at the entrance from the Eternal Life in Ancient Egypt exhibit. If you enter from the Butterfly Pavilion hall, walk through the Zoo to where it exits on the other side.

This is an audio-described tour, developed to make the visual aspects of the exhibit more accessible to visitors who are blind or have low vision. The tour goes through the Insect Zoo in 15 sections. Each section has three tracks. The Core track gives directions, a brief description of what's on display including a summary of the text. If you want to learn more, the Detailed Descriptions will spend more time describing visual elements in the section and the Exhibit Text track has the permanent exhibit text, excluding photo credits and figure labels included in the detailed descriptions.

The descriptions of the enclosures, which are the displays with live animals, will reflect what you are likely to find and sometimes notable behaviors, rather than describe a static scene – note that by their nature these exhibits change constantly, and sometimes the resident species are not on display. Signs on the live animal enclosures say: "Please do not tap the glass."

Before we start, a note on measurements: Scientists generally use metric measurements like centimeters, rather than Imperial units like inches. This tour will use metric for describing exhibit contents and Imperial for navigation. For comparison, there are about 2.5 centimeters in an inch, and about 30 centimeters in a foot. A millimeter is one-tenth of a centimeter. For a reference you might have in your pocket, a U.S. nickel coin is almost two centimeters across, and almost two millimeters high.

Let's begin our tour, starting just before you enter from the Ancient Egypt exhibit. On the far left is the exit from the Rainforest section – we'll get there in section 12. For now, head to the large hallway entrance to the right. The wall to your left is covered in a large mural reaching to the ceiling, showing huge plants from a "bug's eye view" – grass, violets, clover, Queens Anne's lace and more grow up from the ground, reaching to the ceiling. Toy wood blocks, nearly a half meter high, are tumbled on the ground to read "Z-O-O" in yellow, blue and red letters. A black grasshopper sits atop the blue "O" block, and a green praying mantis stares out from next to the red O. Other insects rest on leaves, flowers and a

fallen branch. On the left side a diamond-shaped plexiglass sign reads: “O. Orkin Insect Zoo” “This exhibit was made possible through a generous donation from Orkin Pest Control.”

From where you are standing, the Zoo extends forward 25 yards. This hallway has displays on either side for the first 15 yards. At that point, the displays on the left side wrap around a corner and the right end OF a life-size model of an African termite mound. Walking past the termite mound, you will reach a large open area with sets of windows that look over the National Mall to the south (straight ahead) and west (to the right) with displays in the far right corner and along the left side. If instead of walking straight from the termite mound you were to turn the left, the displays continue on your left and on the opposite side for about 6 yards. From there is another hallway to the left, the Rainforest section of the insect zoo, and straight ahead is the Zoo exit to the butterfly pavilion. The Rainforest exhibit is about 16 yards long and exits into the Ancient Egypt exhibit, to your left.

In the open space ahead, volunteers may have insect and arachnid carts out, and tarantula feedings occur three times a day - weekdays at 10:30, 11:30 and 1:30 and weekends at 11:30, 12:30 and 1:30. Be aware that this area can get crowded, particularly during the feedings, and that the carts and a couple low stools may be place in different locations throughout that space. You can visit the carts or feedings at any point during your visit – they are covered in Section 15.

Most of the Zoo has dark blue-green walls that reach up about 9 feet where the top edge is cut in contours like the silhouette of forest tree tops against a background of mottled colors that reach up and end one foot below the ceiling, 13 feet above. Many sections have a short, sloped ledge that extends forward from the wall about 10 inches, at about 2 feet from the ground.

To reach the first section, walk through the opening in front of you and turn to your right.

Section 1: The Amazing Arthropods

The Amazing Arthropods Core Track

This section of the Insect Zoo is about 14 feet across, with two side walls angling in to meet a center wall parallel to the hallway. On the left wall, inset circles of various sizes containing preserved arthropods or written facts cluster around the introduction text like bubbles and continue across to the top of the center wall, above a labeled grasshopper diagram and an interactive display. The right wall has five display cases that extend out slightly, each with an enclosure containing an example of the different major classes of arthropods.

This section introduces the Insect Zoo: Think of lobsters, spiders, beetles, centipedes, and millipedes. They all look different, but their bodies are built the same way, with segments that are fused together. They all belong to the same group of animals – arthropods. Over millions of years, arthropods have managed to flourish everywhere from icy oceans to tropical rainforests, hot deserts to freshwater ponds.

For nearly 475 million years, arthropods have evolved into different groups known as "classes." On the right-side wall, five tall display cases stand next to each other and extend forward a few inches. Each features a different class, with a live arthropod enclosure and a list of characteristics, including the number of body segments, antennae and legs. The species in each enclosure may change but will be from the same class.

From left to right the displays feature:

- Class Diplopoda [dip-low-PO-da] – Millipedes, with a wormlike, cylindrical body and many segments, 1 pair of antennae, and many legs, 2 pairs on most segments
- Class Crustacea [crus-TAY-sheea] – including sowbugs, crabs and barnacles, with 2 body regions, a front cephalothorax [SEF-a-low-THO-rax] (a fused head and thorax) and an abdomen, 2 pairs of antennae, and 5 or more pairs of legs
- Class Insecta [in-SEC-ta] – Insects, with 3 body regions: head, thorax, and abdomen, 1 pair of antennae, Usually 1-2 pairs of wings (sometimes none), and 3 pairs of legs
- Class Chilopoda [ki-law-PO-da] – Centipedes, with a wormlike, flattened body with many segments, 1 pair of antennae, and many legs, 1 pair on most body segments
- Class Arachnida [a-rack-NI-da] – including spiders and scorpions, with either a single body segment or both a cephalothorax and an abdomen; no antennae, and 4 pairs of legs

The center wall, on the left side, has a diagram of a grasshopper, its body segments separated like a cut apart illustration. The top of the diagram starts around 5 feet off the ground, and is faintly tactile, so you may be able to feel it–it is slightly raised and has a tackier texture than the rest of the wall. The labeled body parts are:

- **Exoskeleton**. The arthropod's shell-like "skeleton" found on the outside of the body, moved by internal muscles.

- **Antennae**. The primary sense organs used to touch, smell, and feel vibrations.
- **Head**. The front segment, with the antennae, eyes, mouth, and "brain" - a bundle of nerve cells
- **Thorax**. The middle segment that powers the arthropod, with all the leg and wing muscles
- **Abdomen.** The last segment, with reproductive and digestive organs, oxygen supplying spiracles and some sensory organs

To the right of the diagram is an interactive display about bilateral symmetry. Two short inset windows are set at about 3 feet off the floor. Below are raised arrows pointing right, over knobs. The windows show the left half of an illustrated insect – a butterfly (on the left) and a beetle (on the right), with their heads at the top and abdomens pointing down. Moving the knob to the right swings a mirror to meet the edge of the illustration, making the image look "complete" with matching left and right sides.

In the left wall, inset circles have lights that flicker on and off to illuminate the specimens inside, which include:

- A large yellow moth – with a furry body the size and shape of an adult's thumb, about 45 millimeters tall, with two pairs of wings that extend out, spanning 13 centimeters across and 15 centimeters tall from top to bottom
- A brown millipede, its 1.5-centimeter-wide body curled into a spiral 6.5 centimeters across.
- A shiny green beetle, its body just over 3 centimeters long, with frog-like back legs almost as long as the rest of body.

The next section is directly across the hall, along a single wall. Turn to face the opposite direction and walk across about 10 feet.

The Amazing Arthropods Detailed Descriptions

Inset circles with specimens

These circles range in size from 8.5 centimeters to over 30 centimeters across, with 2-6 preserved arthropods in each. Lights that flicker on and off illuminate the contents, which include:

- A large yellow moth – with a furry body, 45 millimeters tall, the size and shape of an adult's thumb, with two large pairs of wings that spread out on either side. The front wings extend up about 6 centimeters, with the tips 13 centimeters apart. The hind wings extend down about 5 centimeters to where a narrow "tail," about 6 centimeters long, sweeps down and to the side. Each wing has a brown circular eyespot.

- A brown millipede curled into a spiral 6 centimeters wide – its tube-shaped body about 1.5 centimeters wide, covered with narrow overlapping rings of a shiny chitin. Small curved legs line the lower edge of the body like a short fringe. The millipede curls around itself two times, with the legs on the inside "edge" of the spiral.

- A jewel-green beetle, its body from head to the end of its abdomen a little over 3 centimeters long, and 2 centimeters at the widest. Three pairs of legs extend from under the abdomen – the front two

pairs are thin and point to the front and to the sides, and the back legs are large and frog-like, just half a centimeter shorter than the rest of body.

Grasshopper diagram

A diagram of a grasshopper is found on the left side of the center wall. The grasshopper is separated into various body parts – like someone cut up a yellow and black illustration. The diagram image's texture is faintly textile and you may be able to feel it – it is slightly raised and a tackier texture than the wall behind it. It starts at the left edge of the wall and sits between 3.5 to 5 feet off the ground. The main body segments, the head, thorax and abdomen, are separated and lined up at a diagonal, with the head near the top right and the abdomen at the bottom left. The body is surrounded by appendages – antenna, legs and wings.

The antennae are at the top right, about 3 centimeters apart at their bases and curved outward. They are about 11 centimeters long, with many small segments, giving the appearance of strings of tiny beads, wider at the bottom and narrowing at the top.

Below and to the left on the diagonal is the head, almost 3 centimeters long and 3.5 centimeters at the widest. It is shaped roughly like a rounded pentagon with the "point" facing toward the antenna, and the bottom section curved inwards where it would meet the thorax. The black eyes, shaped like beans, cap the top "corners" of the pentagon, and along the midline there are symmetrical black markings.

Behind the head on the diagonal is the thorax. Its shaped like a rounded rectangle, slightly wider than the back of the head, 4 centimeters across, and a little more than twice that in length. There are black symmetrical markings. A wing, a narrow oblong nearly 20 centimeters long and 3 centimeters at its widest, is attached on the right side near the front, and is folded back, covering the right edge of the thorax and extending back and out slightly between the back leg and abdomen. The wing has veins crisscrossing like a net. The left side wings are spread and separated, placed off to the left of the thorax and past the legs, stretched out perpendicular to the body. The top wing is a long, narrow oblong, much like the folded wing to the right. The bottom wing is nearly as long and shaped like a very rounded right triangle – with a nearly right angle where the wing would meet the body, just behind the front wing. Six jointed legs surround the thorax, three stretching out on either side, yellow with black marks. The front two pairs are similar sizes, about 8 centimeters long, the front bent to the side and then forward and the middle pair bent to the side and then back, while the last pair is broader and slightly more than twice as long than the other pairs, and reaches back and out at a diagonal in a straight line.

Behind the thorax on the diagonal is the abdomen, stretched out between the back legs and wings. It is slightly longer than the head and thorax put together, about 15 centimeters. Its base is about the same width as the thorax and it narrows to a rounded point and has many segments.

Bilateral symmetry interactive display

The bilateral symmetry display has two inset square windows with knobs below them, at about 2 feet off the floor; raised arrows just above the knobs point right. Behind each window is an illustration of the left half of a butterfly (on the left) and a beetle (on the right), with their heads at the top and abdomens pointing down. The knob below each can be moved to the right to swing a mirror to meet right edge of the illustration, making the image look "complete" with both a left and right side.

The Amazing Arthropods Exhibit Text

O. Orkin Insect Zoo

There are more insects in more places on the planet than any other living creatures!

Although they outnumber us 200 million to one, insects rarely harm humans beyond the occasional bee sting or mosquito bite. In many cases they even benefit us.

Come learn how, over millions of years, insects have managed to flourish everywhere from icy oceans to tropical rainforests, hot deserts to freshwater ponds.

Quote

Insects won't inherit the Earth- they own it now.

Thomas Eisner, Entomologist

Callouts

- It takes about a million **ants** to make 1 kg (2 lb.).
- The **midge** can move its wings more than 1,000 beats per second.
- **Bugs** are particular kinds of insects. In other words, all bugs are insects—but not all insects are bugs.
- The **Borneo walkingstick** (family Phasmidae [FAZ-mi-dee]) has a wingspan of 33 cm (13 in.).
- The world's heaviest insect is the **Goliath beetle** (family Scarabaeidae [scare-ah-BEE-i-dee]) of West Africa, which weighs about 115 g (4 oz).

The Amazing Arthropods

Think of lobsters, spiders, beetles, centipedes, and millipedes. They all look different, but their bodies are built the same way. Believe it or not, they all belong to the same group of animals—**arthropods**, from the Latin, *arthropoda* [ar-thro-PO-da], meaning "jointed legs." More than 90% of earth's animals are arthropods.

Grasshopper diagram labels

Arthropod bodies are made up of **segments** that are fused together. Just like us, the left and right sides of their bodies match, which means that they are **bilaterally symmetrical**.

- **Antennae**. The primary sense organs, used to touch, smell, and feel vibrations. For some insects, antennae act in place of eyes.
- **Head**. Contains the arthropod's eyes, mouth, and "brain"-actually a bundle of nerve cells that directs the insect's actions.
- **Thorax**. Powers the arthropod; all leg and wing muscles are found here.

- **Exoskeleton**. The arthropod “skeleton”-a shell-like body wall found on the outside of the body and moved by internal muscles.
- **Abdomen**. Contains the reproductive and digestive organs, oxygen supplying spiracles and sensory organs, such as cerci.

Interactive display

Bilateral symmetry—having matching left and right sides of the body—has benefits. It promotes forward movement. The head’s sensory organs, the eyes and antennae, meet the world first.

Move handle to make me whole.

…475 Million Years on Earth

For nearly 475 million years—about 470 million years longer than humans have been around—arthropods have met the challenges of a changing earth by evolving into different groups, called **classes**. Insects are a class of arthropod.

Class Diplopoda [dip-low-PO-da]

Millipedes are arthropods with…

- many legs, 2 pairs on most body segments
- a wormlike, cylindrical body with many segments
- 1 pair of antennae

Class Crustacea [crus-TAY-sheea]

Sowbugs, crayfish, lobsters, crabs, and **barnacles** are arthropods with…

- 10 or more legs in pairs
- 2 body regions: **abdomen** and **cephalothorax** [SEF-a-low-THO-rax]
- 2 pairs of antennae

Class Insecta [in-SEC-ta]

Insects are arthropods with…

- 6 legs, in pairs
- 3 body regions: the head, thorax, and abdomen
- Usually 1-2 pairs of wings (sometimes none)
- 1 pair of antennae

Class Chilopoda [ki-lo-PO-da]

Centipedes are arthropods with…

- many legs, 1 pair on most body segments
- a wormlike, flattened body with many segments
- 1 pair of antennae

Class Arachnida [a-rack-NI-da]

Spiders, scorpions, ticks, and **mites** are arthropods with…

- 8 legs in 4 pairs
- 1-2 body regions: if 2, the front (head and thorax) is called the **cephalothorax**, and the back is called the **abdomen**
- No antennae

Section 2: 300 Million Years Ago

300 Million Years Ago Core Track

This section of the Insect Zoo is a 15-foot span of wall, with a 6-foot-wide inset window showing a diorama of a prehistoric swamp scene. A ledge along the window has a labeled diagram of the diorama and a piece of amber. On the wall to the right, illustrations of hundreds of arthropods sweep up from a point near the ground, starting as a narrow stream of tiny drawings and widening in a "s" shape with an extra curve back at the top, with larger and larger drawings. Midway up the illustration is an inset video screen.

This section focuses on the early history of arthropods, which arose over 450 million years ago. They became the dominant life form in the Carboniferous [car-BON-if-er-uhs] period, about 300 million years ago, when the earth's climate was warm and humid. Arthropods are still the major life form today, accounting for more than 90% of all animals on earth. There may be more than 30 million insect species.

The diorama depicts a Carboniferous swamp at actual size. The walls around the diorama are painted with trees and small rises of land – and a lizard-like Pelycosaur [PEL-uh-ca-soar] reptile, with a ridged sail on its back.

The center area models a patch of water surrounded by fallen logs, plants and animals. Several arthropods can be found, including a 30-centimeter-long dragonfly-like insect – about as long as an adult's forearm, wrist to elbow, and a light brown centipede, about 4 centimeters long.

Below, a 3-centimeter-wide piece of amber is displayed in the ledge. The translucent material glows orange from the light above. A termite is visible in the amber – the dark body is curved down in a "c" shape, and two pairs of overlapping wings fan out behind. Amber is hardened tree resin, which can trap and preserve soft-bodied insects like this 22-million-year-old termite, and help scientists investigate insect history.

To the right a screen plays a video about how insects evolved on earth; narration plays from speakers at the bottom of the screen.

The next section is to the right along this wall. Walk a few feet to the right to where the wall angles inward.

300 Million Years Ago Detailed Descriptions

Diorama

The diorama depicts a scene of a Carboniferous [car-BON-if-er-uhs] swamp from 300 million years ago, at actual size. The window is 6 feet wide, 4 feet tall and 3 feet off the ground. Inside, the walls surrounding the diorama are painted as a background, and the center area has models of trees, animals and water. The background shows a mostly flat expanse, with still, murky green water stretching back between small rises of land and somewhat odd "trees"- these trees have narrow trunks like palm trees, and the long leaves at the top of the tree growing upwards in a cluster that narrows to the top – almost like the shape of a flower bud before it opens. Small plants and fallen logs also sit on the ground. In the

distance on the right, is a lizard-like Pelycosaur [PEL-uh-ca-soar] reptile, a bulky green-grey creature that has a tall, thin crest along its back with vertical ridges, resembling a paper fan.

The foreground models portray a patch of water surrounded by trees, plants and fallen logs. A large dragonfly-like insect, about as long as an adult's forearm, wrist to elbow, stands on a fallen log with exposed roots sits in the middle of the water/ It has a black body, red abdomen and grey wings with black bands. To the right, a log lays at the edge of the water, with a yellow a snake-like Aistopod [ay-EST-o-pod] Amphibian gliding up from the water and over the log. Fern-like plants grow all around, with a few plants with a single vertical stem, with circular leaf-like structures growing out perpendicular to the stem every few inches, like flat plates on a skewer. On the back bank, a red spider about 9 centimeters long crawls over fallen branches. Tree trunks stretch up from the ground, one on the right edge of the diorama and two on the left. On the left most trunk, a 12-centimeter-long green katydid-like insect clings facing down, its light green forewings folded over its body. A large brown cockroach sits between the roots of the center tree. A light brown centipede, about 4 centimeters long, is on the tree to the right – its segmented body is only about a wide as a pencil, with rows of long jointed legs that extend out to either side, making its "footprint" almost as wide as it is long. Two grasshopper-like insects sit toward the back, one on a fern and one on a log. They are brown, about 8 centimeters long, and their wings are stretched out to the left and right of, with a wingspan about as long as the length.

Amber fossil

A 3-centimeter-long piece of amber containing a termite fossil is displayed through a window in the ledge. The amber is oblong, wider at the left side than the right, and is lit from above making the translucent material glow with yellows and oranges. A termite is visible in the amber – the dark body, blocking the light, is shaped like a "c" with the points downward. Legs curl below, and above near the center, four wings fan out behind the insect – each is slightly longer than body itself. The wings are thin and let most of the light pass through, appearing much lighter than the body.

Insect evolution video

Text: How did insects evolve on Earth?

A line drawing of an insect appears at the center of the screen. It has three segments – head, thorax and abdomen. It is vertical with its head pointing to the top of the screen. The head is a rounded triangle with the point facing forward, with eyes on the far sides and two antennae reaching forward. Below the head is the thorax, a rounded rectangle, just about as wide as the head, with horizontal lines separating it into three segments of roughly the same size. It has three pairs of jointed legs, one pair extending to the sides from each segment. Behind the thorax is the abdomen, which is oval in shape and has nine segments; the first segment after the abdomen narrows slightly, and then the others curve out and then in to form an oval a bit broader than thorax, ending in a rounded point.

Text: The earliest insect fossils date back 350 million years.

At the bottom of the screen a colored illustration appears of the same insect. The insect is a brownish green and stands facing to the right.

Text: They show us a wingless, earth-bound creature.

The illustrated insect rotates to angle forward partway, and then again to face straight forward.

Text: Some scientists think that their first adaptation for survival came when plants began to compete with one another for exposure to the sun, sprouting taller and taller.

The line drawing disappears.

Text: In a process that took millions of years, the thoraxes of some insects sprouted fixed planes that extended outward.

The insect rotates to face forward and to the left in a diagonal. Short plates appear on the top side of the insect's thorax, extending to either side with rounded edges that reach just past the edge of the thorax.

Text: Eventually, these planes developed muscles.

The insect rotates to face left. The plates on the thorax flap up and down.

Text: They became capable of controlling direction. Ultimately, they gained the ability to flap. This made them most efficient fliers.

Another line drawing of an insect appears in the center, and the illustration disappears. The line drawing is similar to the first, with the addition of wings that extend straight out to the side from each segment of the thorax, each attached about halfway between the center of the thorax and the edge. The top pair is a rounded triangle shape, with the front edge angling out and slightly forwards, and each extend out a little more than twice as wide as the insect itself. The middle pair is shorter, with the front edge at a horizontal, with the back edge curved. The last pair are small buds, just barely reaching past the side of the thorax.

Text: Winged insect first appeared about 300 million years ago, scientists believe. The earliest flying insects had three sets of wings - - one for each thoracic segment.

The insect line drawing's wings are now longer – the front pair are each a bit more than three times the width of the insect, the middle pair over twice the width, and the last pair almost twice the width.

Text: But the first set dropped out as the second and third became more highly developed, gaining joints at their bases.

The insect line drawing now has two pairs of long wings.

Text: It was the emergence of these joints that first allowed insects to fold in their wings.

The wings on the drawing angle downwards slightly, and then fold down over the body, overlapping slightly at the center.

Text: This was a tremendous event in their evolution, since flying insects could now insinuate themselves into spaces much smaller than their wingspan.

A colored illustration of a dragonfly-like insect appears at the bottom of the screen, facing left. It has a rounded head, oval from the side. Behind it is the thorax, a rounded shape, with two pairs of nearly clear wings. The wings are long and rounded at the tips, held straight up over the body and tilted back slightly. Pairs of jointed legs reach out and down, at the front, middle and back of the thorax. The segmented abdomen behind the thorax is narrow and curves up at the end.

Text: Dragonflies, for example, once had wingspans of two feet.

The illustration rotates, first facing forward and to the left, and then straight forward. Both the illustration and the line drawing are replaced by a line drawing of a dragonfly. Its head is dominated by a pair of eyes that meet in the middle, with just a small part of the head extending past them. On the thorax behind are two pairs of wings, long and with many dark veins crisscrossing like netting with some thicker horizontal lines. There are three pairs of legs, and the last two pairs are partially obscured by the wings. The narrow, segmented abdomen stretches down past the edge of the screen.

Text: But decreasing size seems to have been a key factor in promoting the survival of successful insect species.

The dragonfly illustration disappears and is replaced by a line drawing of a housefly, much shorter than the dragonfly. It has a rounded head with two eyes on either side separated by a narrow gap. The thorax behind it has three broad segments. Membranous wings are attached at the outer edge of the second segment. They are narrow and flare out in an elongated teardrop shape and are folded back and to the side, covering the sides of the thorax and abdomen behind. There are three pairs of legs, one extending forward and the others extending backward, partly covered by the wings. The segmented abdomen is a short oval shape. A small animated fly flies up from the bottom center, flits around the screen and exits to the left.

300 Million Years Ago Exhibit Text

Life in the Swamp, 300 Million Years Ago

What was life like in the really old days? Arthropods became the dominant life form in the Carboniferous [car-BON-if-er-uhs] period, about 300 million years ago, when lowland swamps covered much of the earth's land surface. The warm, humid climate of these vast swamps permitted luxuriant plant growth, which in turn supported a variety of animal life.

Diorama diagram labels

Katydid-like Insect

Dragonfly-like Insect

Lizard-like Pelycosaur [PEL-uh-ca-soar] Reptile

Spider

Grasshopper-like Insect

Dragonfly-like Insect

Snake-like Aistopod [ay-EST-o-pod] Amphibian

Cockroach

Scorpion

Centipede

Giants from the Past

Three hundred million years ago, Carboniferous swamps swarmed with arthropods, shown above at actual size. Today arthropods are still the major life form, accounting for more than 90 percent of all the animals on Earth.

Sealed in Time

Why is it so hard to study insect evolution? Because, for the most part, insects are soft-bodied, and they decay rapidly when they die, leaving few clues about their anatomy.

However, there is a natural preservative that helps scientists investigate insect history—amber, or fossilized tree resin. The fate of insects trapped in the sticky resin is literally sealed when it hardens into amber.

Specimen Label

This fossil **termite** (family Mastotermitidae [mas-tow-ter-MI-ti-dee]) has been trapped in amber for 22 million years. By studying it, scientists have been able to glean many clues to an understanding of the past geographic distribution of termite species.

Quote

Whence we see spiders, flies, or ants entombed and preserved forever in amber, a more than royal tomb.

-Francis Bacon, *Historia Vitae et Mortis*

While there is only one human species today,

there may be more than **30 million insect species**!

Scientists define a species as a group or population of individuals that can breed in nature and produce fertile offspring. Every species has a unique set of characteristics that it develops over time. This means that arthropods have had more than 450 million years since the group arose to undergo mutations—the tiny changes that can result in new kinds of individuals and, eventually, new species.

Video captions

How did insects evolve on Earth?

The earliest insect fossils date back 350 million years.

They show us a wingless, earth-bound creature.

Some scientists think that their first adaptation for survival came when plants began to compete with one another for exposure to the sun, sprouting taller and taller.

In a process that took millions of years, the thoraxes of some insects sprouted fixed planes that extended outward.

Eventually, these planes developed muscles.

They became capable of controlling direction.

Ultimately, they gained the ability to flap.

This made them most efficient fliers.

Winged insect first appeared about 300 million years ago, scientists believe.

The earliest flying insects had three sets of wings -- one for each thoracic segment.

But the first set dropped out as the second and third became more highly developed, gaining joints at their bases.

It was the emergence of these joints that first allowed insects to fold in their wings. This was a tremendous event in their evolution, since flying insects could now insinuate themselves into spaces much smaller than their wingspan.

Dragonflies, for example, once had wingspans of two feet.

But decreasing size seems to have been a key factor in promoting the survival of successful insect species.

Section 3: Thriving Through Change

Thriving Through Change Core Track

This section of the Insect Zoo is 14 feet wide, with two side walls angling in to meet a center wall parallel to the hallway. A ledge runs along all three walls. The left wall has four large, touchable sculptures of insect heads. The center wall has two enclosures, photos and a video. The right wall has a large grey drawing of a cricket, 4 feet across, and large photographs.

This section explores some adaptations that have been key to insects' evolutionary success: high reproductive rates, short generation times, and specialized ways of eating, seeing, flying, and growing up.

Insects have adapted to eating different diets, with the same mouthparts modified in different species. On left wall at different heights are four clay-red sculptures of enlarged insect heads with purple mouthparts, set against a rough rectangle. You can touch the sculptures to feel the head and mouthparts. Below each is a cartoon of the insect with tools for mouths.

The leftmost sculpture, a foot above the ledge, is a grasshopper, with basic chewing mouthparts that grind food. On the sculpture, the mouthparts are rounded plates at the bottom front of the head, with finger-like appendages on either side. The cartoon grasshopper has a plier wrench for a head.

Four inches to the right and a foot higher up is the next sculpture - a mosquito. It uses needle-tipped tubes to pierce plants and animals and suck out juice and blood. The round head has a long straight tube reaching down from the bottom center, with two finger-like appendages and a grooved ribbon-like structure behind the tube. The cartoon mosquito has a syringe for a body.

Four inches to the right and 1.5 feet higher up is the next sculpture - a fly. Their mouths have scrapers for food and sponges for liquid. The head is like three overlapping spheres – the smooth sphere at top with two bumpy spheres, the compound eyes, pressed into the side. From the bottom, the mouth, a s a stout tube reaches down. Midway along the length of the tube, two thin appendages extend forward. The cartoon fly has a sponge for a mouth.

Four inches to the right and starting lower, 1.5 feet above the ledge, is the last sculpture - a butterfly. It sips nectar with a long tube, which on the sculpture reaches down and curls into a spiral. The cartoon butterfly has a straw for a mouth.

Insects also have specialized ways of growing up – most go through either complete or incomplete metamorphosis. Complete metamorphosis has distinct stages from egg to larva, to pupa, to adult. In incomplete metamorphosis, the egg becomes a nymph, which grows into an adult more gradually.

The center wall has two enclosures; the ledge below has photos of each life stage and a video showing a swallowtail caterpillar becoming a butterfly.

The enclosure on the left contains Tobacco Hornworms, an example of complete metamorphosis. The enclosure has small plants growing in dirt. Eggs and the larvae, green caterpillars with thin red horns at one end, are found on the leaves. The pupae, glossy brown leathery capsules, are on the ground. The adults, mottled brown and grey moths, may be on the ground or on plants.

The enclosure on the right contains White-Spotted assassin bugs, an example of incomplete metamorphosis. The enclosure has a split log and plants. The adults are black insects, about 3 centimeters long, with a pair of white spots on their backs and a yellow band on their legs. The smaller nymphs are wingless with red, oval bodies and a wide stripe of yellow on their legs. The adults and larger nymphs are often on the log, while the smallest nymphs are usually on the ground and in the plants.

The wall to the right has examples of sensory adaptations and flight. On the left are photos - a dragonfly with a huge compound eye, a katydid with thin antennae three times its body length - and a katydid diagram showing the structures that make and sense sounds. On the right is a photo of a pair of mating dragonflies, bodies contorted into an outline of a heart, and a photo and specimen of a blowfly, which can fly 300 times its body length in a second.

The next section is across the hall. Turn to face the opposite direction and walk across about 13 feet.

Thriving Through Change Detailed Descriptions

Insect head sculptures

On the left wall, four enlarged insect head sculptures are set on roughly textured rectangle backgrounds, clay-red in color with the mouthparts painted purple. Below each sculpture on the ledge is a cartoon of the insect with the mouthparts replaced by tools with similar functions.

The first insect head on the left is a grasshopper. The sculpture starts about a foot off the ledge. The head is a boxy oval shape, 13 centimeters wide and 22 centimeters tall, with large round eyes capping the top corners. A pair of nearly 40-centimeter-long jointed antenna extend upwards from a few centimeters below the top of the head, just to the inside edges of the eyes, curving back and reaching up. Three round ocelli, simple eyes, are set in a triangle in the area between the antennae. The mouthparts fill the lower quarter of the head – if you feel down from the top edge of the head, you will feel a slight dip about 8 centimeters from the top, where the top plate of the head ends. About 10 centimeters below will be a larger dip, where a broad plate extends down – this is the top of the mouthparts. Rounded plates, shaped like blunt shovels, extend down toward the floor and curve in toward the wall. A bit lower on either side, a long, fingerlike appendage curls down and inward, almost touching. The drawing on the ledge is red with black outlines, and shows a grasshopper facing to the left with its head replaced with the head of a plier wrench, the grooved gripping surfaces slightly open where the mouth would be, a bolt in the place of the eye, and insect-like antenna reaching up from above the “eye” bolt.

The second insect, to the right, is a mosquito. The sculpture starts about 2 feet above the ledge. The head 15 centimeters across, shaped like three overlapping spheres – a smooth sphere at top with two spheres covered with tightly clustered raised dots pressed into the side. These are the eyes, which meet at the midline and filling the lower two thirds of the head. From the bottom, the mouth, a s a stout tube reaches down. Just below the center front of the head are the segmented antenna, which reach down and out from a connected pair of rounded socket-like structures. The mouthparts start just below. At the center is a bulb-like structure from which a long, narrow needle reaches down 30 centimeters. Where the bulb meets the needle, a structure shaped like a ribbon folded the long way into a V shape surrounds the needle where it meets the bulb – this “ribbon” extends down, curving out to the right and

then back again to wrap around the needle again near the end. On the far sides of the bulb, finger-like appendages extend down and out in a V shape, about a quarter the length of the needle. The drawing on the ledge is orange with black outlines and shows a mosquito with a cylindrical syringe for a body, with the needle pointing left. At the point where the barrel meets the needle, a pair of antenna curve up just in front of an eye. Behind it, three pairs of legs extend along the barrel. At the top of the barrel, midway down, long, narrow membranous wings are folded together, raised slightly and reaching back over the plunger of the syringe.

The third insect is a fly. The sculpture starts 3.5 feet above the ledge. The globe-like head is 20 centimeters wide and has large eyes covering the top side "corners" with tightly pack rows of raised dots. The center front of the head has an indent in the shape of a triangle pointed upwards. Branched antennae extend from the top of this indent: a pair of fat tubes droop downwards, and just below the base of each, a thin needle-like structure extends down and out, just inside and parallel to the edges of the triangular indent. The mouthparts extend downward from the bottom center of the head. A wide tube extends down 11 centimeters, flaring out at the bottom. About half-way down this tube two side-by-side finger-like structures extend forward. On the ledge, the drawing, light green with black outlines, shows a house fly with a sponge for a mouth – a tube extends from the head and ends in a large round, craggy sponge.

The rightmost insect is a butterfly. The sculpture starts about 1.5 feet above the ledge. The head is shaped like a horizontal oval pill 12 centimeters wide and 8 centimeters tall, with a broad, furry-looking band wrapping around the center from top to bottom. The eyes cover the sides of the "pill" in a tight grid of small indents. Straight, narrow antennae reach up in a V from the top of the head, about 30 centimeters long. The mouthparts start at the bottom center of the head. A wrinkled blub sits at the center, with two small bumps just below on either side. A long, narrow tube extends down from the bulb 20 centimeters before spiraling up to the right. On the ledge, the drawing, yellow with black outlines, shows a butterfly with a straw for a mouth – the front of the head meets the top of a striped, bent straw pointing down.

Tobacco hornworms enclosure

The enclosure on the left contains Tobacco Hornworms. The bottom of the enclosure is covered in dirt, with several short plants, usually tomato plants. On the leaves you might find the eggs, small, light green spheres, about 1.5 millimeters across. The larvae are smooth green caterpillars, with black and white markings and a thin red horn on one end. These can be found on the plants in a range of sizes, the smallest just 2 millimeters, the longest 6 centimeters. These may be found sitting still, or walking in an inchworm like undulation, or eating. The pupae can be found on the ground, glossy brown leathery capsules, about 4 centimeters long and 1.5 centimeter wide that narrow to a point at one end, and at the other end have a rounded cap, with a narrow tube that reaches up and then loops back down to meet the tube about a quarter of the way down, a little like a handle. The outside of the pupa has grooves and indents that resemble the body parts and segments of the adults. These pupae may occasionally move, twitching the narrower segmented abdomen section back and forth. The adult moths may be found on the stems or on the ground. Their bodies are narrow ovals about 4 centimeters long, covered in tiny scales that giving them a furry appearance. They have a short round head, and behind it the thorax broadens out slightly. Two pairs of wings are attached to the thorax. The wings are narrow, rounded triangles. When the moth is at rest, the wings are often held open flat along back and

out to sides of the body, together looking like a broad triangle pointed forward, and covering part of the thorax and abdomen, which narrows to a rounded point. The moths are mostly covered in mottled brown and white markings, though two rows of yellowish orange spots along either side of the abdomen may peek out from under the wings. The adults are nocturnal and are rarely seen flying during the museum's open hours but may occasionally be found hovering like hummingbirds over the flowers and extending their long proboscis down to feed.

White-spotted assassin bugs enclosure

In the enclosure on the right, a split log is set on the ground, flat side facing the glass, with plants on the right and behind. The adult White-spotted assassin bugs can be found throughout the enclosure, black insects about 3 centimeters long – with bodies shaped a little like a violin, with a small diamond shaped head in the place of the violin's neck, with round eyes capping the side corners. The mouthparts, a curved proboscis, extend slightly forward from the front point and then curve down and under - from the side, it looks like the front of the head has been stretched like putty and looped below the head. Behind the head is a broader thorax – the top bulge of the violin. Black wings extend from the thorax, folded back and covering the abdomen, forming the larger bulge of the violin. Each wing has a white dot, just past the thorax. They have three pairs of long, thin legs that extend out, black with a yellow stripe around part of the first segment that extends out from under the insect. The nymphs can be found nearly everywhere – their bodies are more oblong, with a narrow black head, short black thorax and reddish flattened oval abdomen. On each of the three pairs of legs, the long section extending past the body is a bright yellow, with the farther segments being black. The nymphs range in size from a few millimeters to 2.5 centimeters, and the smallest are brighter red. Eggs may be found on the ground, shiny brown cylinders the size of sesame seeds. You may also see small brown crickets in the enclosure – standing on the log, running on the ground, or being captured or eaten by one of the assassin bugs. Parts of dead crickets litter the ground. On the ledge are labeled photographs of each life stage.

Video: Swallowtail caterpillar becoming a butterfly

In the ledge below the enclosures is a screen showing a minute-long looping video with several life stages of a swallowtail caterpillar becoming a butterfly. A round egg is attached to a thin green stem and from inside a small shiny black head is chewing a hole in the egg. The larva emerges, revealing a spiky, brownish body with yellow spots. Next, a larger caterpillar with a plump body, bright yellow with black stripes and spots, devours a stem. Then a pupating caterpillar, looking like a scrunched-up tube, hangs below a tilted stem, braced by a loop of silk anchored to the stem. The black and yellow skin-like exoskeleton sloughs off revealing a yellowish-green exoskeleton. Later the pupa has darkened to a mottled brown. Later the pupa pulses as cracks at the top spread. A fuzzy black and yellow body with crumpled wings climbs out. Later the butterfly hangs upside down with flattened wings, mostly bright yellow framed by black veins and a row of blue spots near the edge of the hind wing.

Senses and flight images

On the left is a large photograph of the front part of a dragonfly, tilted downward. The head is seen in profile near the center of the right side of the image, globe-like, and is dominated by an eye, an oval covering most of the side of the head with a shiny surface. The thorax and abdomen stretch up past the top left corner of the image and are covered in short diagonal black and yellow stripes. The front two pairs of legs, black and yellow with thin spines sticking out, cling to a brown object at the bottom right.

The center a photograph shows a katydid. A green insect faces left, standing on a thin twig reaching up from the bottom right. It resembles a teardrop-shaped leaf on its side – narrow head end facing left, with a pair of long thin antennae reaching out and slightly down, about three times as long as the rest of the body.

On the ledge below is a diagram drawing of a katydid with the front wings folded up and away from the body. A comb-like structure underneath the top of the front wings, just above where it meets the body is identified as the structure that male katydids rub together to make sounds. Small ovals on the second segment of the front legs, just past the "knee" are identified as slits on both males and females that are sensitive to vibrations.

On the wall the rightmost photograph is a pair of mating dragonflies, standing on a blade of grass that reaches across the bottom of the image. At first glance the image looks like a stylized red outline of a heart, on its side with the narrow end pointing left and the rounded end pointing right. One red and black dragonfly stands on the left side of the grass blade, facing left. Its long, narrow abdomen angles up and then curls down, resting on the back of the thorax of another dragonfly. The second dragonfly's abdomen curls down under the body, and then angles up to connect to the underside of the first dragonfly.

Thriving Through Change Exhibit Text

Thriving through change

Why have insects been so successful? A talent for **adaptation**, primarily. The keys to insects' evolutionary success are high reproductive rates; short generation times; and specialized ways of eating, seeing, flying, and growing up.

What a Mouth!

Over the millennia insects have adopted many ingenious eating mechanisms—including tubes, multiple mouthparts, scrapers, and sponges. These specialized tools enable them to flourish on the food available to them in particular environments.

Jaws, Too.

Take a close look at the basic chewing mouthparts of the grasshopper (painted purple). The same mouthparts have been modified in the other insects for liquid diets.

Illustration Labels

Most insects, such as this **grasshopper**, use five different mouthparts to grind their food and move it toward the back of the mouth.

Using needle-tipped tubes, **mosquitoes** pierce the skin of plants and animals to suck out juices and blood.

Houseflies and some other insects use scrapers to dislodge the surface of their food and sponges to collect the draining liquid.

Butterflies and **moths** uncurl long tubes to sip the sweet nectar deep inside flowers.

Why Don't They Just Grow Up?

Insects' relatively speedy passage from birth to adulthood enables them to breed quickly and increase rapidly in number, adapt swiftly to new opportunities, and meet new challenges. Most insects grow up by gradual or complete metamorphosis. In **gradual metamorphosis**, an **egg** becomes a **nymph**, which evolves gradually into an **adult**. Nymphs and adults eat the same foods and live in the same places. In **complete metamorphosis**, an insect progresses through several distinct stages: **egg** to **larva**, to **pupa** to **adult**. Larvae and adults may eat different foods, thus avoiding competition for a single resource.

Complete Metamorphosis

Tobacco Hornworm (*Manduca sexta*) [man-DU-ca SEX-ta] eggs become larvae, that shed their exoskeletons several times before transforming to pupae and, finally, the pupae transform into adults. The larvae and adults not only look very different, but they also have separate sources of food.

Video Label

Watch the **swallowtail** caterpillar become a butterfly. How many stages do you see?

Incomplete Metamorphosis

White-spotted assassin bug (*Platymeris biguttata*) [pla-TEE-mer-is bi-gut-TAH-tah] eggs hatch into small, wingless nymphs that look very similar to grown-up assassin bugs. The nymphs shed their exoskeletons several times before emerging as fully-winged adults. Both nymphs and adults live in the same surroundings and eat the same food.

Quote:

The wide air is full of joyous wings.

– W. C. Bryant.

Hunting for Supper

Insects use their eyes or antennae to find food. Some can smell odors over a great distance; others can detect vibrations and hear sounds that people cannot. These diverse strategies help insects find different foods.

Hunting for Supper photo captions

Dragonflies and other airborne hunters use their large eyes to spot a likely lunch of fly or mosquito.

Plant-eaters that have small eyes, such as this **katydid**, use their long antennae to pick up the scent of food.

Flexible Flyers

The ability to fly is one of the greatest keys to insects' success! Long before birds or bats, insects were the first creatures to fly. Flight gave them new territories to explore, a way to escape danger, and more places to search for food and mates.

Flexible Flyers photo captions

Love on the wing…Mating pairs of **dragonflies** and **damselflies** (order Odonata [OH-du-NA-ta]) stay clasped for several hours and will even fly while joined together.

Male katydids make music with their wings. Each species has its own repertoire of calls for courtship and territorial aggression.

Diagram labels

Male katydids make sounds by rubbing special structures on their front wings together.

Both **male** and **female katydids** have slits on their front legs that are sensitive to vibrations—especially those made by their own kind.

Specimen label

On the go…Cruising at 11 km (7 mi.) per hour, a **blowfly** (family Calliphoridae [cal-LI-for-i-dee]) can cover a distance of 300 times its body length per second.

Interactive pullout

The adults of some insects don't feed at all? Their mouthparts are useless or too reduced to take in food or water.

Section 4: Dealing With Danger

Dealing With Danger Core Track

This section of the Insect Zoo is 9 feet wide, with two side walls angling in to meet a center wall that is parallel to the hallway, with a ledge along the entire section. The center wall has a large image with a button below, flanked by two enclosures. The right-side wall has three enclosures. The left side has a video screen, a photograph, and two displays with preserved specimens.

This section focuses on defenses that insects use against birds and other enemies. Some use sharp spines or foul odors. For many species, their appearance helps them deal with danger. Some use camouflage, escaping notice by looking like parts of their surroundings. Others use bright colors to warn predators they are toxic. Some species mimic the colors or shapes of something toxic or ferocious, whether or not they have those defenses too.

In the center wall, a large pane is set in the middle with a button on the ledge below. It shows an illustrated forest scene, a tree trunk reaching up on the right and grass, bushes and pink flowers growing on the ground. A close look may reveal outlines of camouflaged insects. Pushing the button below light ups parts of the image, revealing a beetle with long antennae and a moth on the trunk, a leaf-like insect hanging in the branches, a long stick-like insect and a katydid in the bushes, and a mantis hiding among the flowers.

The enclosure to the left contains Macleay's [ma-CLAY-s] Spectre walking sticks – they are amazing look-alikes. Its eggs look like seeds, the nymphs resemble venomous ants, and adults are camouflaged as plants. Inside the enclosure is a bundle of branches with green leaves. Hiding among the branches are long insects, in shades of brown and tan. The adult males are thin, 9 centimeters long, and look like long, rolled up dead leaves with mottled brown coloring. The adult females are slightly longer and wider, a lighter brown color and are prickly looking, like rough bark. A clear plastic hatchery with eggs and nymphs is on the ground. The eggs are about the size and shape of a popcorn kernel, with white and brown markings. The smallest nymphs have dark thin bodies with a large red head.

The right-side enclosure contains jungle nymphs, which have spikes and can give off a chemical smell or hiss if threatened. The brown males and larger green females both blend into the branches in the enclosure.

The wall to the right has Eastern Lubber Grasshoppers in the leftmost enclosure. The adults of these large grasshoppers have bright warning colors - mixtures of yellows, oranges and reds with black markings.

The center enclosure contains Milkweed Bugs – their red and black color warns of the toxins stored in their bodies, gained from eating milkweed, pods of which may be found in the enclosure. The adult milkweed bugs are about the size and shape of large sunflower seeds, colored black and reddish orange. The nymphs are more bulbous, colored mostly orange with some black markings.

The rightmost enclosure contains Giant Walking Leaf insects. They are flattened and light green, with leaf-like vein patterns and some symmetrical patches of brownish red.

The left wall has examples of mimicry. You may hear narration from a video screen at the lower left, that shows a bird encountering its first monarch butterfly. A bird that eats a toxin-laden monarch even once is likely to avoid orange-and-black butterflies and other similarly colored insects after that. On the ledge below, an inset display contains two orange and black butterflies – a viceroy and a monarch butterfly.

On the right, an inset box with a sliding lens has pinned specimens, showing how some insects mimic more ferocious bees and wasps. Above, a photo shows a bee on a purple thistle flower.

The next section continues to the left. Follow the wall to the left to where it turns.

Dealing With Danger Detailed Descriptions

We Are Not Here interactive illustration

The center of the wall has a large inset pane, with a button on the ledge below it. It shows an illustration of a forest scene, a tree trunk reaching up on the right and grass and small plants growing on the ground, colored in greens and browns with small pink flowers near the middle. A close look may reveal outlines of camouflaged insects. Pushing the button below light ups up parts of the image, revealing a moth and a longhorn beetle on the trunk, a leaf insect hanging in the branches, a long stick-like insect and a katydid in the bushes, and a mantis hiding among the flowers.

Macleay's [ma-CLAY-s] Spectre enclosure

In the enclosure, a short log holds a bundle of branches with green leaves. Hiding among the branches are long insects in shades of brown and tan. There are two types – some are thin, about 9 centimeters long, looking a bit like dead leaves with mottled brown coloring that are slightly curled and split along the long edge, in a bundle a bit bigger around than a pencil – a close look shows that some of these are long wings stretching back behind a short thorax and pill-shaped head. The three pairs of legs have flattened segments. Other insects are longer, about 11 centimeters long, and fatter and more resemble rough bark, and are generally a lighter tan color. The pill-shaped head has tiny spikes on it, and the thorax has two pairs of tiny shriveled wings, about the size of sunflower seeds. The abdomen has tiny spikes and flattened plates that resemble bark; the abdomen may be resting or curled up like a scorpion. The legs have flattened sections with spikes along the edges. The photos below identify the thinner type as the adult males and the larger type as adult females. Both adults may also be found on the ground or hanging from the ceiling of the enclosure. On the ground in the front is a hatchery - a clear container with two stacked chambers. The lower section has dirt and eggs, which look like small seeds, about the size and shape of small unpopped popcorn kernels, with white and brown markings, and can also be found on the ground of the enclosure. The top chamber may have nymphs, small insects that look like leggy ants.

Jungle nymphs enclosure

A short log in the center holds a bundle of branches with green leaves. Blending into the branches are long, prickly insects. The males are mottled greyish brown and white, with long, thin bodies about 7 centimeters long. Their wings look like strips of decaying leaves laying across their bodies, with a light green stripe on the lower edge. The wings extend back from a short, stick-like thorax, and the jointed legs stick out like thick twigs. The head, legs and thorax are covered in short narrow spines. The females are green, with wider bodies about 13 centimeters long. The body is flattened so that it is broader

across, with a pea-shaped head followed by a broad thorax, about 3 centimeters at the widest. On the thorax are two small green leaf-like wings that lay overlapping slightly. The wings are short, about a quarter the length of the insect, and only overlap a few segments of the abdomen. The sides of the abdomen have a slightly serrated edge. The jointed legs extending out under the thorax look like green stems. All of the body parts except the wings have short, scattered spines – and the spines on the ventral surface are a light blue.

Giant Walking Leaf enclosure

From behind an artificial rock on the ground, branches with broad green leaves reach up. A close look will show that some of the "leaves" are insects- they are generally a lighter green color, and look like veined leaves, with some brown spots along the center spine, and symmetrical crescents or patches of brownish-red on the edges, resembling leaves damaged where they have been torn or chewed. The legs have flattened plates that also look like flat leaves – the insects look like they have been cut out of a leaf. The largest reach 10 centimeters in length. Smaller nymphs can be seen, sometimes clinging to the ceiling. The smallest, a centimeter long, are brown right after hatching, and turn green within a few days.

Eastern Lubber Grasshoppers enclosure

The enclosure has gnarled wood branches set on a pebbled ground, and green plants and lettuce leaves. Large grasshoppers can be found throughout– the adults are colorful, their bodies showing mixtures of yellows, oranges and reds with black markings. They are about 6 centimeters long, generally tube shaped, with a blunt boxy head at one end, and the abdomen tapers at the other end. On the head, two segmented antennae reach up from center of the top front. The antenna is yellow close to the head and black toward the far end. Black oval eyes are on either side. The mouthparts point down, with broad plates covering the bottom section of the head with two pairs of small, fingerlike appendages on either side. Just behind the head, a plate on the thorax wraps down around the sides. The front wings extend from under this plate and fold over the sides of body, covering about a third of it. These are hardened wings, with black vein-like markings. Occasionally, the hindwings peek out, like a folded crepe paper fan, red edged in black. The front two pairs of legs are thin and match the main colors of the body with a row of small black spines. The back legs are longer and broader. The abdomen extends back from the thorax with each segment overlapping a slightly smaller one behind it. In males the abdomen tapers to rounded point, and in females it ends with a set of short trowel-like plates. You may also find the grasshopper nymphs, which look similar except that they are wingless and have black bodies, with a few thin lines of yellow, red or orange.

Milkweed Bugs enclosure

The enclosure has flat chunks of wood on the ground along with short dishes with water. A single-stemmed artificial plant reaches up from the center, with long flat leaves and clusters of small flowers reaching out; there may also be real milkweed seed pods in late summer and early fall. Any of the surfaces may be covered with milkweed bugs. The adults are about 15 millimeters long and shaped like large sunflower seeds, colored black and reddish orange. Thin black antennae reach out from the head at the narrow end of the "seed." From above, there are distinctive black and orange markings. The head is mostly orange red, with black eyes on either side. Behind the head, a plate on the top front of the thorax stretches back about a fifth of length of the body, making a triangle with the head as the front

point. It is black with the sides are edged in orange. Wings extend from underneath the plate at either side and are generally folded back flat over the body and covering the rest of the thorax and all of the abdomen. The wings are black and orange – the top triangles of each wing are orange up to the point where they overlap, and the black of the body below shows between them, giving the appearance of a black triangle pointing back on an orange background. Where the wings start to overlap they are black, looking like a band around the center fifth of the body. Behind this section is another pair of triangles, lined up with their points to the front center. The rest of the wings are black. This species can crawl on glass, in which case the underside can be seen clearly– the underside is mostly orange with black markings. From underneath the three segments of the thorax where each pair of thin black legs extends are also visible.

The nymphs can also be found in the enclosure, similar in shape but smaller, more bulbous and without wings, and colored mostly orange with smaller black dots and markings.

Video of Jay eating a monarch butterfly

Text: This blue jay, which eats *Panthea* moths, has a taste for butterflies, too. But this one has never eaten monarch or viceroy.

A blue jay stands on a piece of wood, tipping its head in different directions before hopping into the evergreen branches behind it.

Text: When presented here with a monarch the naïve jay catches it, dismembers it, and eats it.

A monarch butterfly is shown standing on an evergreen branch. Its body is black with white spots, and two pairs of wings are folded up – orange with black veins, edged in black with white spots. It holds the butterfly down with its feet and picks at it with its beak, before tipping its head up and swallowing the insect.

The jay hops over, captured the butterfly in its beak, then flies back to the piece of wood.

Text: Birds are not born knowing how to hunt - - they have to learn the hard way. After about 12 minutes, the milkweed toxin in the monarch begins to affect the jay.

The jay, standing on the wood, starts twitching and shaking its head around, and patches of feathers fluff out before laying back down. It opens and closes its beak, and the feathers on its throat ripple in and out.

Text: It could make the jay extremely ill. But it contains an emetic, causing the jay to regurgitate before the poison does any real harm.

The jay bends down and quickly rubs either side of its beak on the wood, spits up, and then hops to face away.

Viceroy and Monarch butterfly specimens ledge display

An inset display contains two orange and black butterflies – the viceroy and the monarch butterfly. Both butterflies have black tube-shaped bodies and are posed with their wings spread – the top pair are like rounded right triangles, with the bottom edge stretching straight out, turning upwards and then angling back to meet the body. The bottom wings are shaped like wedges with curved tops. The wings of both

butterflies are mostly orange with thin black lines along the veins of the wings and thick black marks and white spots around the edges of the wings. The viceroy is slightly smaller, a lighter orange color, and has an additional thin black line on the hindwing that follows the same curve as the black marks on the edge.

Bee or Fly, you decide… specimen display

To the right, above the ledge is an inset lit box, about 1.5 feet wide and half a foot tall. A magnifying lens in a square frame is set in front and can slide from side to side. Inside the box are four large circles each with a pair of pinned specimens, labeled with their names.

The leftmost pair is labeled Pepsis [PEP-suhs] wasp and Robber fly – the fly is missing. The wasp is large, body about 2 centimeters long, a reddish-brown color, with long, yellowed membranous wings.

The next pair is labeled Yellow jacket wasp and Syrphid [syr-fid] fly. Both are small, about 1-centimeter-long with dark brown and yellowish stripes, and long, membranous wings. A close look will show that the wasp has a brighter yellow color and slightly different markings, and long antenna that point up and out, while the fly has short, bristly antenna pointed downward, and much larger eyes.

The third pair is labeled Bald-faced Hornet and Syrphid fly. Both have stout bodies, about 1.5 centimeters long, mostly brown with yellow markings at the head, legs and front of the thorax, and narrow membranous wings. A close comparison will note that the hornet has long antenna, while the fly's is almost too small to see. The markings are slightly different, and the hornet is more elongated that the fly. While the hornet's eyes look like shiny ball bearings on either side of the head, the fly's eyes cover most of the head, meeting at the center, and have brown and yellow stripes.

The fourth pair is labeled Bumble bee and Mallota [mal-LOW-tah] fly; the fly is missing. The bumble bee has a broad, furry body, about 2 centimeters long and 1 centimeter wide, mostly yellow with darker markings, and narrow membranous wings.

Honeybee photograph

A square photograph shows a honeybee sitting on purple thistle flowers. Two thistle flowers fill most of the image – a tuft of pinkish-purple petals atop a pale green spiky bulb. A honeybee stands arched on the flower to the right. Its dark head is tilted down to the flower. Behind the head is a brown thorax covered in orange fuzz, with two pairs of membranous wings pointed back and up. The abdomen arches down behind the thorax, and oval with orange and dark brown stripes.

Dealing With Danger Exhibit Text

Dealing with Danger

Surrounded by birds and other enemies, insects summon an impressive range of defensive weapons to protect themselves.

We Are Not Here

Insects with the advantage of **camouflage** are able to escape danger simply by looking like sticks, leaves, or other parts of their surroundings. Some stick mimics are so well camouflaged that they can sit safely in full view of their enemy.

Jungle nymph

Heteropteryx dilatate [HED-er-OP-ter-iks DIL-uh-TAH-tuh]

Southeast Asia

The sharp spines that cover this species' thorax and legs stab any creature trying to capture it. Jungle nymphs also hiss and give off a chemical smell if threatened.

Macleay's [ma-CLAY-s] Spectre

Extatosoma tiaratum [EK-stat-TOH-suh-muh TEE-ar-uh-tum]

Australia

This insect is an amazing look-alike. Ants mistake its eggs for seeds and haul them to safety underground. As nymphs, they resemble venomous ants, so predators stay clear. Adults can sway like a twig in the breeze when threatened.

Here We Are

From bright warning colors to sharp spines to foul odors, some insects advertise to keep their enemy away.

Eastern Lubber Grasshopper

Romalea microptera [ro-MA-lee-a my-CROP-ter-a]

Gulf Coast, United States

Despite its name, these landlubbers are poor jumpers and can't fly. Their bright colors are a warning—predators that eat the grasshopper usually vomit up the spiny creature before their digestive juices begin to work.

Milkweed Bugs

Oncopeltus fasciatus [on-co-PEL-tus fas-si-AY-tus]

United States

These insects store toxins from milkweed plants in their bodies. Their red-and-black coloring warns birds and other predators to steer clear—they taste terrible.

Giant Walking Leaf

Phyllium giganteum [FIL-ee-um JY-gan-TE-um]

Southeast Asia

This insect hides in plain sight because the vein pattern on its wings looks similar to veins on the leaves where it lives.

Who Are We?

Looking or acting like something else to avoid being eaten is a key form of defense for many insects. Several inedible species survive through **Muellerian** [MYU-ler-i-an] **mimicry**—tricking predators by resembling other species that are also distasteful.

Video label

A bird that has tried to eat a toxin-laden monarch just once is likely to avoid orange-and-black butterflies altogether.

Video captions

This blue jay, which eats *Panthea* moths, has a taste for butterflies, too.

But this one has never eaten monarch or viceroy.

When presented here with a monarch the naïve jay catches it, dismembers it, and eats it.

Birds are not born knowing how to hunt - - they have to learn the hard way.

After about 12 minutes, the milkweed toxin in the monarch begins to affect the jay.

It could make the jay extremely ill.

But it contains an emetic, causing the jay to regurgitate before the poison does any real harm.

Look Alikes

With their black and orange wings, **viceroy** (*Limentis archippus* [lim-EE-ni-tis ar-KIP-pus]) and **monarch butterflies** (*Danaus plexippus* [DA-na-us plex-IP-pus]) look amazingly similar, and both usually taste bad. A bird that eats a toxin-laden monarch even once is likely to avoid orange-and-black butterflies and other similarly colored insects after that.

Bee or fly, you decide…

Because they look so much like more ferocious bees and wasps, many insects can go openly about their business on flowers and other exposed plants.

Specimen labels, left to right:

- Pepsis [PEP-suhs] wasp and Robber fly
- Yellow jacket wasp and Syrphid [syr-fid] fly
- Bald-faced Hornet and Syrphid fly
- Bumblebee and Mallota [mal-LOW-tah] fly

Interactive pullout

Playing dead? Some insect species will fake their own death if they are touched.

Section 5: Spider Strategies

Spider Strategies Core Track

This section of the Insect Zoo consists of two sides of an angled corner – a 6 foot wall next to the Dealing with Danger section and a 4 foot wall that extends away to the left.

Both walls have black lines tracing a spiderweb that reaches up, and the top of the wall is cut in the shape of the web's edge. Four enclosures sit in an L shape around the corner. On either side of the enclosures are photos and text.

This section features spiders – carnivorous arthropods that use a diversity of strategies to capture insects. Web-spinning spiders are "sit-and-wait" hunters that spin silken tangles and sheets to capture prey. Active hunters use several strategies to track prey - some rely on vision, others on touch or vibrations, and some use camouflage too.

On the wall on the right are six numbered photographs of spiderwebs – some have strands like spokes on a wheel with a line spiraling out from the center, while others appear more tangled. Some have colored spider outlines or labeled strands. Text below provides details about each web.

The enclosures at the corner feature active hunter spiders, with labels and photos on the ledge below. Behind the smooth front glass on either side of the corner, the four enclosures are separated by clear panes; there is no tactile indication of the divisions.

The right-most enclosure, next to the web photos and spanning 10 inches, contains a Pink-toed Tarantula, a species that often lives in trees. It may be hiding in the foliage, clinging to the sides, or in a silk pocket it has made on the wall, sometimes with just its feet peeking out. It is a dark color, except for the tips of its feet, with are capped with a light pink.

The enclosure at the corner, spanning 12 inches from the Pink-toed enclosure and continuing for 12 inches around the corner, contains a Goliath Birdeater, a giant tarantula that can eat almost any animal smaller than it. The enclosure is covered in a reddish-brown dirt, with a piece of wood. The large tarantula is almost the same color as the ground, with a few lighter markings, and covered with light hairs. Its cephalothorax [SEF-a-low-THO-rax], the front segment that combines the head and thorax, is about 4 centimeters across, and the large, bulbous abdomen is about the size of a pool ball. Its legs extend from the cephalothorax, each about 9 centimeters long.

The next enclosure, spanning 10 inches contains a Mexican Orange-kneed tarantula, black with orange marks, including a dark orange ring around the first knee-like leg joint.

The left-most enclosure, 10 inches wide, contains a Wolf Spider. This spider's body is about 1.5-centimeter-long, with thin legs nearly twice as long as the body. Its body is brown, with a thin, light stripe along the top of its cephalothorax. Its long legs are a lighter sandy brown. It is often hard to find, as it can hide behind the small pieces of wood or rocks in the enclosure and its coloring blends into the sandy ground.

The wall to the left of the enclosures has two large photos. In the top photo, a white spider with small orange spots sits in a cluster of purple flowers with a bumblebee held in its mouth. Below, a colorful

spider stands on a branch, mostly black and white with red and light blue markings, with two pairs of eyes clearly visible.

The next section continues to the left. Follow the wall to the left to where it turns.

Spider Strategies Detailed Descriptions

Numbered spiderwebs photographs

All the webs are white on black backgrounds.

1. A sparse, geometric triangular web set in the fork of a branch. The branch splits near the bottom and reaches up in a V to either side of the image. From the top left a thick thread, highlighted in yellow, extends at a diagonal toward the right bottom for about a centimeter. Just beyond the highlighting stops before splitting into 4 strands that fan out in a triangle – the top strand is near horizontal, connecting to the top of the right branch, and the bottom strand is nearly vertical, reaching down to a tangle of silk near the fork, just below the rightmost branch. Two lines of silk connects these, closing the triangle; the rightmost connecting strand is pulled slightly by the middle two strands from the top left. In each space between the fanned-out strands there are 15 strands running across, parallel each other and very evenly spaced. The thick yellow strand is labeled as the attachment thread, and the strand just past it is labeled “tension thread.” This is a spring trap of the triangle spider.

2. This smaller square photograph shows a messy web with a distinct center. Rough, almost fuzzy looking strands of silk reach in from all sides with irregular spacing. As they approach the center they split and cross to make a disordered tangle that gets denser near the center. The center, however, is a very regular circle of black, as if someone used a cookie-cutter to remove the middle. A strand near the bottom is labeled “hackle band,” and the web is made by a *Kukulcania hibernalis* [ku-KUL-can-ia hi-ber-NAL-is] spider.

3. This web appears to have two parts – a flat, tangled net stretched parallel to the ground, with strands reaching out to the sides and front. Another net is hanging down from the top, the tangled center part forming a bowl-like or hammock shape that almost touches the bottom net, a few short strands connect the two, and a spider is highlighted in yellow between the two, standing upside down from the top net. This is a hammock web of the bowl-and-doily spider.

4. This web has dozens of thin, straight strands reaching from the top and bottom edges, and a sparse tangle of strands going across about a third of the way from the top. Near the bottom some strands have a thicker appearance, and one is labeled “glue droplets.” One strand reaching up at a diagonal from the bottom right corner is labeled “attachment lines.” This is a scaffold web of Steatoda [ste-ah-TOW-da].

5. This web is like the classic spiral web. Strands from each corner connect in a rough square around the edges. From the center, strands radiate out and split, connecting to the strands at the edge, a bit like spokes on a wheel. These are widely spaced with about 20 “spokes.” Starting about a quarter the way up one of the spokes from the center, another strand spirals clockwise around and out, circling the center about eight times with even spacing, at the center a spider is highlighted in yellow. This is a loosely-woven orb web of the ray spider.

6. This web is also like the classic spiral web, with much more tightly woven strands. The “corners” of the web connect to the edge of the image in nine spots. From the center, about seventy strands radiate out, connecting to the strands at the edge, a bit like spokes on a wheel but much more tightly packed. Lines spiral out from the center, too tight to clearly follow. At the very center the spiral is so tight that it looks almost solid, and then there is a short gap with no cross-strands before a slightly looser spiral starts again. A red highlighted spider sits a bit below to the left of the center. This is a typical orb web of the garden spider.

Pink-toed Tarantula enclosure

Dark brown dirt covers the bottom, with a chunk of wood and plants growing up. This tarantula may be hiding under the wood or behind the vegetation or may be clinging to one of the walls. It is about 5 centimeters long, with a 9-centimeter leg span, and its body is a dark color and covered in short reddish hairs, except for the tips of its feet, with are capped dense tufts of light pink colored hairs. On each foot the tuft is split partway into two lobes, looking a little like a pair of toes.

Goliath Birdeater enclosure

The enclosure is covered in a reddish-brown dirt, with a piece of rough wood that sits with an arch above the ground, and tall green plants. Some faint lines of silk may be found on the ground. The large tarantula an is almost the same color as the ground, with a few lighter markings, and covered with light hairs. It can often be found sitting under the arch. Its cephalothorax [SEF-a-low-THO-rax], the front body segment that is both the head and thorax, is about 4 centimeters across and is mostly flattened, with light groves stretching out from an indent in the center like spokes on a wheel. Near the front of the head is a small, shiny cluster of pinhead-sized eyes. Below at the edge of the head is a light stripe, and below that extends the chelicera, the fanged jaws - a pair of tube-like structures, curving down. These transition from a soft looking matte texture with hairs to a hard, shiny fang at the ends. On either side of the fangs is a pedipalp, which in this species look like half-sized legs. Four pairs of legs reach out from beneath the cephalothorax, about the width of a pencil, with lighter markings at the joints. Behind the cephalothorax is a large, bulbous abdomen about the size of a pool ball. At the far tip of the abdomen are two structures that look a little like fingers – these are the spinnerets and may be tucked under the abdomen. The abdomen and the legs are covered in thin, sparse hairs about 2 centimeters long. Sometimes the abdomen will have a patch of hairs missing, usually on one side near the back, where the tarantula has defensively flicked off some of its hairs.

Mexican Orange-kneed tarantula enclosure

The enclosure is covered in sand and small pebbles, with a few rocks, small pieces of wood and a water dish. This tarantula is about 5 centimeters long with a 9-centimeter leg span, with black and orange coloring. It is easy to find with little to hide behind, and coloring that stands out against the sand. The cephalothorax is flattened, darker in the center and lightening to an almost blond color on the edges. Dark chelicera, the jaws with fangs, extend out and down from the center front of the body. On either side is a pedipalp, a thin, jointed appendage that resemble small legs in this species. Behind the pedipalps, four pairs of legs radiate out along the sides of the cephalothorax. The legs and pedipalps are black with rings of a light orange color at the joints, giving them a striped look – and the first joint beyond the body have a darker orange color at the bend of the “knee.” Behind the cephalothorax is the bulbous abdomen. The whole body is covered in bristly hairs.

Wolf Spider enclosure

The enclosure is covered in sand and small pebbles, with a few rocks, a branch and small pieces of wood and a water dish, and a few patches of silk. This is a brown and greyish or sandy brown colored spider, with a 1.5-centimeter-long body and thin legs nearly twice as long. It is often hard to find, as it can hide behind the wood or rocks and its coloring blends into the sandy ground. This spider's cephalothorax is oval shaped and slightly flattened, with small dark, shiny eyes on either side of the front point, and a thin, light stripe starting at the front and leading back along the top. The thin, short pedipalps are often curled down on either side of the mouthparts, and four pairs of long, narrow jointed legs radiate from the underside of the cephalothorax. Behind is the abdomen, which is slightly longer and more rounded.

Crab spider photograph

A cluster of pale purple flowers along a stem reach horizontally across the middle of the image. Near the right side, a white spider with small orange spots is nestled in among the blooms, a bumblebee held in its mouth. The spider has a rounded cephalothorax with the front part, the mouthparts, buried in the bee. Just below the mouthparts two small jointed appendages, looking a little like fingers, curl out to either side. Behind those, on either side of the cephalothorax, long, thin white legs arch up and then down again. The almost spherical abdomen is much larger, about 3 times the size of the cephalothorax, and appears to sit on top of the back edge of the cephalothorax. It is white and appears soft, almost like a round marshmallow.

Jumping spider photograph

The spider stands on a branch and fills most of the image, facing down along the center and extending back, past the top edge of the photo. This is a colorful spider, mostly black and white with red and light blue markings. The cephalothorax is shaped like flattened inverted bowl, black with red along the top "edge" and four white dots on the top. Two pairs of eyes are clearly visible. A large round pair of eyes face forward, filling most of the front of the head. Flanking this pair of eyes is another smaller eye, positioned so the tops of the eyes are aligned, and the smaller pair reaching down a little less than half as far as the larger pair. Below the eyes are clusters of white hairs, and a short narrow, segmented pedipalp is visible to the right – it is also surrounded by white hairs and looks a little like a bottle brush. The narrow oval shaped abdomen reaches back behind the head, with a vertical light blue stripe with black speckles at the center flanked by dark red stripes. Two pairs of legs are bent up near the front of the head, and two pairs of legs stretch back alongside the abdomen. The legs are black with small white markings.

Spider Strategies Exhibit Text

Spider Strategies

Spiders are carnivorous; insect populations would be totally out of control without them. Why are spiders so successful? Through a diversity of strategies—primarily **sit-and-wait** and **active hunting**—they can capture insects from all walks and flights of life.

Aerial Trappers

Sit-and-wait hunters include the **web-spinners**. They compensate for sedentary ways and poor eyesight by spinning silken tangles and sheets to enlarge their dinner plates.

Spider Web Photograph Captions

1. The **spring trap** of the **triangle spider** (*Hyptiotes* sp. [hip-tee-OH-tees species]) is made of dry, or cribellate, silk. The spider forms a living spring between the tension thread and the attachment threads. When prey lands on the web, the spider releases the tension—collapsing the web around the prey.

2. The dense **hackle bands** woven by *Kukulcania hibernalis* [ku-KUL-can-ia hi-ber-NAL-is] work like Velcro to trap prey. They are made of a dry catching, or cribellate, silk.

3. The **hammock web** of the **bowl-and-doily spider** (*Frontinella pyramitela* [fron-tin-EL-ah pir-am-i-TEL-a]) traps prey that fall into its sticky, tangled lines. The spider waits underneath the bowl to bite victims and pull them through the web for dinner.

4. The **scaffold web** of *Steatoda* [ste-ah-TOW-da] has gluey droplets at the base of the attachment lines. An insect unfortunate enough to wander into one of these lines gets stuck and breaks it. The spider then hauls the victim up into the web.

5. The loosely-woven **orb web** of the **ray spider** (*Theridiosoma* sp. [ther-ih-dio-SO-ma species]) resists the low impact of small prey like midges and mosquitoes. The spider pulls the center down to form an umbrella shape. When an insect lands, the spider lets go and the web springs back and ensnares the prey.

6. The typical **orb web** of the **garden spider** (*Mangora gibberosa* [man-GO-ra gib-ber-OH-sa]) has sticky spirals and dry spokes. The tight web resists the high impact of fast-moving prey like the blowfly across the aisle.

Why don’t spiders stick to their webs?

Sometimes they do. But they are experts at getting out of sticky spots. It also helps to have oily feet and spin dry spokes. Spiders can hopscotch around possible traps.

Land Rovers

Hunters use several strategies to track their prey. Some rely on vision, some on touch. Others combine these senses with camouflage or an ability to sense vibrations.

Pink-toed Tarantula

Avicularia sp. [a-vic-u-LAR-ia]

South America

Unlike most tarantulas, this species lives in trees, stringing silken hammocks among branches and capturing prey on the ground. If they fall, they’re rarely harmed, and they can swim back to a tree when they land in water.

Goliath Birdeater

Theraphosa blondi [thhe-ruh-FO-suh BLAHN-dee]

South America

This giant tarantula can be found in South America's rainforests. Birds are not part of their regular diet, but these tarantulas can eat almost any animal smaller than they are. When threatened the spider may rub sections of its fangs together to make a loud hissing sound. This is a unique way for a spider to avoid predation.

Mexican Orange-kneed tarantula

Brachypelma smithii [braa-kee-PEL-mah SMITH-ee]

Southern Mexico

It takes 10 years for these tarantulas to reach maturity. Male tarantulas die at about this age, but females can live for more than 20 years. Because the species is endangered, the Insect Zoo registered these specimens with a national spider breeding program overseen by TITAG, the Terrestrial Invertebrate Taxon Advisory Group.

Wolf Spider

Lycosidae sp. [ly-KO-si-dee species]

United States

These spiders capture their prey with speed and power, aided by eyes that can see in four directions at once.

Photo captions

Ambush predators, **crab spiders** (family Thomisidae [tho-mis-**I**-dae]) conceal themselves on flowers and wait for unsuspecting morsels like this bumblebee to walk by.

Jumping spiders (family Salticidae [sal-TI-sea-dae]) use their large, forward-facing eyes to spot prey from a distance, then leap upon their victim.

Interactive pullout

Did you know…spider females are usually larger than males?

Section 6: Insect Societies

Insect Societies Core Track

This section of the Insect Zoo covers a single 10-foot-long wall, with two enclosures alternating with two groups of images. At the left, this section runs into the Termite Mound model, with a low tunnel at its base starting a few feet back from this section's wall, so be aware that small children (and occasional adults) may be crawling out near the left end of this section.

This section focuses on social insects, such as termites, ants, and many wasps and bees, that live in highly organized groups called colonies. Each individual has a role to play, working on behalf of the group. The colonies are superorganisms, and in some ways the different castes function like parts a human body: for example, the reproductive castes work like reproductive organs; worker castes are like muscles.

On the right side of the section are three photos below a title of "herders and gathers:" two ants facing each other, their mouthparts meeting; ants on a plant stem, surrounding small red and black insects; and a column of small black and red ants and two larger ants, with long hooked jaws, standing beside.

To the left is an enclosure containing Honeypot Ants. These desert-dwelling ants forage for food during moist weather. Back at the nest, they regurgitate the food they collected to other honeypot workers called repletes [reh-pleats], which serve as living storage jars. This enclosure is a cutaway view of subterranean chambers and the ground above. Small orange-brown ants may be found above ground or in the tunnels. The repletes may be found hanging from the "ceilings" of the chambers, with abdomens that look like translucent orange water balloons filled almost to bursting, sometimes larger than the rest of their bodies. The queen is occasionally visible, plumper and about twice as long as the workers. Workers may also be tending to tiny grub-like larvae and cocoons the size of rice grains.

To the left is a group of three images titled "The Defenders." A pair of stacked photos on the right show an ant's head with long, serrated jaws, and ants carrying a leaf-like insect. To the left, an illustration shows a cross section of an ant nest, with an ant blocking the entrance tunnel with its plug-shaped head.

To the left is an enclosure containing acacia [a-KAY-sha] ants and an acacia plant – in the wild, the small red ants attack leaf-eating insects and clear away competing vegetation from the tree, which in turn provides the ants shelter in large thorns and food, including tiny pill-shaped structures on the leaf tips, called Beltian [bel-SHI-an] bodies.

The next section is the African Termite Mound, which starts at the left end of this section. Follow the termite mound around, past the tunnel opening, to where there is a long inset panel, about 3 feet from the ground.

Insect Societies Detailed Descriptions

Herders and Gatherers photographs

The photograph on the left shows two ants on a leaf. The leaf stretches from the bottom left to the top right. The ants are red brown with darker abdomens. One stands on the left, facing up and to the right,

front pair of legs raised, the other stands above and faces the left – their mouthparts meet at the center, their heads and antenna angled in different directions. Together their bodies resemble a bridge.

To the right and slightly above is a photograph with ants crawling on a plant stem surrounding small red and black insects. The tan stem reaches up from the center bottom; halfway up a green stem forks off to the top left corner. Several insects cluster on the stem, centered around the fork - more than a dozen small red insects with thin black spikes sticking up from their backs. Four larger ants surround them – two above, one on the green stem just past the fork and another on the tan stem above the cluster, both facing downward. The other two are below the cluster on either side of the stem, facing up. The ants are about three times as long as the smaller insects, and a similar reddish color. The ant on the lower right appears to be picking up one of the smaller insects with its jaws.

Below is a photograph of column of small dark ants crawling across light colored ground, with two larger ants standing beside. The column reaches across the center from left to right. The dozens of small ants are black with a dark red abdomen and thin legs and antennae and are so densely packed that it is difficult to pick out individuals. The larger ants have bodies two to three times as long as the others and stand outside the column – one is just above the column facing diagonally to the top left corner, the other is below the column to the right and stands parallel to the stream. These ants are colored differently from the smaller ones – their bodies and legs are a reddish-tan color, with large pale heads. Large hooked jaws reach out from either side of the head and thin antenna extend out to the sides. All the appendages, the jaws, antennae and legs, are dark, nearly black.

Honeypot Ants enclosure

This enclosure shows a cutaway view of a set of subterranean chambers, filling the bottom 9 inches of the enclosure, and the ground above. The ground is covered in dirt with and grasses, pieces of wood and rocks, and a tree stump in the back left. Near the stump is the ants' food – fruit and an occasional small cricket, and a test tube partly filled with water, plugged with cotton. Below is a set of seven connected chambers, lit from behind. The chambers are horizontal ovals shapes of varying sizes, about 4 centimeters tall and 12 to 25 centimeters across. They are arranged in a general pattern of two columns of three rows, all opening to a space along the center. The center left chamber is splits into two lobes on the left side, one atop the other. You may see small ants, light brown with darker abdomens running around above ground or in the tunnels. These worker ants are about a centimeter long. Other ants have enlarged abdomens, some only a little larger than the workers and others with abdomens larger than the rest of their body – these are the repletes [reh-pleats]. The repletes may be found on the ground or sides of the chambers, but those with the largest abdomens hang from the chamber ceilings. The abdomens look a bit like round water balloons, some filled almost to bursting. The bodies are the same brown as the other ants, and the enlarged abdomens are translucent, and almost seem to glow from the light shining from behind, colored pale amber to salmon pink. Larvae may be found in some chambers, pale white grubs, the smallest about 3 millimeters long and the largest almost a centimeter long; some have dark spots in the middle. These may be wiggling on the ground, some even crawling, and worker ants can also be seen caring larvae in their jaws. Cocoons that look like a grain of rice wrapped in silk strands, may be found also. The queen is rarely visible, plumper and about twice as long as the workers and slightly paler in color.

The Defenders images

To the right are two photos, one above the other. The upper photograph is of an ant's head with long, serrated jaws. The round head fills the center top of the image, a shiny red color, with large black eyes on either side near the front. Antenna reach up and out from between the eyes. Below each eye extends a mandible, its base a fifth the width of the head. The mandibles extend forward and inward, narrowing to a slightly hooked point and overlapping just before they end. The mandibles are a bit longer than the head itself and flattened horizontally. The centers are a yellowish color, fading to red at the edges. The outer edge is smooth while the inner edge has serrated points, looking like sharp teeth, and are tipped in black.

Below is a photograph of several ants on what appear to be overlapping leaves. The ants are tangles of reddish tan legs on top of a bluish-green veined leaf. Two prominent ants sit in the center facing us – they have large, squared heads that are a pale color. Large dark mandibles curve downward. They are on top of what looks like a lighter green leaf. A closer look shows that the front part of the leaf is actually a head – it is an insect, being carried by the ants.

On the left is a drawing in orange and a reddish brown on a tan background. It shows a cross section of an ant nest. A vertical wall of packed dirt fills the center two thirds of the image, with a horizontal passageway connecting a dark nest chamber on the left to the outside on the right. On the outside wall an ant clings below the opening – the body is orange outlined in brown, with an egg-shaped head, narrow thorax and oval abdomen. Its bent antennae reach from the middle of the head forward toward the opening, the first long straight segment of the antenna close to the head points out to the sides. The antenna continues with a 90 degree turn upwards, with many small segments that look like beads on a string. Inside the passage is a larger ant that fills the space, blocking the opening – its body is similar to the other ant, except its head looks like the front section has been sliced off in a straight cut. The ant is positioned so that this flat surface is flush with outer wall, filling the opening.

Acacia [a-KAY-sha] Ant enclosure

This enclosure has a small acacia tree growing up from the center, with very narrow brown stems and thin green branches – the thickest is about as wide as a pencil, and the narrowest is like wire. Large thorns stick out from the stems, just under a centimeter wide at their base, and narrowing to a point about 3 centimeters long. Some are paired, and angle up from opposite sides of a stem to form a very wide V shape. A few of the thorns have small holes, a millimeter or two wide, usually near the base. The branches of the plant have clusters of tiny leaves arranged in a characteristic pattern. Small flattened leaves, shaped like ovals a centimeter long and 2 millimeters wide line either side of a very thin stem, tilted slightly toward the end, looking a bit like a feather. These sets of leaves are in turn arranged in pairs along slight larger branches. At the very tip of some leaves is a small yellowish pill-shaped structure, about a couple millimeters long, and about a fourth that width – these are Beltian [bel-SHI-an] bodies. You may find small red ants, about 1 centimeter long, standing or moving around the plant.

Insect Societies Exhibit Text

Insect Societies

Social insects—termites, ants, and many wasps and bees—band together in highly organized groups called **colonies**. Insects within a colony all share the same mother and act on behalf of the group. They "talk" to each other with chemical signals to find food or avoid an enemy.
Each social insect has a role to play: the queen lays eggs while the workers build nest structures, gather food, and rear young.

Colonies are superorganisms

larger than the sum of their parts. Evolution has worked on them as if they are a single being. In some ways, a colony is similar to a human body: reproductive castes work like reproductive organs; worker castes are like muscles; and the individuals that carry food or messages perform like circulatory and nervous systems.

Quote

As a thinker and a planner, the ant is the equal of [anyone]…

– Mark Twain, What is Man?

Herders and Gatherers

Social insects—particularly ants—have been extremely successful in finding food almost anywhere. As a group ants will eat just about anything, but some species specialize in the kind of food they eat and the way they get it.

Herders and Gatherers photo captions

Some ants herd **treehopper nymphs** (family Membracidae [mem-BRAH-sea-dee]) in order to milk them for the nutrient rich **honeydew** they make from plant sap.

Ants have two stomachs: a personal stomach and group stomach, or **crop**. When an ant with a full crop meets a hungry nest mate, it will throw up a crop of food and pass it to the other ant, mouth to mouth. The polite word for this is **trophallaxis** [troph-a-LAX-is].

On a raid, **South American army ants** (*Eciton* [ESS-i-ton]) are like a living stream of hungry mouths eating just about anything in their path.

Honeypot Ant

Myrmecocystus sp. [mer-MEC-o-CYS-tus species]

Southwestern United States

In moist weather, desert-dwelling **honeypot ants** forage for nectar, or honeydew (a waste product of aphids and scale insects). They return to the underground nest to regurgitate their loads to other honeypot workers called repletes [reh-pleats]. The repletes serve as living storage jars that other honeypots draw from during long, dry periods.

Honeypot ant photo caption

These honeypot ants are workers that act as living food storage containers.

Do you see them hanging from the top of the tunnels in the ant nest above?

The Defenders

Once food is in the nest, ants still have to defend it and themselves from predators.

The Defenders illustration and photo captions

Using their heads…To keep enemies out, some ant soldiers block nest entrances with their plug-shaped heads.

Formidable foes…Ant soldiers, or major workers, defend nests and workers with their cutting or crushing jaws, stings, and poisonous secretions.

Ant gangs…Just as they work together to carry food, ants work together to kill their enemies.

In exchange for food and shelter from the bull's horn acacia [a-KAY-sha],

acacia ants (*Pseudomyrmex* [soo-do-mer-MEX]) fiercely attack leaf-eating insects and keep the base of the tree clear of competing vegetation.

Acacia ant photo captions

An **acacia ant queen** lays eggs and rears the next generation of workers in a hollowed-out thorn of the bull's horn acacia tree.

Acacia ants depend on the protein-rich leaf tips called **Beltian** [bel-SHI-an] **bodies** and the sugars from **leaf stem nectar sources** of the bull's horn acacia tree.

Section 7: African Termite Mound

African Termite Mound Core Track

This section of the Insect Zoo is a life-size model of an African termite mound set around the corner where the Insect Societies section ends and marks where the main hallway empties into the large open space – you can feel the craggy outer walls. The base of the mound is roughly circular, and if it were a clock face, with 12 o'clock facing the direction of the wall and windows, the end of the Insect Societies section would intersect it at 2 o'clock, and you could walk around most of it, until 12 o'clock. A tunnel through the base runs straight through from about 3 o'clock to 9 o'clock. Display panels and video screens are set in the rough outer wall and inside the tunnel. A sound recording from a termite colony plays inside the mound – from further away the chewing may sound like moving water.

Termites, a cockroach relative, have highly organized societies similar to those of ants, with kings, queens, soldiers and workers. The nests of the African mound termite are engineering marvels, built of sand, soil, and termite saliva. This model termite mound has a large base about 8 feet tall, with several rough spire-like mounds extending up further. The highest "spire" reaches to about 15 feet, into a dome cut into the ceiling.

You can crawl into the tunnel - it is 33 inches tall and 30 inches wide at the base. Inside is an illustrated cross section of three connected chambers of a termite mound.

Past the tunnel entrance at 6 o'clock is a 3.5-foot-long panel with text and an inset display detailing each of the five labor roles, such as soldiers and workers, including an orange line drawing of an individual and a pin for a preserved specimen.

Going around clockwise, past the tunnel exit to 11 o'clock, an inset panel has text and a labeled diagram of a mound cross-section.

Above the right corner of the both displays, inset screens play a looping video with scenes from a termite colony such as workers outside collecting bits of straw or in the nest tending to the queen.

The next section is in the corner of the open space, past the windows near the left side of the mound. Be aware that the arachnid and insect carts may be stored along the windows when not in use, and they have solid signs at head height that stick out to the side about 9 inches. There may also be low stools on the ground in the area. Follow the termite mound around to the left as far as you can, then follow the short wall and windows to where the picket fence starts.

African Termite Mound Detailed Descriptions

Termite mound model

This section is a life-size model of an African termite mound – it is set at the end of the exhibit walls on the west side of the Insect Zoo, and you can walk around about three quarters of it. The craggy outer walls can be touched to get a sense of the shape of an actual termite mound.

The mound is a cluster of rounded spires, which form one large mass at the base. Starting about 8 feet up some spires narrow enough to be distinct from one another. Some spires end only a few inches

above the main mass in a blunt rounded cap, while the tallest spire reach up to about 15 feet – in fact, they reach above the ceiling, which has dome-shaped cut out to accommodate the top.

There is a tunnel running through the base, from near the Insect Societies section, straight through the center and exiting into the large open space. It is 33 inches tall and 30 inches wide at the base and arched at the top. Inside the tunnel is backlit illustration of three connected chambers of a termite mound in cross section. the center one containing a large queen and eggs being tended to by workers. A recording of sounds from a termite mound plays from within the structure, loudest in the tunnel. From afar it may sound like moving water, but closer to the source the sounds of chewing can often be resolved.

Social Life of Termites display panel

This 3.5-foot-long panel on the outside of the termite mound has text on the left. To the right is the inset display, featuring five different termite castes. For each caste, there is an orange line drawing of an individual, text, and a pin for a preserved specimen. All the termite specimens are a pale cream color.

The first caste, on the left, is the Primary queen. The drawing shows a termite with a very large abdomen and no wings – it looks a bit like a fat caterpillar with the head of a termite. The specimen's pale body is about 4 centimeters long, about as wide as a finger, topped with a small orange nub of a head.

To the right and above is the secondary reproductive, which resembles the primary queen in the enlarged drawing, with a less oversized abdomen, and much smaller, 8 millimeters long and a pale cream color.

To the right and below is the primary king. The drawing shows that he has membranous wings, shaped like elongated teardrops, folded over his body covering everything behind the thorax; the specimen is missing.

Above and to the right is the soldier caste, which has a very large head. The specimen is 11 millimeters long, and its head is as large as the rest of the body, with two long hook-like jaws, tipped in black, crossed in front. No wings cover the segmented abdomen.

The last caste, below and to the far right, sis the worker caste. Similar to the soldiers these are small, 1 centimeter long and wingless, but have smaller heads and mouthparts.

Master Architects display panel

This panel, on the far-left side, past the tunnel opening, includes a diagram with a cross-section of a mound, labeling features like air ducts and nurseries, and text further detailing the features.

The diagram, with yellow lines on a brown background, shows a termite mound, shaped roughly like a cone. A quarter of it has been cut away to show a cross section. There are over a hundred tightly packed cells in the center, are thick walls between the clustered cells and outside. There are three types of cells, and labels identify one of each. The fungus gardens are large, somewhat rounded chambers are found throughout, concentrated along the bottom and sides. The nurseries are narrow cells that are almost more thick, irregular horizontal lines than a space, fill most of the rest of the space. The single royal in the middle is highlighted in white. It is long, narrow at the left and right and bulging up in the center –

wider and taller than the nurseries, and shorter than the fungus gardens. The top of the center, above the cells, is shaded, and near the top a broad tunnel extends to the right, leading to the air ducts, narrow channels reaching down through the nest's walls.

African Termite Mound Exhibit Text

Social Life of Termites

Termites have been called social cockroaches because they are related to roaches, and they have evolved highly organized societies similar to those of ants.

Termite colonies consist of a king, queen, female and male soldiers, and workers. Termites have an organized division of labor, "talk" to each other with chemicals called pheromones, and work together for the greater good of the colony.

Caste illustration and specimen labels:

- The **primary queen** is much larger than other termites: more than 10 cm (4 in.) long and very plump. During her 10-year life span, she lays 30,000 eggs each day—a total of more than 100 million eggs.
- **Secondary reproductives** are able to take over if the primary reproductives (king and queen) die, even though their bodies are not as well developed.
- The **primary king** establishes the colony with the primary queen. He is monogamous as far as the primary queen is concerned, but if she dies, he may acquire more than a dozen secondary queens.
- **Soldiers**, although wingless and sterile, have enlarged heads and jaws used to defend their fortress home. Soldiers are female or male.
- **Workers**, both female and male, make up most of the termite nest's population. Their chores include finding food, building the nest, and caring for the young. Workers are pale, blind, and wingless and have chewing mouthparts.

Master Architects: African Mound Termites

Built of sand, soil, and termite saliva, the nest of the **African mound termite** (*Macrotermes natalensis*) [MAC-ro-TER-mes na-tah-LEN-sis] is an engineering marvel. Its walls rise slowly for many years to reach heights of more than 5.5 m (18 ft)—a fitting castle for the termite queen and king and their two million subjects. Thick walls help keep temperature and humidity constant, and an elaborate system of tunnels carries air warmed by millions of termite bodies to the mound's upper air space.

- From the nest's upper air space, the hot air travels back down through a system of ducts beside the thin, outer buttresses of the nest. As the stale air is forced through a series of narrow channels, carbon dioxide is removed from the nest, and new oxygen is brought in.
- At the center of the castle's living quarters is the royal cell, housing the queen, king, and their attendants. Clustered around the royal cell are rooms where eggs are stored, rooms for young termites, and gardens of fungus that workers raise for food.

Section 8: Our House, Their House

Our House, Their House Core Track

This section of the Insect Zoo fills the corner of the large open area, between two sets of floor-to-ceiling windows, surrounded by a curving two-foot-tall picket fence in front of a line of consoles. In the corner itself is a model house, and to the right of the corner is a tall display.

This section highlights insects that we humans interact with.

The right side features some insects that make products used by humans, with a matching game. Against the wall is a tall display shaped like a yellow and orange honeycomb. A cutout honeybee stands near the top, above a cluster of hexagons that extend forward. One reads “TRY AGAIN,” and the others are photographs – some of insects, other of products like silk or honey. A console behind the fence has two rows of buttons and the photos from the wall – insects on top, products below. You can press an insect button and a product button together - if they match, the wall photos will light up. The options and matches are in the detailed descriptions track.

The left side of this section focuses on how our homes and yards make excellent insect habitats.

Along the left side just behind the picket fence are eight consoles; in the corner behind these is a model house. The consoles’ top angled surface has text about an insect, a display in the center, and a wide oval brass plaque below. On the plaques you can feel an embossed insect - all have their heads pointed left; some are positioned upright, as if standing on the plaque, others are positioned on their side. Touching a plaque turns on lights in the model house where that insect can be found.

From right to left, the consoles feature:

- Flour Beetles, found in the kitchen. The plaque has a beetle embossed upright. It has a small rounded rectangular head, followed by the thorax and abdomen, shaped like a domed oval, wider than the head, with a line-like a cut a third of the way back – indicating the top edge of the wings, folded over the body. A pair of segmented antennae curve out from the head and three pairs of segmented legs splay out to the sides.
- German Cockroaches, found in the kitchen. The plaque has a cockroach, embossed upright. It has a stubby, rounded rectangular head, followed by the thorax, starting as a wider, rounded triangle pointing forward. From there the body extends back in an elongated oval, ending in a point. There is a pair of wiry antennae on the head and three pairs of segmented legs.
- Silverfish, found in the bookshelf and bathroom. The plaque has a silverfish embossed upright. It is shaped a bit like a rounded, segmented carrot, with the head at the wide end. Extending from the front of the head are a pair of antennae and two long mouthparts. There are three pairs of legs, and at the tip of the abdomen, three thin appendages sweep back.
- Adult fleas, found on the dog, embossed on its side. The plaque has an embossed flea, positioned on its side. The details are very worn. The body is shaped a bit like a flattened light bulb, with the head at the small end, facing left. Three pairs of legs dangle down.

- Clothes Moths, found in the closet. The plaque has a caterpillar is embossed on its side. The plaque has an embossed caterpillar, positioned on its side. It is body is a worm-like cylinder, with many segments. From the three segments after the head the legs, narrow points, extend down. Further back, four segments have broader points extending down – the prolegs.
- Carpenter Ants, found in the rafters. The plaque has an ant embossed upright. Its body has distinct head, thorax and abdomen. The head a rounded, domed triangle, followed by the narrow domed oval thorax, and a bulbous abdomen. A pair of antenna starts at the top of the head, and three pairs of legs extend from the sides of the thorax.
- Common mosquito, found in the birdbath. The plaque has an embossed mosquito, positioned upright. It has a small rounded head, a broader oval thorax and an elongated, segmented abdomen. The front of the head has mouth parts and antennae pointing forward. Three pairs of legs are splayed out from the thorax, with oval wings stretching out between the first and second pairs of legs.
- Fireflies, found in the yard. The plaque has an embossed adult firefly, positioned upright. Its body is oval-shaped body with short half-circle at the left side, followed by a domed oval, with a short notch at the tip of the abdomen indicating a gap between the wings. A pair of antennae curl out from the sides near the front, and three pairs of legs extend from the sides.

The displays for the flour beetle, German cockroach and clothes moth have live insect enclosures, the others feature images.

In the back corner is a model house with two stories – each about 4 feet tall, part of which is cut open like a doll's house to show the inside of a bedroom and bathroom on the top floor and a living room and kitchen below. In front is a painted yard with a birdbath.

The next section begins opposite the left end of the picket fence. Follow the windows to the left 7 feet until you reach the corner, with a tall structure modeled like a tree, with rough bark.

Our House, Their House Detailed Descriptions

Interactive display: "Without Insects There Would Be No . . ."

The back section is shaped like part of a honeycomb – a cluster of hexagons painted yellow with orange lines. A flat cutout honeybee, yellow and black with light-colored membranous wings, stands near the top. A cluster of 17 of the hexagons extend forward, some farther than others. Near the center one reads "TRY AGAIN." The other are photographs – some of insects, other of products like a jar of shellac or a pile of vegetables.

The console in front of the wall display and just behind the picket fence is easy to reach, with two rows of photos, text and buttons. The console is 4 feet wide and 20 inches front to back. The top row has eight hexagonal photos of insects above a black button and label identifying the insect. Below is a set of eight products – large hexagonal photos with a black button and a label with text about the product; these alternate so that some have the text on top, then the button, then the photo, and others the reverse, so the buttons make a zig zag. The sixteen photos on the console match the photos on the wall.

Text instructs visitors to match the insects to products by pressing one button on the top row and one on the bottom, and then looking at the wall display to see if they match.

The insects are, from left to right:

- Silkworm: a pale segmented larva, curved in a nest of fine white strands.
- Lac [Lack] Insects: a reddish mass wraps around a twig – it looks like small red objects are embedded in a dark red-brown matrix.
- Dermestid [der-MES-tid] beetles: a group of black segmented larvae, with pale legs and tiny spikes rising up like hair.
- Bumblebee: a stout bee, black with yellow fur, sits on a pink flower. Its back leg has a yellow mound of pollen on it.
- Parasitic wasp: a small, long black insect, with pale membranous wings folded over its back, stands on white objects.
- Scale insect: the flat side of a green cactus, with white scaly patches.
- Honeybee: A yellow and brow bee, with clear membranous wings, stands on a yellow flower.
- Fruit fly: a reddish fly, pill shaped with a capsule-like head capped with red eyes. Clear membranous wings are folded over the body.

The products, from left to right, with their producers are:

- Cochineal [KAWCH-uh-neel] (red) Dye: a natural product to color cosmetics, textiles and medicines made from dried and ground insects. The photo shows fabric with stripes of red, blue and white are shown. On one piece there are embroidered insect figures. This matches to scale insects.
- Pollination: a service provided by this and certain other flying insects, enabling plants to produce fruits and vegetables. A pile of fruits and vegetables is shown. This matches to the bumblebee.
- Genetics: these insects are ideal for this type of research because they reproduce quickly and only have four pairs of chromosomes. The image is of stained cells, dark purple strands on a blue background. This matches to fruit fly.
- Silk: a natural fiber for luxury clothing that comes from a caterpillar's salivary glands. The image shows folded red silk fabric, with cocoons of fine white strands of silk. This matches to silkworm.
- Honey: a delicacy made from plant nectar gathered by these insects. The photo shows a jar with chunks of honeycomb, and wooden honey dipper held above it. This matches to honeybee.
- Shellac: A mixture of substances secreted by an insect. The photo shows a jar labeled "natural shellac" with a paintbrush on top, sitting in front of glossy coated wood. This matches to lac [Lack] insect.

- Decomposition: This service returns the nutrients in decaying plants and animals to the soil. The image shows a white bird skeleton on brown soil. This matches to dermestid beetle.
- Pest control: A service performed by insect-eating insects, keeping pests in check. The image shows a green caterpillar, with white pill-shaped bundles attached to its body. This matches to parasitic wasp.

Model house

The model house is two stories, complete with angled roof and chimney reaching up. Each story is about 4 feet tall. The top story has a cutaway into a space with illustrations depicting a bedroom and bathroom – one wall is painted with a tall white wardrobe, a door open to show hanging clothes below a shelf of folded clothing. Next to the wardrobe is a bed. The intersecting wall has a closed white door painted on it. To the right of the door, a "wall" extends slightly, separating the "bedroom" from a room with tiles and a mirror. A flat, painted cutout of a white pedestal sink sits in front of the mirror. The right side of the second story depicts the exterior of the house – a brick face with a window with a dark green frame and narrow shutters on either side. Inside the widow yellow curtains are pulled to either side. The brick pattern continues to the edges of the house and down between the two first-story rooms.

On the lower floor, the left most "room" depicts a living room. Just in front of the left wall is a flat cutout of a bookshelf, parallel to the wall, painted with a pair of closed cabinets on the bottom., colorful books on the two middle shelves, and the top shelf has a short vase and small pictures leaning on stands, including circular frames with a red beetle and a white and black butterfly. To the left of the shelf, a low, green cushioned armchair is set below a window, green curtains open to show flowers and a picket fence in front of bushes and a house. The intersecting wall has a narrow door painted on the left, open to show a view of a black and white tiled floor and a green refrigerator. To the right is a green sofa, matching the chair, below a landscape painting of mountains and a lake, with end tables and green lamps on either side. In the center of the "room" is a circular rug with a painted cutout of a brown and white dog. The dog sits, tongue out and floppy ears out, its right hind leg poised to scratch its ear. The edge of the floor separating the bedroom and living room is painted as if it was a cross section, showing cut ends of spaced out wood beams. To the right of the living room is a space showing a kitchen with a black and white tiled floor. The right-side wall has a green refrigerator on the left with white cabinets. At the center is a sink under a window, with beige curtains pulled aside to provide a view of a yard. The cabinet door under the sink is open, showing colorful cleaning supplies such as a green spray bottle with a red and yellow label. A cabinet above and to the right of the sink is open showing pantry items such as a brown sack with a red and white label reading "mix." The left side wall shows a stove with cabinets above, and the door to the living room. In front of the house the ground is painted green, with flowers along the wall below the "rooms." The exhibit wall to the left has a mural painted as if looking from the front yard up the street – a green lawn surrounded by a picket fence, a blue and white three-story house next door, and a red and blue house beyond that. In front is a cutout of a birdbath, a shallow white dish sitting on top of a white column base, with water reflecting greens and blues and two birds sitting on the edge.

Consoles of insects found around homes

The front of the exhibit is lined with consoles just behind the picket fence. These are each 18 inches wide and 20 inches from front to back, each painted a different color. Each feature a different insect

common around homes. The top angled surface has a window in the center with a display. There is text above about the insect, and below the window is an oval brass plaque. On the plaques you can feel an embossed insect - all have their heads pointed left; some are positioned upright, as if standing on the plaque, others are positioned on their side. You can feel these – some fine details are missing. Touching each plaque will turn on small lights in the house scene where the insect can be found.

Flour beetles

The first console on the right is a light purple color and features Flour Beetles.

The display window looks down into a box, like the bottom of a drawer covered in flour. The flour is unevenly spread and discolored. Against the light color of the flour, a few isolated flour beetles can be seen, a dark color, about 3 millimeters long.

The plaque has an embossed adult beetle, positioned upright. The head, on the left, is shaped like a small rounded rectangle. Behind the head, the thorax and abdomen are shaped like a domed oval, wider than the head, with a line-like a cut a third of the way back – indicating the front edge of the wings that fold over the end of the thorax and completely covers the abdomen. On the head, a pair of segmented antennae curve out from the front corners, a little like horns. Three pairs of segmented legs splay out to the sides of the body, the front pair pointing forward, the others back.

German cockroaches

The second console on the right is a red and features German Cockroaches.

The window looks down into a dirty looking space with dark stains, an overturned white mug, a green scrubby sponge and a plastic cylinder. Bits of food such as small slices of sweet potato may also be inside, along with small cockroaches. The cockroaches are a dark brown and about 1.5 centimeters long.

The plaque has an embossed cockroach, positioned upright. The details main body are worn down. The head, on the left, is a stubby, rounded rectangle shape. Behind the head, the front of the thorax is shaped like a rounded triangle pointing forward, about twice as wide as the head, and from there the body extends back in an elongated oval, ending in a point. A pair of wiry antennae start at the sides of the head – first reaching up and out and then curving around to the back – a little like a “w” shape if they met in the middle of the head. Behind the head is the thorax and abdomen. Three pairs of segmented legs splay out to the sides, the front pair pointing forward, the others back.

Silverfish

Third from the right is a bright blue console featuring Silverfish.

The window shows a photograph of a silverfish on a rough ground. It is grey, and an ovoid shape, almost club-like, with a short head capping a thick thorax, and an abdomen that tapers to a narrow, rounded point. Two long thin antenna reach out from the front of the head in a wide V. On the thorax behind the head there are three broad overlapping plates. Pairs of beige, wedge shaped legs stick out to either side of each of the three segments. The abdomen has many smaller segments, and three long, thin structures extend out from the last segment – one straight back and two to either side.

The plaque has an embossed silverfish, positioned upright. The body is shaped a bit like a rounded, segmented carrot, with the wide end on the left, curved up slightly. At the front of the head are two

pairs of appendages – the antennae extend forward from near the center, then arc back, a bit like a “w” with a slight gap at the middle. On either side of the base of the antenna are long mouthparts, with two short segments, first pointing forward and out, and then bending in to meet at the center, making a diamond shaped outline. Behind these, three pairs of legs are bent backwards close to either side of the body. At narrow, rounded tip of the abdomen, three thin appendages sweep back, with faint paired spines sticking out along the sides.

Fleas

The fourth console from the right is bright orange and features adult fleas.

The window shows a magnified view of a flea from the side. The body is a light brown color, lit from behind, giving it a translucent look. The rounded cap-like head has a small round black eye on the side, and short bristly mouthparts points down. The thorax behind the head has overlapping plates, about the same width as the base of the head, and three pairs of segmented legs hang down, the front pair smallest and the back pair largest. The legs have fine spikes or bristles sticking down and out, and a hook is visible at the end of some of the legs. Behind the thorax abdomen segments get broader, making on oval at its widest point is about three times as wide as the thorax.

The plaque has an embossed flea, positioned on its side. The details are very worn. The head is pointed left, with a divot where the eye would be. The body is shaped a bit like a flattened light bulb, with the head at the small end, and the abdomen on the other side ending in a bit of a point. Three pairs of legs dangle down from near the front of the body – the set of three left side legs pair, facing you, is distinct, with several jointed segments in a generally zig-zag pattern; near the second joint of each of these the right side of the leg pair is visible – a fainter segment that extends out to the left a little more forward than the “top” set.

Clothes moths

The fifth console from the right is light green and features Clothes Moths.

The window shows a space with piles of fine brown debris, with a twisted skein of green yarn and a band of fabric that has been partly decayed. Small, narrow moths, about 7 millimeters long, are found all over – many are dead, and some walking around. They have pale wings, often held folded over their bodies, making them look a little like walking grains of brown rice. They sometimes flutter the wings out to the sides. The cocoons of the pupae can sometimes be seen, about 1 centimeter long, looking like a narrow, rolled piece of cotton, though often the cocoon is coated in the dust of the debris. The small larvae are generally hidden out of view, in the fabric that they are eating.

The plaque has an embossed caterpillar, positioned on its side. It is body is a worm-like cylinder, with many segments. The head, pointed to the left, is slightly pointed. Behind it are the three segments of the thorax, each with a narrow point extending down – the legs. Behind that are nine segments of the abdomen. Four of the segments in the middle have broader points extending down – the prolegs.

Carpenter ants

The next console, third from the left, is a light yellow and features Carpenter Ants. The window shows a photograph of an ant standing on ground covered in bits of plants, wood and a stick. The ant has a dark,

boxy head, an orange-red thorax and legs, and a dark egg-shaped abdomen with two thin white lines going around it.

The plaque has an embossed ant, positioned upright. The body has distinct head, thorax and abdomen. The head is shaped like a rounded, domed triangle, pointed left. Behind the head is the thorax, a tall and narrow domed oval, with one point meeting the back of the head and other the abdomen – a narrow flat ring flowed by a segmented bulb shape. A pair of antenna starts on either side of the top of the head, leading down along the head and out to the side, and then bend to point forward to the left. Along the sides of the thorax, three pairs of legs extend out to the sides – the first pair pointed forward and the others pointed back.

Mosquitos

The second console from the left is a dark green and features the common.

The window shows a microscope image of the head of a mosquito – most of the round head is covered in tightly packed rows of dots – the eyes. Bristly antenna extending up from two donut-like bulbs set side by side along the midline in the center of the head. Below are the mouthparts - a raised plate bulges out slightly, and at the bottom center a smooth tube reaches out and down, flanked by two long hairy appendages.

The plaque has an embossed mosquito, positioned upright. Its small rounded head points left, followed by the broader oval of the thorax, and then the elongated, segmented abdomen. From the front of the head are five faint, straight appendages fan out – the mouth parts and antennae. Extending out to the sides of the thorax is a pair of wings and three pairs of long, thin segmented legs. The front pair of legs reach forward to the left; behind these the oval shaped, veined wings extend straight out to the side. The last two pairs of legs point backward.

Fireflies

The console on the far left is pink and features fireflies.

The window has a photograph of a firefly from above, standing on a green leaf. The body is shaped like a long oval. The head is covered by a broad, half-circle plate on the thorax, and segmented antenna reach out in a V from the front. The plate has a thick black line down the center, with light yellow on either side, and two brown dots at the center side by side. Behind the flat edge, two long hard wings are folded back – almost meeting in a straight line along the midline. The wings are dark with yellow along the inner and outer edges, and a faint yellow line along the middle. Three pairs of leg are visible - two pairs reach out and to the side, and the back pair is bent and mostly hidden by the abdomen except for the “knee” and “toes” that stick out. The legs are black with yellow marking at some joints, and with two lobes these are tipped in yellow, looking a bit like socks on feet.

The plaque has an embossed adult firefly, positioned upright. Its oval-shaped body is pointed to the left. At the front is a short-half circle, part of the thorax extending over the head. From underneath, a pair of segmented antennae extend to the sides and curve forward. Behind that wings extend back covering the body, a domed oval ending in a rounded point; a short notch at the tip of the abdomen indicates a slight gap between the wings. Three pairs of legs extend from the sides, the front pair pointing forward, the others back.

Our House, Their House Exhibit Text

Without Insects, There Would Be No…

Hold down an insect button on the top row and then press a product button below. Look up to see if they match.

Top row buttons

- Silkworm
- Lac Insect
- Dermestid [der-MES-tid] Beetle
- Bumblebee
- Parasitic Wasp
- Scale Insect
- Honeybee
- Fruit Fly

Match these insects with the products below.

Bottom row buttons

- **Cochineal** [KAWCH-uh-neel] **(Red) Dye** A natural product used to color cosmetics, textiles, and medicines that is made from the dried and ground bodies of these insects.
- **Pollination** A service performed by these and certain other flying insects that enables plants to produce fruits and vegetables.
- **Genetics** A vital form of scientific research that is ideal for these insects because they only have four pairs of chromosomes and reproduce quickly.
- **Silk** A natural fiber used to produce luxury clothing items that comes from the salivary glands of these caterpillars.
- **Honey** A popular delicacy made from plant nectar gathered by these insects. The United States produces about 90 million kg (200 million lbs.) of this commercially each year.
- **Shellac** A mixture of substances secreted by these insects, it is still used despite widespread synthetic versions.
- **Decomposition** Insects that perform this service turn decaying animals and plants into nutrients that enrich the soil.
- **Pest Control** An important service performed by these insect-eating insects that keeps pest populations in balance.

Our House, Their House

Our homes and backyards make excellent insect habitats. What looks like a single human habitat is in fact many different ones—no matter where we look, we might find an entire insect ecosystem.

How do they get in? Often we bring them in ourselves—in food we buy, wood we bring in for the fire, and even on our pets. Once in, they find ways to pass through doors and walls and sometimes into places we can only imagine.

To share; furnished house.

Warm, tropical setting all year. Unlimited food supply. No major predators. Spacious, packed closets. Big backyard. Countless nooks and crannies. Sedate, warm-blooded pets. Damp basement full of rotting wood beams. Plenty of room for a growing family! …**No appointment necessary.**

What Is a Pest?

Insects play a critical role in our lives, but when they come inside our homes, uninvited, we call them pests.

Console text

- **Flour beetles** (*Tribolium* sp. [tri-bo-LI-um species]) are not finicky in their food preferences. They feast on grains, pastas, dried fruits, nuts, chocolate, even cayenne pepper, and, of course, flour. They require no drinking water at all, and in one year a female can lay up to 1,000 eggs. Touch me to find where I hide **in the kitchen.**

- **German cockroaches** (*Blatella germanica* [BLAH-tell-uh jer-MAN-ih-kuh]). The most widespread household pests are the roaches. Of the over 50 species found in the United States, only four are pests. These German cockroaches are the most common. And no wonder—if left alone, one female can produce over 30,000 offspring in a single year! Touch me to find where I hide **in the kitchen**.

- **Silverfish** (*Lepisma saccharina* [luh-PIS-muh SAK-uh-REE-nuh]) inhabit bookcases, shelves, basements, and other nooks and crannies of human habitation. This insect has a particular fondness for carbohydrates in any form—from flour to paste to bookbindings. Silverfish will even eat the starch out of collars and cuffs! Touch me to find where I live **in the bookshelf and bathroom**.

- **Adult fleas** (family Pulicidae [pew-LIS-i-dae]) are thin and well armored, which mean they can slip among the densest hair and avoid being crushed. If their food supply—blood—is cut off, flea cocoons can wait for a year or more before emerging. Vibrations, heat, and smell will rouse the cocoons. Touch me to find where I hide **in the living room**.

- **Clothes moths** (*Tineola biselliella* [TI-ne-o-la bis-sel-i-EL-la]) are among the few insects adapted to eat keratin, a protein found in animal products, such as hair, fur, and feathers. They come out of the closet each year when we unpack our winter clothes. Regular cleaning, careful storage, and mothballs all keep them at bay. Touch me to find where I hide **in the closet**.

- **Carpenter ants** (*Camponotus* sp. [cam-poh-NOH-tus species]) like to tunnel in dead wood. Although they chew the wood to make their nests, they feed on insects as well as sugar and other sweets. Touch me to find where I hide **in the rafters**.
- The female **common mosquito** (*Culex pipiens* [QUE-lex PIP-ee-yenz]) takes advantage of any standing water, including nutrient-rich birdbaths, to lay rafts of 100 to 300 eggs. The eggs hatch after several days, and the larvae and pupae live in water until they emerge as flying adults. To survive winter, adult mosquitos take shelter from the elements. Touch me to find where I live **in the birdbath**.
- **Fireflies** (*Photurus* sp. [PHO-tur-is]) are really beetles whose flashings fill our summer evenings with their mating signals. Males flash in patterns and wait for the wingless females sitting in the grass to flash back. Touch me to find where I live **in the yard**.

Section 9: Entomologists at Work

Entomologists at Work Core Track

This section of the Insect Zoo is along one wall, spanning 25 feet from the windows on the right to the corner at the left. At the right end is a model tree, with panels about bees to the left. Next to these is a window into the insect rearing room. To the left are several panels of text and a display window. A ledge spans the wall starting just past the tree model.

This section explores entomology and how the museum and experts care for and study arthropods.

In the right corner is a modeled tree, reaching from floor to ceiling with an inset oval window in the trunk. The contents have been removed and the display will be remodeled or removed.

On the wall to the left is a display shaped like cells of a honeycomb with photos and text about honey bees.

Next is a 3.5-foot-wide window with a view into the insect rearing room, through the emergence chamber. The Museum receives shipments of pupae of over 100 different species of butterflies and moths from around the world, and many are kept here until they emerge - a ledge photo shows a staff member in a lab coat examining pupae.

The emergence chamber is directly behind the window into the lab, a set of metal shelves within a glass case. Pupae hang from planks below the shelves; cards identify the species and show an adult photo. Some pupae you may see are a pill-shaped 2.5-centimeter-long butterfly chrysalis, metallic gold with black markings, or ones that look like brown or green leaves twisted into a narrow 2-centimeter-long tube. There may be cocoons wrapped in beige silk and dead brown leaves - these can reach 9 centimeters long! You may see butterflies or moths emerging or hanging from an empty pupa after stretching out their wings.

Through the emergence chamber the insect rearing room can be seen – there are shelves of aquariums and other arthropod enclosures. You may see staff working.

On the wall to the left are panels. To the right, a set of nested boxes describe different groups of arthropods. On the left is a description of scientific names and classification, the key to identifying a specific species, using *Apis mellifera* [APE-iss mell-IF-er-ruh], the honeybee, as an example.

The left third of this section has a 3.5-foot-wide case with rotating displays about entomology research.

The next section is just around the corner – continue following this wall to where it makes a wide turn.

Entomologists at Work Detailed Descriptions

Queen bee photo

Several bees are standing on top of honeycomb, and the center one is larger than the others, about twice as long. Her segmented, golden-colored abdomen significantly longer – unlike the other bees, who's wings mostly cover their abdomens when folded down, hers only reach back about halfway.

Drone bee photo

The second photo features a drone. A few bees stand on honeycomb, and a drone stands at the top center half again as long as the others, and stouter. His shiny black eyes feel the top of the head, reaching from either side and meeting at the middle, while the others have smaller eyes that don't meet.

Worker bees photo

Nine bees stand on honeycomb, with some capped cells and some open. Five all point inward toward the center, their heads close together. To the side one bee has its head in a cell – only the abdomen, pointing upwards, is visible. The bees all look similar. Their heads are oval shaped, with shiny black eyes at top sides, and short black antenna extending from below and to the center line. Behind the head is a rounded thorax. It looks dark, with yellowish fuzz. From the sides of the thorax membranous wings extend back. The wings are shaped like elongated teardrops, and nearly clear, making it easy to see the long abdomen behind the thorax. These are segmented, with stripes of a yellowish orange and a dark brown.

Larvae photo

Honeycomb cells fill the image, some are capped, a reddish orange color to the wax. Other cells are open, and most have a white segmented grub-like larvae curved in to fill the cell.

Emergence chamber

Just past the window into the lab is a set of metal shelves within a glass case. There are three shelf spaces – spanning the top of each shelf are metal bars parallel to the window, with small white planks, about the size of a large index card and 2 centimeters thick hanging parallel to the shelf. Each has one or more cards with a photo of a butterfly or moth and labels with common and scientific names and where the species comes from. Pupae hang from these planks, held in place by thin pins placed through a short tuft of silk at the top of the pupa or tabs of paper glued to the pupa. Some pupae you may see inlcude a pill-shaped 2.5-centimeter-long chrysalis, a metallic gold with black markings. Others look like brown or green leaves that have been twisted into a rough, narrow 2-centimeter tube. There may also be cocoons

wrapped in beige silk with dead brown leaves wrapped around the surface – these can reach up to 9 centimeters long! You may also see butterflies or moths in the process of emerging, or just emerged with crumpled wings, or just hanging out after stretching out their wings. Occasionally you will find recently emerged butterflies that have lost their grip and fallen to the shelf below.

Rearing room

Through the emergence chamber the insect rearing room can be seen – with shelves of aquariums and other habitats for arthropods, tables and equipment. You may see staff working.

Staff member photo

An Insect Zoo staff member in a lab coat examining a pupa in her hands, in front of a shelf with an open cardboard box with white trays packed with pupae and more trays on the shelf.

Entomologists at Work Exhibit Text

Inside the Hive

Honeybees (*Apis mellifera* [APE-iss mell-IF-er-ruh]) are social insects that band together and divide up the hard work of building and maintaining a hive. Thousands of bees live in a colony like this one, which includes three different types of adults—drones, workers, and a queen.

Honeybee photo captions

- The colony's **queen**—it's only sexually mature female—can lay up to a thousand eggs a day. She's the mother of most of the bees living here. Though she doesn't run the hive, at least half the bees would follow if she left to start a new colony.
- Male **drones** have one primary mission—fertilizing a queen during her maiden flight. Once the deed is done, they die almost instantly. Workers remove any remaining drones at the end of every summer.
- Most bees you see outside are sterile females, or **workers**, that take care of the colony's chores: cleaning the hive, feeding the brood, making beeswax for the honeycomb, guarding against predators, and foraging for pollen and nectar.
- The queen lays one **egg** in each cell. If she also releases sperm into a cell, the egg develops into a worker, or, if needed, a new queen. Unfertilized eggs become drones.

Who's Who in the Hive?

To find the queen, search for a crowd of workers, and she'll be in the middle. The workers make sure she's fed and cared for.

Notice that some bees have heavier bodies and bigger heads. They're **drones**.

Can you see newly laid eggs that look like tiny rice grains in some cells? The eggs hatch after three days, and pearly white **larvae** emerge.

House of Wax

Ever wonder how a **honeybee** (*Apis mellifera*) **hive** works? Inside is a highly organized society with intricate divisions of labor. **Workers**, sterile female bees, do most of the work. They…

- build the honeycomb of wax generated from glands under their abdomens;
- raise the young;
- forage for pollen to feed the larvae and nectar to make honey;
- Protect the nest from predators.

In many species, work is age-related. The worker starts out as a cleaner and passes through the roles of nurse, builder, guard, and—finally—forager. Bees seen outside the beehive are almost always workers that have left the nest to forage for pollen and nectar and protect the hive against predators.

At Risk?

In the last decade, honeybee numbers have been falling, and scientists are not sure why. Most believe that multiple factors are involved, including pesticides, fungicides, parasites, and declining plant diversity. It is believed that these factors are contributing to a mysterious condition called colony collapse disorder that causes bees to abandon their hives.

The impact could be devastating. Fewer bees mean fewer crops. One-third of the U.S. diet comes from crops pollinated by insects.

Interactive pullout

Did you know…honeybee foragers fly as far as 3 km (2 mi.) in search of pollen and nectar to bring back to the hive?

What's Happening Here?

This is our nursery, or emergence chamber, where pupae transform to butterflies and moths. The Museum receives shipments of over 100 different species from around the world, and here you can see many of them in the final days of their metamorphosis.

As the butterflies and moths emerge, they fill their delicate wings with liquid from their abdomens. Once the wings harden, we carefully move them to the Butterfly Pavilion next door.

Ledge photo caption

An Insect Zoo staff member carefully unpacks pupae from around the world.

Behind the Scenes!

The many-legged creatures in the Insect Zoo were chosen for the revealing stories they tell about the natural world.

To exhibit live insects, our staff must know what they need to stay healthy and reproduce—no easy feat! Many insects have not been closely studied, and they inhabit an amazing range of habitats in almost every corner of the world.

Quote:

No [one] can truly be called an entomologist, sir; the subject is too vast for any single human intelligence to grasp.
Oliver Wendell Holmes
The Poet at the Breakfast Table

What's in a Name?

Besides having a common name, every insect has a scientific name. That name—which belongs to one and only one species in the world—is the key to its identity.

Quote

"What's the use of their having names," the Gnat said, "if they won't answer to them?"

"No use to them," said Alice, "but it's useful to the people who name them, I suppose."

Lewis Carroll, *Through the Looking Glass*

How do insects get their names?

There may be as many as 30 million insect species. Insect taxonomists identify and name insects using a standard hierarchical system.

Consider the Honeybee; AKA *Apis mellifera* [APE-iss mell-IF-er-ruh]

The first name, *Apis*, puts the bee in a particular **genus**.

The second name, *mellifera*, is its specific – or **species** – name.

The honeybee's scientific names comes from the Latin for "bee that carries honey."

Chart

Category	Honeybees
Kingdom	Animalia
Phylum	Arthopoda (animals with jointed legs)
Class	Insecta [in-SEC-ta] (arthropods with three body parts)
Order	Hymenoptera [HY-me-NOP-te-ruh] (membrane-wing insects)
Family	Apidae [AP-i-dae] (including honeybees and bumblebees)
Genus	***Apis*** (true honeybees)
Species	***mellifera*** (common honeybees)

Nested illustrated wall chart

- **Arthropods** are invertebrates with hard outer skeletons, segmented bodies, and jointed legs.
- **Trilobites** [TRI-low-bite-s] (extinct) are marine arthropods with a hard upper shell and three body sections
- **Myriapods** [MYR-ia-pod-s] are arthropods with many pairs of unbranched legs.
    - Includes millipedes and centipedes
- **Chelicerates** [CHE-li-CER-ate-s] are arthropods with extra appendages in front of the mouth, no antennae, and two body sections.
    - **Arachnids** are chelicerates with eight legs.
        - Includes spiders, scorpions, ticks and mites
    - **Horseshoe crabs**
- **Pancrustaceans** are arthropods with a flexible outer skeleton and two-part legs.

- **Insects** are pancrustaceans with six legs and three body sections
    - Most diverse group of animals with as many as 30 million species including *Apis mellifera*
- **Crustaceans** are pancrustaceans with three body sections.
    - Includes crabs, lobsters, shrimp, and barnacles

How Do We Know?

Our knowledge of insects and their relatives comes from three centuries of collecting and studying them. With some 35 million species, the insect collection at the Museum is the largest in the world. Scientists here and from around the globe use the collection to explore the incredible diversity of insects on Earth. *[Please note that this panel has a typo which will be corrected – there are 35 million **specimens** in the Museum's insect collection.]*

Section 10: How Dangerous Are They?

How Dangerous Are They? Core Track

This section of the Insect Zoo stretches about 5 feet along part of a single wall. There are two small enclosures at the center, and text and images on the surrounding wall and ledge.

This section focuses on some of the few instances of insects that can be a danger to humans, through bites or as carriers of harmful diseases.

The plague and malaria are both carried by insects. The Oriental rat flea picks up the plague-causing bacteria from rats before passing it to humans through bites, while the Anopheles mosquito transmits the protozoan that causes malaria.

Above the enclosures is a large illustration, grey lines covering a 3-foot span of the blue wall, showing a scene from the Black Death – a field outside a 14th-century European city, where bodies stacked in horse-drawn carts are moved to graves.

Below the illustration to the left are two circles, with drawings of malarial and common mosquitos at rest.

In the center are two enclosures; text and photos below provide information about the residents, spiders that can be harmful to humans, but only bite in self-defense. The enclosures are separated by a clear wall – the left has a terra cotta flower pot on its side, and right a gardening glove and a hand shovel.

The left enclosure contains a black widow spider, often found inside the pot, supported by thin silk strands. It has smooth black body, nearly a centimeter long, with a large round abdomen and long thin legs about 2 centimeters long. Depending on its position, you may see the characteristic red hourglass marking under the abdomen.

The enclosure to the right contains a brown recluse spider. This spider can be difficult to find, as its light brown color blends into the dirt and it is often near the glove or shovel blade edge.

A sign to the right describes the distribution of these spiders in the United States, with shaded maps – black widows are found across the all lower 48 states, while the range of brown recluse is limited to a small area in the southwest and an area in the south central and Midwest region.

The next section is just around the corner to the left - follow the wall to just past the turn.

How Dangerous Are They? Detailed Descriptions

The Black Death illustration

Above the enclosures and to the left is an illustrated scene, about 3 feet wide and 1.5 feet tall, with dark lines on the blue background of the wall showing a scene from the Black Death – set in a field, with the buildings of a 14th century European city in the background. A long building with peaked roofs and a short tower sits at the left. In the field, men in old-fashioned dress move stiff-looking bodies from horse-

drawn carts into large open graves. Behind them, other figures stand near covered graves, one with a shovel.

Mosquito illustrations

Two 13-centimeter-wide circles are affixed to the wall, each with a drawing of a single mosquito. The left one is labeled “malarial mosquito at rest” and the right one is labeled “common mosquito at rest.” Both have long, tube shaped bodies, medium length antennae with short bristles coming out, a long needle-like mouth, what looks like a single wing folded along the back, and long thin legs. The malarial mosquito is smaller, with all six legs on the ground and its body tipped at a diagonal with its head down and abdomen pointing up to the right. The common mosquito is larger, with the middle pair of legs held off the ground, sweeping up and back past the end of the abdomen. The body is parallel to the ground.

Black widow and Brown Recluse enclosures

In the center, two enclosures are separated by a clear wall, and together look like a dirt-covered corner of a garden – on the left is a terra cotta flower pot on its side, the open top facing forward and to the right. A thin scrap of wood lays in the pot and a stick leans up against the separating wall.

On the right, a pink gardening glove lays on the ground, partly covered in dirt, and a small hand shovel leans up against the front right corner, resting on the tip of the white blade with a green handle pointed up.

The left enclosure contains a black widow spider. The interior of the pot has thin silk strands tangled throughout and connecting to the side walls and pieces of wood. The black widow spider can often be found in the pot or near the opening, suspending among the tangle of silk. It is a small spider with smooth black body with a large round abdomen and long thin legs – the body is about 9 millimeters long, and each leg is a little more than twice as long as the body itself. Depending on the spider’s position, the characteristic red hourglass markings under the abdomen may be visible, also shown in the photo below the enclosure.

The enclosure to the right contains a brown recluse spider. This small brown spider is often difficult to find, its light brown color helping it to blend into the dirt and is often hiding on the ground near debris or where the shovel blade meets the ground. The body is only about 5 millimeters long, while the thin legs are each about three times as long. A photo below shows the characteristic violin-shaped dark brown marking on the front of the tan cephalothorax [SEF-a-low-THO-rax].

How Dangerous Are They? Exhibit Text

How Dangerous Are They?

Close encounters with bees and wasps are sometimes too close, and their stings do hurt. But for most of us, contacts with these or other insects cause little more than annoyance.

In a few instances, however, insects have tremendous impact on human life and history as carriers of deadly or very harmful diseases.

Black Death illustration caption

The **bubonic plague**, or Black Death, was the worst disease epidemic in human history. It took 14 million lives (nearly one out of four people) in 14th-century Europe. The plague is passed to humans by the bite of the **Oriental rat flea** (*Xenopsylla cheopis* [zen-OP-syl-la KY-op-is]), which picks up the disease-causing bacteria from rats. The plague still occurs in various parts of the world—even in the United States!

Mosquito illustration caption

- Malarial mosquito at rest
- Common mosquito at rest

Malaria kills thousands of people each year. It is caused by protozoans transmitted by the *Anopheles* **mosquito**. While there are few cases in North America, the threat of malaria is great in the tropics - where most Anopheles mosquitoes live. Travelers can take medications and other precautions to reduce the risk of contracting malaria.

Brown recluse spider distribution

These spiders live in the south-central and southwestern United States, and a few isolated populations may exist outside their natural range.

Top map caption

The range of brown recluse spiders (*Loxosceles* sp. [lawx-AW-sel-ees species]) in the United States.

Black widow spider distribution

Black widows are more prevalent in warmer regions, but they're found throughout the United States.

Bottom map caption

The range of black widow spiders (*Latrodectus* sp. [LAT-ro-DEC-tus species]) in the United States.

Insect relative

Contrary to popular belief, **black widows** (*Latrodectus* sp.) aren't aggressive towards humans and only bite in self-defense. Their venom contains neurotoxins that attack a victim's nervous system and cause nausea, pain, and respiratory problems. But taking antivenin can neutralize the neurotoxins.

If you see a spider with a red hourglass marking, it's a black widow. These spiders wrap their victims in a cocoon of silk. When ready to feed, they inject the prey with digestive enzymes that liquefy the body—then suck up the fluid remains.

Insect relative

Brown Recluse spiders (*Loxosceles* sp.) are skittish. They prefer to run when threatened and bite only in self-defense. But if they do bite, cytotoxins in their venom attack cell tissue and the wound can take months to heal.

These secretive spiders hunt at night and retreat to dark, hidden spaces by day. They live outside under leaf debris, rocks, and logs, but are equally at home indoors. To identify the spider, look for the violin-shaped marking.

Interactive pullout

Bite or Sting? Insects such as mosquitoes and fleas bite with their mouthparts. Others, such as bees and wasps, inflict pain with a stinger at the end of their abdomens.

Section 11: Sonoran Desert Dwellers

Sonoran Desert Dwellers Core Track

This section of the Insect Zoo covers an 8-foot-long wall, plus the short caps where the corners are cut at an angle. Five enclosures and a ledge below span the section.

This section focuses on desert arthropods, which have different adaptions to handle the special challenges of heat, water shortages, and evaporation, for example by having waxy coatings that keep in water or being active only at night.

The set of five enclosures are separated by clear panes and mimic a desert scene – ground covered in sand and rocks, with cactus, dead wood and animal bones in some. Hiding is a way some desert arthropods avoid the heat, and many of the resident arthropods hide under or near objects in their enclosure. Text and photos on the ledge provide more information about each resident.

The right most enclosure, seen from panes around the right side corner and the first foot of the main wall, contains a dark brown and reddish-tan centipede, with a flattened, segmented body, with one pair of legs extending to the sides from each segment behind the head.

The second enclosure, to the left, is 2 feet wide and contains a vinegaroon [vineGAR-oon], with a dark, stout, rounded body and a wire-thin tail-like structure, almost as long as the body itself.

The center enclosure, 2 feet wide, contains two types of darkling beetles, and occasionally velvet ants. The larger beetle species is about 3 centimeters long with a black, smooth exterior. The smaller species is about 2 centimeters long and is usually a dusty bluish-grey color with a rougher exterior with lines of tiny raised dots. Both have a small head and rounded thorax, from which hardened wings fold back over the rest of the body, giving it a domed appearance. The velvet ants look like large black furry ants with a patch of red fur on the abdomen and are actually wasps.

The next enclosure to the left, 2 feet wide, contains a tarantula, its tan and brown body covered in light hairs, which often hides in its burrow, a tunnel that leads down along the glass, ending in a rounded space.

The last enclosure, the last foot of the main wall and continuing around the corner, contains a brown and tan scorpion, about 10 centimeters long.

The next section is across the hall. From the left corner of this section, turn to face the opposite direction and walk forward about 7 feet to the rainforest entrance, where the floor changes from carpeting to smooth concrete.

Sonoran Desert Dwellers Detailed Descriptions

Enclosure series

The enclosures for this section are in a series, separated by evenly spaced clear panes, and cover all of a 8-foot-long wall, along with the caps of the wall where they make 135-degree angle turns. Together, the enclosures mimic a desert scene – ground covered with a mix of sand and rocks, no vegetation aside from cactus and dead wood, and a few small animal bones.

Centipede enclosure

The rightmost enclosure has clear panes on both sides of the corner, staring in-line with the previous section, with a before turning and stretching 12 inches along the main wall. Inside, the ground slopes down from the left to right, with a piece of wood, a small animal skull and a water dish. The centipede may be burrowed out of sight under the water dish. The centipede is about 12 centimeters long, with a flattened, segmented body, with one pair of legs extending to the sides from each segment behind the head. The body is dark brown and a lighter reddish brown – the front part of the body is mostly dark, with the exoskeleton lightening gradually moving away from the head. The head is rounded, with two long antennae extending forward. Where the segments overlap the exoskeleton is dark, giving a slightly striped look. The legs are a pale color, slightly broader at the base than the point and increasing in size from the front to back. The last pair of legs, which are thickened compared to the others, will generally be pointed back in a V, and the rest will generally reach out to the sides.

Vinegaroon [vinegar-roon] enclosure

The enclosure contains a short, round cactus with long, flat spines, and a few pieces of dry wood. The vinegaroon is often found hiding at the base of the cactus, and its long, thin tail-like flagellum blends in with the cactus needles. It has a dark, rounded body, about 3 centimeters long, with a wire-thin tail-like flagellum that extends from the back center of the abdomen and can be almost as long as the body. The cephalothorax [SEF-a-low-THO-rax] is a boxy oval shape, and the front corners have thick, flattened jointed pedipalps, which end in pinchers. Just behind each pedipalp is a long, thin, antenna-like leg – these are often held out to the side with the last two long segments bent forward – if stretched out, these would be about as long as the body and outstretched pedipalps. The other three pairs of legs are shorter and slightly stouter. The abdomen is a rounded oval. At the center of the back is a short thick tube, like a cap on a toothpaste tube, that the flagellum extends from.

Darkling beetles enclosure

This enclosure contains two types of darkling beetles. Occasionally there are also velvet ants, which will be noted by a white card label inside the enclosure. The enclosure has pieces of wood, a small animal skull and jawbone, and sometimes pieces of food such as sweet potato slices. The larger species is about 3 centimeters long with a black, smooth exterior. The smaller species is about 2 centimeters long, with a rougher exterior, and is usually a dusty bluish-grey color. Both have a similar body plan. They have small head, often pointed downwards in front of a rounded thorax. Hardened forewings fold back over the rest of the body, giving it a domed appearance. The legs are thin and jointed, with the top segments thicker and flattened compared to the later segments. There may also be velvet ants in this enclosure. They look like furry ants, 2 centimeters long, mostly black with patches of red “fur” on the top surface of their abdomen, thorax and head, giving them their name, though they are actually wasps. Only the wingless females will be present.

Tarantula enclosure

A gnarled piece of wood sits on the ground with rocks, and a tunnel leads down from the right corner along the front glass, ending in a rounded space. The tarantula is often found hiding down in the tunnel or under the wood. The tarantula’s body is about 5 centimeters long. Its cephalothorax is a light tan brown, while its abdomen is a darker brown. There may be paler patches on the abdomen where the darker hairs have been flicked off as a defensive response. Its pedipalps and legs are covered with fine

short hairs, and start out light brown near the top, where they meet the body, and darken toward the feet.

Scorpion enclosure

Near the middle of the enclosure is an upright oval cactus with long flattened spines. The scorpion is often found hiding at the base of the cactus. The scorpion is about 10 centimeters from head to the end of the stinger and brown and tan in color. The rounded oval shaped body is dark on the top, with fat pinchers reaching out at the front. The legs and the pinchers are light colored. The segmented tail is almost as long as the rest of the body and is also a lighter color.

Sonoran Desert Dwellers Exhibit Text

Desert Dwellers

Desert arthropods have adapted in many ways to the special challenges of heat, water shortages, and evaporation.

To retain water:

- A thick, waxy body covering keeps water from evaporating.
- They remove water form solid foods and reabsorb water from their feces.

To avoid starvation:

- Many are active only when the plants they eat are plentiful.
- Others subsist on seeds and grasses blown across the sand.

To survive in the dessert sun:

- Many venture out only at night.
- During the day they conceal themselves underground or beneath plants and rocks.

Insect relative

Centipedes rely on speed, strength, and venom from their fanglike front legs to overpower prey. Though centipede bites are painful, their venom is not deadly to humans.

Insect relative

Whip scorpions, or **vinegaroons** [vinegar-roon-s], overpower their prey with sharp pincers. They squirt acetic acid–the main ingredient in vinegar–from their abdomens to ward off enemies.

The darkling beetle

(family Tenebrionidae [te-ne-bri-ON-i-dae]) gets along on the tiny amount of water it extracts from seeds. Hard, waxy forewings protect its breathing tubes from the harsh desert air.

Insect relative

Tarantulas (family Theraphosidae [ther-ah-FO-suh-dee]) spend most of their lives in burrows and feed on mice, frogs, lizards, and insects.

Insect relative

Hungry **scorpions** use their pincers to grab and tear other arthropods to pieces. Only when a meal is unmanageable do scorpions use their venomous stingers.

Interactive pullout

Did you know…the whip scorpion earned its nickname-vinegaroon-from its ability to squirt enemies with a concentrated spray of acetic acid (vinegar) from the base of its tail?

Section 12: Rainforest Riches

Rainforest Riches Core Track

This large section of the Insect Zoo includes both sides of a 50-foot-long exhibit hallway. -For this tour, you should start along the right side of the hallway, which has a textured wall – the smooth walls to left at the start include a staff-only door that can open outwards. You may notice a change in lighting when you enter, as it is darker than the previous section. This section is built like a rocky corridor through a rainforest – it is a bit like walking through a diorama. You can feel the textured walls and artificial trees as you proceed, and vines and tree branches stretch out above. In places parts of the wall jut out further than where they meet the ground. On the far end, this corridor exits into the Ancient Egypt exhibit. The section contains panels of text, ten enclosures and several displays of preserved specimens. Ledges below most enclosures have related text and photos.

This section focuses on rainforest dwellers. Two large panels at the entrance describe rainforests with an illustration and a map.

Following along the right side, the wall turns lightly to the left about 17 feet down. A window is set into the wall 3 feet above the ground, showing a diorama with passionflower vines and Heliconius [hel-i-CO-ni-us] butterflies – the butterflies lay eggs on the vines, which have a range of defenses against the hungry caterpillars that will hatch out. Preserved butterflies and caterpillars are posed on a passionfruit vine model, and signs point out examples of plant defenses such as false egg spots.

Beyond, the path curves around and a low bench extends from the right-side wall – 20 inches from the ground and nearly 5 feet long. Just past the bench is a three-sided enclosure with a ledge, filled with colorful bromeliad plants and cone-headed katydids. The katydids are about 5 centimeters long and bright green, with a single yellow horn-like projection on the head.

To the left of the katydids the wall curves in and around before you reach are two enclosures inset about a foot into the wall next to each other, both with smooth angled ledges in front of the inset windows. The short enclosure on the right, starting 2 feet off the ground, is full of plants, including a pitcher plant; photos below show other types of carnivorous plants. The enclosure to the left, starting 2.5 feet off the ground, has emperor scorpions, but it is dark, with no lights inside. On the ledge below is a button– pressing it turns on a UV “black” light, which makes any scorpions in view glow blue green.

To the left, the wall curves around and another enclosure is embedded in the wall. It contains Amblypygids [AM-blee-PIIG-ids], which lurk in cracks and other protected places. Their mottled brown bodies are flattened, with a broad triangular cephalothorax [SEF-a-low-THO-rax] and oval abdomen. Long, spiked pedipalps extend from the front of the head, often held straight out to the side and folded in half. Behind the pedipalps are four sets of long segmented legs – the first pair resembling long wiry antennae.

Beyond this enclosure is the exit to the Ancient Egypt exhibit. To continue this tour, turn to face opposite from the amblypygid enclosure and walk forward about 6 feet. You will be in front of a large model strangler fig tree with thick vines tangled around the trunk; in eight of the gaps are small oval windows. Five have enclosures with live insects that are rotated, and such as praying mantises, small

stick insects and large rhinoceros beetles. The others have preserved specimens: a morpho butterfly, a peanut headed bug and a longhorn beetle.

To the left of the fig tree is a large mound covering most of the wall, with a tree on top and roots reaching down along either side and between two enclosure windows. These contains leafcutter ants, which gather leaves and plant material to feed their underground gardens of fungus, their sole source of food. The left side has space for a bundle of leafy branches, and a tunnel leads through the center wall to the right side, which has six small chambers. When inhabited, these chambers may have different contents – some filled with clumps of a fuzzy white and grey fungus, with ants tending to the garden. Currently, a TV monitor in the left section shows a live feed of a young colony being raised in the rearing lab until it is ready to be placed on exhibit. This more magnified view of the fungus garden may show that the fungus clump exteriors have tall but thin ridges in irregular patterns, made of tiny brown pieces of plant matter and small white dots of fungus. An inset box on the right, below the chambers, has a preserved Queen specimen with a large dark red, almost black, body.

To the left the mound slopes down and a tree is set against the left side wall, with the large brown mass of a termite nest at the fork of a branch. Below, on the slope of the mound about 18 inches off the ground is small inset enclosure, window parallel to the floor, with Giant Cockroaches. These are about 6 centimeters long, and are a flattened oval shape, a light yellow-brown with dark brown markings.

The next section is around the corner from where you entered. Continue along the wall and turn right when you get to the main hallway.

Rainforest Riches Detailed Descriptions

Canopies: The Final Frontier panel

The panel is filled with an illustration of a rainforest – four colors of silhouettes of trees and other vegetation. Labels identify four layers identified: the forest floor, on the ground with small plants; the shrub layer, just above the ground with larger plants; the canopy layer, up in the branches of most of the trees; and the emergent layer: the branches of isolated trees taller than the others.

Passionfruit vines and butterflies display

This 2-foot wide display case is set into the wall, 3 feet above the ground, with signs and a diorama with a flowering vine and insects. Preserved butterflies and caterpillars are posed on an artificial passionfruit vine that starts at the bottom left of the window and reaches up and across to the left side. The butterflies have thin, dark bodies about 2.5 centimeters long, with long wings that stretch out to the sides for a span of 6 centimeters. The wings are dark brown with an orange diagonal stripe across the middle of the front pair. The caterpillars are small, only about 2.5 centimeters long, and are light yellow with thin, needle-like spines sticking out along their bodies. One hangs down from the edge of a leaf. Behind its head, on the thorax, are three pairs of narrow legs that hold onto the leaf. The segmented abdomen extends back, and starting on the third segment back, there are five “prolegs” that are fleshy, triangular appendages that also hold onto the leaf. At the bottom of the case, small brown ants sit on a horizontal section of the vine. The vine’s leaves are dark green with three broad pointed lobes. Thin green tendrils extend from the main stem, most ending in a tight corkscrew spiral. The flowers are bright red – open flowers have nine long thin petals arranged in a flat circle, like spokes on a wheel, and at the

center has thin strips surrounding a long stamen that splits into several thinner strips with yellow oval or white spherical lobes.

Cone-headed Katydids enclosure

This three-sided enclosure filled with colorful plants and cone-headed katydids. The plants are bromeliads [bro-MEEL-i-ad-s], and the ones on the ground have long leaves extending out in a cluster from the base. In some, a center flower-like stalk has shorter colorful leaves – one may be pink, another yellow and peach colored. The katydids often are found near the bases of the plants or on the walls. They are 5 to 6 centimeters long and a bright green color. The bodies are narrow at the front and back, and 1.5-centimeter-wide near the thorax. The head is an oval shape, slanted down – at the top the head narrows and extends up in a single yellow horn-like projection. One either side of the horn are long thin antenna that narrow to almost the width of hair. Just below on either side is a small whitish sphere– the eyes. The bottom third of the head is dominated by the mouthparts with shovel-like plates at the top and bottom, and green fingerlike appendages on the sides. Behind the head, a plate on the thorax wraps around the top of the body, extending back slightly in a half circle, edged in yellow. From below this half-circle plate extend membranous wings that resemble leaves and fold together at an angle and cover the body, a little like a folded piece of paper. The top edge of the wings has an irregular reddish line. The six long legs that extend from below the thorax are shaped like thin, bent straws, and are green with small yellowish spikes spaced out along the front edge. The females have a long, thin ovipositor that sticks out from the back of the abdomen, like a narrow toothpick, in colors matching the body.

Carnivorous plants enclosure

The first enclosure is full of plants, and there are photos and text below about three types of carnivorous plants: pitcher plants, butterwort and bladderworts. A pitcher plant l is found in the enclosure above. The pitcher plant flower is 3 to 4 centimeters tall, shaped like a round-bottomed tube that bulges slightly near the bottom. The top “opening” is on a slant, and the edge curls out slightly like a rim. At the top point of the slanted opening is an oval-shaped “lid,” attached by a narrow hinge, that covers the tube’s opening like an umbrella. It is pink with and pale orange when young and brownish green with red splotches when older. A thin, wire-like pink stem connects the bottom of the flower to the rest of the plant. The photo of the butterwort has five fat, fuzzy leaves, which are white with some faint green coloring and resemble petals, overlapping each other at the center. The leaves are covered with short transparent stalks, not much bigger than short hairs, rounded at the tops like with a drop of liquid. The bladderworts photo shows a cluster of flowers growing out of a container of water. The thin green stems reach out of the water with small whitish-yellow flowers, some narrow buds and other with petals spread. Below the water, branching structures can be made out.

Emperor scorpions enclosure

This enclosure is unlit, and only the front inch or so can be seen by the light from the exhibit outside. Pressing the button below the window turns on a UV “black” light – the light casts a purple-blue color on most of the enclosure, and any scorpions in view (or any parts of their shells) glow a bright blue green under UV light. A mirror in the back right may show any scorpions hiding in the left side of the enclosure. This species is about 10 centimeters long from the head to the tip of the stinger, with pinchers about 4 centimeters long. They are a shiny black color under normal light.

Amblypygids [AM-blee-PIIG-id-s] enclosure

The enclosure is encircled with rocky walls and extends past the window to the left, and the amblypygids often hide off to the sides in the nooks and crannies - a mirror in the back right shows some of the area to the left. The amblypygids are a mottled brown color. Their cephalothorax [SEF-a-low-THO-rax] is a rounded triangular shape with the point facing forward, about 1.5 centimeters wide. Behind it, the abdomen is shaped like a flat, segmented oval, just as wide and a little longer than the cephalothorax. Short paired mouthparts extend from the front of the cephalothorax, with the long, spiked pedipalps extending to either side. These are shaped like slightly flattened tubes and are segmented with pinchers on the ends. The first large segment extends straight out to the side, about as long as the body is wide. The next segment is almost as long, ending in the small pinchers, and the joint between them is like an elbow – often the joint is fully bent so that the two segments are folded together, like someone holding their arms straight out from the shoulder, with elbows bent in. When the joint is opened, the inner row of spikes can be seen. Behind the pedipalps are four sets of long segmented legs – most are about twice as long as the body itself, but the front pair of legs are very long and antenna like, twice as long as the other legs.

Strangler fig tree display

a large tree with thick vines tangled around the trunk; in some of the gaps are inset windows. Behind the inset windows are three spaces with preserved specimens and five enclosures with live insects. The insects in this tree are regularly rotated and are likely to include large beetles such as a rainbow stag beetle or rhinoceros beetle, praying mantises and smaller stick insects. The preserved specimens are a Morpho butterfly, a Peanut headed bug and a Longhorn beetle.

Morpho specimen

This butterfly is pinned to a vertical piece of wood, its wings open and fully spread. Its body is about 2.5 centimeters long, roughly tube shaped, and covered in long, fine scales, giving it a slightly furry appearance, greyish brown in color. Two long thin antennae reach out side-by-side from the head, parallel to the wood below.

The wings are large, and on each side the top and bottom pairs overlap along the middle, so that together they are shaped like an uppercase “D,” with the curved edge meeting the body. The wings are covered in scales, which are each colored, like pixels, and most are too small to be distinguish without magnification. The open sides of the wings are covered in iridescent scales that shift in color from blue to purple to almost no color, purple, depending on how the light hits it. The edges of the wings are brown with white marks, and that coloring can be made out underneath the iridescent scales when the light is not directly on it. The inner edge of the bottom wings that frame the body and extend down and out, have a fringe of long tan scales.

Peanut-head bug specimen

The Peanut-head bug on a piece of wood that leans against the back of the space, tilted toward the window, posed so that it is facing upwards to the back left. This is a large bug, about 10 centimeters long. Its head looks like small inflated balloon roughly the shape of a peanut shell, yellowish brown with some orange marks, and is about a third the length of the body, just under 3 centimeters long. Near the base of the head, just in front of the thorax, a pair of small eyes are set to the sides, small black beads.

Behind the head, the thorax and abdomen shaped like a thumb, extending back in a cylinder, about 2.5-centimeter-wide rounded at the end. Just behind the head, a thin plate on the thorax warps around, about 7 millimeters from front to back. Behind it at the center is a triangular plate about 1.5 centimeters wide and half a centimeter long, with point toward the abdomen. The front wings are attached just to the side of the front corners of this triangle, and are folded over the body, framing the triangle and meeting along the midline. They cover the rest of the thorax and all of the abdomen, wrapping around and ending in a rounded knob at the back. The wings are a yellowish green with white speckles.

The thin, segmented legs reach out and down from under the abdomen, yellow and grey.

Longhorn beetle specimen

The longhorn beetle specimen is posed on a piece of wood that is tilted toward the window, facing to the right.

The beetle is a about 3.5 centimeters long, and 1.5 centimeters at its widest point. It has dark brown and light yellow-tan markings. The head is shaped like a short, rounded cylinder about 7 millimeters long. Two long antennae reach out, forward and then curving back, starting near the front of the head, on either side at the top. Each antenna is about as long as the beetle itself. The base of each antennae is a small, dark rounded segment. Beyond that are seven segments, each about 6 millimeters long. The first four segments have small hairs all around pointing toward the tips of the antennae, brown near the base and yellow near the top, giving a striped look. The last three segments are yellow with no hairs.

Behind the head is the armored thorax. The first section has a plate that wraps around the sides with four small spikes spaced apart, one pair on the edge the top and another pair straight out to the sides. This section is mostly a dark brown, with light brown on a line along the midline and on the spikes. The hardened front wings attach to the body just behind this section, folded back over the rest of the body, meeting at the midline, together looking like an elongated shield in a rounded rectangle. The wings have symmetrical markings of yellow and dark brown shades. The six legs are light brown, shaped like thin, bent tubes, reaching out to the side and then down to the wood below.

Leafcutter ants enclosure

This Leafcutter Ants display spans about 14 feet, shaped like a sloping mound under a tree. Near the center, a thick root that reaches down along the front and divides the display into two sides. Currently, a TV monitor is in the left section with a live feed of the young colony being raised in the rearing lab until it is strong enough to be placed on exhibit. The view shows ants tending to clumps of their white and grey fungus. This more magnified view of the fungus garden may show that the exterior of the fungus clumps have thin ridges in irregular patterns, made of tiny brown pieces of plant matter and small white dots of fungus. The ridges seem a bit like the walls of honeycomb cells, but with erratic shapes rather than regular hexagons. When inhabited, the large enclosure on the left will have a bundle of leafy branches in the center, and a tunnel leads through the center wall on the right to the section with six small windows that look into small chambers, and another widow showing a long strip of clear tubing. On the left, ants may be chewing a line along a leaf to cut off a piece of leaves and then carrying them into the tube to the chambers on the right. These chambers may have different contents – in some, the ants may be chewing the leaves to pulp, which is then used to grow the fungus in fuzzy white and grey clumps fungus, or tending to the garden. Other chambers may be used as a trash bin, keeping debris like

from rotting leaves or dead ants away from the other chambers. Below the chamber windows, an inset box shows a preserved specimen of a Queen – about 2 centimeters long, with a dark red, almost black, body.

Giant Cockroaches enclosure

This shallow enclosure is near the ground, and the window is parallel to the floor. Viewed from above, the window is an oblong, and the brown rocky sides of the enclosure curves out a little further than the edge of the window. The cockroaches are often found hiding on these sides. These are large, about 6 centimeters long, and from the top appear to be a flattened oval, light yellow brown with dark brown markings. From the top, often all that can be seen is a broad oval plate on the thorax and the wings folded flat over the thorax and abdomen. The oval plate on the front of the thorax is large enough to cover the head and extends out to the sides. The plate is a light brown with a dark blotch in the center. Behind the plate the cockroach's broad, shiny membranous wings are folded over each other forming a flat oval. The wings are light colored and sometimes have darker blotches where they overlap near the middle. The wings are thin enough that with enough light, the segmented abdomen is visible through them – the abdomen is almost as wide as the folded wings.

Rainforest Riches Exhibit Text

Rainforest Riches

Welcome to the **tropical rainforest**–home to nearly half of Earth's species of living things–where the climate is never too hot or too cold. For 60 million years, ancient rainforests have been just right for an unbelievable number of plants and animals.

It's a Jungle in Here

Rainforests are bursting with life, and the problem for plants and animals is balance. How do they compete for time, space and food?

Some rainforest animals are active at night, others by day. Some live high in the canopy, others near the ground. Some prefer dark hiding places, others live out in the open.

Map Caption

Covering an estimated 7% of earth's surface, tropical rainforests stretch around the equatorial belt. Animals and plants that live in the New World, or Neotropics, are quite different from those that live in the Old World tropics, which reach from West Africa to Australia.

Canopies: The Final Frontier

Thousands, perhaps millions, of unknown insect species await discovery high in the jungle canopy.

A typical rainforest has several zones–each brimming with its own mix of flora and fauna.

Canopy illustration Labels

Emergent Layer

Canopy Layer

Shrub Layer

Forest Floor

The forest **canopy** is the richest level. There, **photosynthesis**—the process by which sunlight nourishes plants—drives an explosive burst of life. More than half of the rainforest's plants and animal species are born, reproduce, and live their entire lives without ever touching the ground.

It Takes All Kinds

The sheer number and diversity of insects found in the world's rainforests amazes and inspires scientists, environmentalists, and nature lovers alike. Here are just a few of the species that make the rainforest such a model of biological diversity, or **biodiversity**.

Strategic Defenses

Rainforest insects and plants have had a long love-hate relationship.

Heliconius [hel-i-CO-ni-us] butterflies (*Heliconius* sp.) lay their eggs on **passionflower vine** (*Passiflora* sp. [pas-si-FLO-ra species]) leaves. When the eggs hatch into hungry, leaf-eating **caterpillars**, the passionflower vines protect themselves with a range of defenses.

The Heliconius caterpillars and butterflies are **real preserved specimens**.

The passionflower vines and the ants are **models**

Diorama labels

Fake eggs…The passionflower vine will sometimes grow parts that look like Heliconius **butterfly eggs**. Since Heliconius caterpillars are cannibalistic, the butterflies avoid laying their eggs on leaves that appear to be occupied.

Dumpers…Heliconius butterflies like to lay eggs on upward-curling tendrils of passionflower vines. Some vines produce **weak tendrils** that give way under the weight of developing eggs.

Guards…Passionflower vines may enlist **ants** to pick off young Heliconius caterpillars developing on the leaves. In return, the vines supply the ants with nectar.

Life in a Bromeliad [bro-MEEL-i-ad]

Bromeliads often host a crowd: beetle larvae, spiders, sow bugs, cockroaches, and pseudoscorpions can coexist in the same plant.

Pools of water that collect in bromeliad bases provide breeding grounds for many rainforest mosquitoes (family Culicidae [kew-LISS-ih-dee]).

"Swamp" Creatures

Many bromeliads are a type of epiphyte, plants that use other plants, trees, or cliff walls for support. Often, they provide surprising arthropod microhabitats—habitats within habitats. Like small aquariums, some hold as much as two gallons (7 L) of water.

Look for cone-headed katydids (family Tettigoniidae [tet-i-gon-EYE-i-dae]) on the plants and rocks above. They often crawl into the watery bases of plants to look for an insect feast.

What's for Dinner?

Katydids are omnivores: we feed them fruit and greens as well as mealworms and crickets. The powerful lower jaw, or mandible, is equally good for slicing up fruit or catching and dissecting prey.

Life on the Edge

In the wild, the scorpions and carnivorous plants below thrive in places too harsh or marginal for many other species. Scorpions endure freezing temperatures as well as scorching deserts, and some species can even survive on just one insect a year.

In a bizarre reordering of life, carnivorous plants prey exclusively on insects in the ponds, marshes, and poor soils where they flourish.

Photo captions

Lured by the **pitcher plant's** (*Nepenthes* sp. [ne-PEN-theez species]) sugary nectar and enticing colors, an insect slips down the slick interior and drowns in the pool of fluid below.

A **butterwort** (*Pinguicula* sp.) is a death trap for small insects trapped in its sticky goo. Once the goo, or mucilage, envelops the prey, digestive enzymes finish the job.

Beautiful enough for the garden, **bladderworts** (*Utricularia* sp. [you-trik-you-lare-ee-uh]) have unseen perils. An insect brushes a hair on the mouthlike foliage, and it's suddenly sucked into the bladder hidden underneath.

Glow in the Dark

Watch these emperor scorpions turn an eerie, blue-green color when the ultraviolet light goes on. All scorpions fluoresce in the dark like this, and scientists are trying to find out why.

Some research suggests that fluorescence may help scorpions avoid predators. Their entire bodies collect light when they're in the open where predators can see them. But the glow fades in the shade, indicating a safe place to hide.

Emperor Scorpion

Pandinus imperata [pan-DEE-nuhs im-pu-RAH-tawr]

West Africa

Press the button to watch the emperor scorpions glow.

Amblypigids [AM-blee-PIIG-id-s]

Damon diadema [DAY-mon di-ah-DE-ma]

Central Africa

Amblypigids lurk in cracks, under bark, and in other protected places. When the sun sets, they emerge to stalk prey, spearing their victims with spiny limbs called pedipalps. Amblipigids are also known as tailless whip scorpions, but they aren't true scorpions.

They Live

With their unsurpassed ability to adapt to changing environments, insects will always be around to fascinate and sometimes annoy us. They will continue to find ways to reproduce, obtain food, disperse, and hide—a cycle that will go on and on until long after we are gone.

Killer Trees

Home is where you make it… **Strangler fig** trees, are known to people in the Amazonian rainforest as killer trees for their habit of squeezing the life out of their host trees. But an old strangler tree is filled with holes and cracks and twisted, fused roots that are home to many living creatures.

Specimen labels

Morpho Butterfly

Morpho sp.

Central and South America (preserved specimen)

Peanut-head Bug

Fulgora laternaria [ful-GO-ra lat-er-NAR-ia]

Central and South America (preserved specimen)

Longhorn Beetle

Cerambycidae sp. [ser-am-BIS-i-dae species]

Central and South America (preserved specimen)

Ants!

The rainforest crawls with ants of many kinds. Since they emerged 100 million years ago, ants have had to deal with many of the same problems faced by humans–war, hunger, and environmental stress. The earliest ants belonged to primitive hunting communities. The more advanced species form great societies with highly specialized castes of workers and soldiers. Some species herd other insects. Some enslave one another.

Only humans surpass ants in the many ways they make a living.

Leafcutter Ant

Atta cephalotes [at-TAH sef-a-LOW-tees]

Central and South America

These ants build and maintain underground gardens of fungus, a behavior that evolved more than 50 million years ago. The fungus provides their sole source of food.

The larger ants forage for leaves, flowers, and plant pieces to take back to the nest. There, small ants chew the vegetation to pulp to make fertilizer for the fungus.

Specimen label

Queen

Leaf-cutters live in colonies of three to four million individuals dwelling in thousands of underground rooms. Their pruning and nesting habits enrich the soil around them.

Sign text

Look up to see a ***Nasutitermes*** [nuh-SOO-duh-ter-meez] **termite** nest. It's easy to spot. But the termites themselves are concealed, busily chewing away the insides of dead trees and logs.

While we may consider termites pests, they are important recyclers of nutrients in lowland rainforests. Without termites and ants, the jungle would soon smother in its own litter.

Look down to see **giant cockroaches** (*Blaberus giganteus* [blah-BER-us jy-GAAN-tee-us]). They live in forest litter and tree hollows. The young are found in guano, or bat droppings, at tree bases. Like most cockroaches, they prefer night to day.

Section 13: Mangrove Swamp

Mangrove Swamp Core Track

This section of the Insect Zoo spans 13 feet. At the left end, the wall angles forward slightly with text and images. On the right, an 8-foot-wide window into a diorama of a mangrove swamp starts at 3 feet above the ground. In the wall below, near the ground, 5 half globes of clear acrylic that extend a few inches out.

This section features mangrove swamps, microhabitats on tropical and subtropical coasts with plants and animals evolved to cope with the changing conditions, such as the changing tide levels and mixtures of fresh- and salt- water.

The diorama has four mangrove trees, their trunks a few centimeters across, with roots extending down from the trunk into the translucent green resin "water," looking a bit like leafless, upside down branches. In the trees are a termite nest, a large irregular mass that looks like a mound of dirt wrapped around the trunk, and animals such as crabs and beetle larvae; some are identified by signs. Drawings of trees form a backdrop and continue on the outer wall around the window.

Below are five "bubble tanks" a foot or so off the ground. The marine arthropods in these tanks change; a sign on the left lists some possible species with photos, such as peppermint shrimp.

The next section is to the left. Follow the wall to where a ledge starts.

Mangrove Swamp Detailed Descriptions

Mangrove diorama

The 8-foot-wide diorama that depicts a mangrove swamp. There are four mangrove trees, their trunks 3 to 5 centimeters across, with roots extending into translucent green resin depicting the swamp's water. The mangrove trees have unusual roots – rather than starting near the ground, the trees have many roots that extend from the trunk between 6 to 30 centimeters above the water – these roots then curve down to below the water, looking a bit like leafless, upside down branches. There are a few branches with clusters of green leaves that extend out from the trunks a few inches above the highest roots. There are a few branches above the roots, with clusters of green leaves. On tree at the far right, where one of the roots splits off, there is a termite nest, looking like a large irregular mass that looks like a mound of dirt wrapped around the trunk.

Diorama specimens

At the left, at a cluster of roots about half a meter above the water is a large light blue land crab. Its body is about 6 centimeters across, and reared up on its back legs, with the pincers raised, so that the segments and plates on the underside are visible. The left pincher is about twice the size of the right. On roots in front of there a few snails – their shells spiral like a cone to a tight point, about 1.5 centimeters in length, with light and dark orange markings.

Toward the middle of the display, small Mangrove Tree Crabs climb up the side of a tree. They are small, about 2 centimeters across, and their orange color almost matches the bark of the mangrove trees. To

the right, one of the roots has the front section cut away to reveal a tunnel-like space with a wood-boring beetle larvae and shredded wood. The larva is a 3-centimeter-long grub, light colored with several bulging segments. Further up the branch stands an adult beetle, brown with long antennae curved back on either side of the body.

To the right, three fiddler crabs stand on branching roots. These are pale yellow crabs. The two females are small, their bodies about 1 to 1.5 centimeters, with small white legs and pinchers. The male is larger, his body about 2 centimeters wide, and facing forward, his pincher leg on the right is much larger than the one on the left – the pincher claw is 2.5 centimeters long, longer than the body is wide, and the smaller top fork of the pincher is about as large as the other pincher, 1 centimeter long.

Mangrove Swamp Exhibit Text

Mangrove Swamp

Lush mangrove swamps that dominate the world's tropical and subtropical coasts provide a wealth of plant and animal habitats. Life in these microhabitats is marked by constant change, bringing both a steady flow of nutrients and a daily set of hazards. Mangrove creatures have evolved ways of coping.

The biggest challenge for insects is the water itself—a changing mix of salty seawater and freshwater from rain and runoff. Water levels rise and fall, first exposing roots to the air, and then washing over the water-soaked land. Water temperatures waver between extremes of warm and cold with cruel regularity.

Above the Tides

Animals living above the tidal zone stay well concealed. Heat and wind will kill exposed land crabs, spiders, and other arthropods.

Mangrove leaves and branches support **leaf-mining caterpillars, bagworms, ants** and **crickets**.

Intertidal Swamp

Water levels in this zone change daily by more than .3 m (1 ft.), which affects water temperature. Arthropods have evolved ways of coping with the warmer temperatures and higher salt levels of low tides.

Below the Tides

Seagrass and mangrove silt roots provide both food and shelter for many arthropods, including **crabs, shrimps,** and **lobster**. Mangrove animals, such as the pistol shrimp and blue crab, can regulate the concentration of seawater in their bodies, allowing them to withstand changes in the salinity of seawater around them.

Diorama signs

- **Land crabs** dig burrows to reach the cooling water table. They can plug the openings to lock out enemies and to reduce extreme temperature changes.

- **Mangrove tree crabs** travel from the intertidal area to the uppermost branches of red mangrove trees, seeking shelter and leaves to eat. Some crabs slow down their breathing to prevent hot air from drying out their gills.
- **Wood-boring beetle larvae** carve galleries in wood, altering branching patterns in prop roots and tree limbs.
- **Fiddler crabs**, which live in burrows and mud flats, slow their breathing as temperatures rise to protect themselves against the heat and drying action of the sun.
- **Termites** build huge nests and covered walkways between branches.

Explore the bubble tanks to the right to see if you can discover these marine arthropods.

- arrow crab (*Stenorhynochus seticornis* [sten-o-RHYN-chus set-I-corn-is])
- coral banded shrimp (*Stenopus hispidus* [sten-O-pus HIS-pi-dus])
- decorator crab (*Camposcia retusa* [cam-PO-sea-a re-TU-sa])
- emerald crab (*Mithrax sculptus* [myth-RAX sculp-TUS])
- blue leg hermit crab (*Clibanarius tricolor* [cli-BAN-ar-e-us TRI-co-lor])
- skunk cleaner shrimp (*Lysmata amboinensis* [lys-MA-tah am-bo-i-en-sis])
- peppermint shrimp (*Lysmata wurdemanni* [lys-MA-tah WURD-ee-man-ni])
- camel shrimp (*Rhynchocinetes durbansis* [rhyn-KO-see-i-ne-tes dur-ban-EN-sis])
- fire shrimp (*Lysmata debelius* [lys-MA-tah de-BEL-ius])

Section 14: Freshwater Pond

Freshwater Pond Core Track

This section of the Insect Zoo spans five walls set around the corner of the "Thriving through Change" and "Mangrove Swamp" sections. A ledge features text, photos, specimens and an interactive display.

This section focuses on ponds, which offer arthropods many different microhabitats - they can live on or hang from the pond's surface, swim freely, or burrow in the mud bottom. All five sides of this section have clear panes above the ledge instead of a solid wall, and the middle three sides each have a large aquarium, 3 feet long in the center wall and 2.5 feet wide on either side. Behind the panes is a large photo of an edge of a pond, with gaps for the aquariums. The aquariums have different mixes of arthropods, which rotate. Residents may include water scorpions – long dark brown insects, with a tail-like breathing tube at the end of their abdomen, or crustaceans such as a blue crayfish.

The first short side, next to the Mangrove section, shows part of the pond photo on the wall and photos and text about giant water bugs, waterscorpions and whirligig beetles on the ledge.

The second side, to the left, has an aquarium, and on the ledge, a water scavenger beetle photo with text, and an inset window with a photo and pinned specimens of a Water boatman, giant water bug, backswimmer, and predaceous diving beetle – all are in shades of brown, and the first and second are small, about a centimeter long, and the other two are larger, 3 or 4 times as long.

The third side, at the center, has an aquarium in the wall. The ledge has text, and in the middle, an interactive video screen. It features the sounds of insects and other animals from around ponds. The screen has eight boxes labeled with the name of an animal. Touching a box will bring up a photo or video of the animal above a spectrogram of the sound and play the call. To access the buttons, a volunteer may be able to help, or you can find full instructions in the detailed description layer. The animals listed are:

- Red Winged Blackbird: a video shows a black bird with a sliver of red and orange on its shoulders, which tips its head up as it calls.
- Field Cricket: a photo shows a dark brown cricket from above.
- Water Boatman: a photo of a flattened, teardrop shaped insect under water.
- Katydid: a video of a bright green katydid viewed from below, abdomen squeezing and expanding as it calls.
- Spring Peeper Frog: a photo shows an orange and brown frog.
- Cone-Headed Grasshopper: a photo of a green insect with yellow markings facing forward.
- Cicadas: a video shows a black, yellow and red cicada standing on a tree branch.
- Kingfisher: Two photos show the heads of birds facing left with their long beaks open slightly – first a light blue bird then a reddish-orange one.

The fourth side has an aquarium in the wall. On the ledge is a photo and text about water striders, and an inset window showing a diagram and pinned specimen of a naiad, the aquatic immature form of dragonflies and damselflies.

The last side is in line with the Thriving Through Change section. It shows part of the pond photo on the wall and a labeled photo of a whirligig beetle head, highlighting the divided eye that lets it see above the water from the top part and underwater from the bottom part.

This is the last permanent exhibit section on the tour. The next section covers the carts and tarantula feedings – if you haven't checked those out yet and want to, they will be behind you in the large open area.

If you are finished, go to the Conclusions track.

Freshwater Pond Detailed Descriptions

Preserved specimens

Four preserved specimens are pinned in a row in an inset display. All are pinned with their back sides, with wings, facing the window, and arranged vertically with their heads pointing up.

- A water boatman: This is the first insect on the left. It is tan, about 1 centimeter long, oval shaped, with the head flatten slightly and the abdomen end coming to a pointed end. The head is broad but short, and at the back is a slight gap where the thorax connects – it looks a little like a cap perched on the thorax. The eyes are along the sides of the head. The front of the thorax has a rounded triangular plate pointing back. The forewings attach on either side just behind the start of the plate and are light brown and membranous. They cover the thorax and abdomen, the edges of which can be seen at the sides. Oar-like back legs peak out from the sides, curving back to frame the body, nearly meeting beyond the end of the wings. These legs are featured in the photo to the right, which shows a black and tan water boatman swimming with the oar-like legs seeping to the sides.
- Giant water bug: This large insect is second from the left. It is about 4 centimeters long and 1.5 centimeter at its widest, and its body has an oval shape, with the far ends coming to a point. The head is roughly triangular. The two dark eyes fill the sides of the front third of the head, separated by a 2 millimeter strip. The compound eyes are dark and roughly triangular in shape. Beyond the head is a thin plate along the thorax that just the attachment points of the wings on either side. The folded wings are membranous and a light brown color. The top inner edges frame a triangle of the thorax below, and then the wings overlap to cover the rest of the thorax and the abdomen. Near the center, a corner of the hindwing peeks out, a clear whitish color. The back edges of the abdomen just peek out to either side of the wings, and at the back tip, two cerci point back, narrow appendages that end in a point. The insect has three pairs of legs. The first pair are folded forward under the body and extend past the sides of the head in a wedge shape, angled out. They extend about almost 1 centimeter past the head, starting about 2 millimeters wide and narrowing to a rounded point. The back two pairs are made of flattened segments; on some, hooks are visible tips of the feet.

- Backswimmers: This is the third specimen from the left. It is small, about 1 centimeter long, mostly a pale tan with some light brown parks. The overall shape is an oval. The head is rounded, dominated by a pair of eyes, round brown spots on either side of the head brown color. Behind the head, a plate wraps around the front top of the thorax, broadening out a bit to the back. The forewings attach behind the side corners of the plate, and the wings fold back over the rest of the body with the triangular gap between the wings at the top framing reddish-orange coloring on the thorax. The specimen has long, thin legs – the front pair and the left middle pair are broken off. The back pair are very long – they are posed pointing back and the bent back, and if stretched out they would each be a bit longer than the body itself.

- Predacious diving beetle: This is the last specimen on the right. It is large, about 3 centimeters long and 1 centimeter at its widest. The body is a large, shiny oval dome, mostly a red-brown color, with stripes of light orange along the sides of the thorax and wings. The head is a rounded cap, and the eyes are on the sides – light yellow-brown ovals with a dark spot in the center, and thin segmented antenna stretch out to the sides from the far edges. Behind the head is a broad plate, rounded along the front edge with a straight horizontal edge at the back, behind this plate the front pair of wings start, folded back. The outer edges of the wings follow the rounded edge of the plate and reach back in an oval; both wings meet at the center in a straight, vertical line. The wings are smooth and slightly domed, covering the remaining thorax and all of the abdomen. Three pairs of legs can be seen extending out from under the body, mostly the same red-brown color. The front and middle pairs are thin and pointed, with the middle pair being longer, with a spike-like spur forking off. The back pair are folded back under the body and extend from near the back of the abdomen and are like curved oars, a little broad and flattened, ending in a point. The inner edge of these legs is a yellow color, which up close is seen to be a stiff fringe that points back along the curve.

Naiads [NEYE-ad-s] specimen and diagram

A naiad specimen is pinned in the display, about 4 centimeters long, positioned vertically, with its legs down toward the back of the display. This long insect is dark brown, with an odd mouthpiece – looking from above, it extends forward like a flattened tube, with ridges on the sides that curl forward at the end in a sharp “c” shape. The mouthparts extend 1 centimeter forward from the head, while the rest of the head is only 6 millimeters long. The head is a flattened round shape, broader with a pair of round eyes bulging out on either side. From the side, the mouth descends down from the center a couple millimeters and then forward, in a J shape. Behind the head, is the thorax. Thin brown legs extend underneath, one pair each at the front, center, and back, and there is also a pair of short wing buds, dark brown, narrow “winglets” that are folded back next to each other, reaching back over the first few segments of the long abdomen. The abdomen is narrow and segmented, ending with two sharp points, next to each other at the center. To the left of the specimen is a diagram a damselfly naiad seen from the side. A cluster of three structures extend from the last segment of the abdomen – they look a bit like oval leaves, with a think center vein, and short fine hairs along the edges. These are labeled as breathing gills.

Whirligig beetle image

This image is from a scanning electron microscope image, all in shades of greys. It shows a close up of the head – two domed oval shapes on the side of the head are labeled, one sitting near the top and one sitting toward the bottom, appearing to be separated by a strip about a wide as each eye. The ovals are labeled as “top part of eye” and “bottom part of eye.”

Who said that? interactive screen

At the center of the wall ledge that faces the Termite mound, diagonal to the main hallway, an interactive video screen shows eight boxes in two columns over a photo of underwater plants, each with the name of an insect, bird or frog found around ponds. Touching a box will bring up an image of the animal with a thin line along the bottom. The call will play aloud and the line will change to show the spectrogram of the sound. To select each box, start from the edge around the screen in the display. Follow the edge down with your finger and then press the screen inwards between 1 to 4 inches – specific locations for each options follow:

- Red Winged Blackbird: from the top left corner follow the edge down 1 inch, the press the screen 1 to 4 inches to the right. The video shows a black bird with a sliver of red and orange on its shoulders standing on a leafy branch, facing forward. It tips its head up and opens its beak as it calls.
- Field Cricket: from the top left corner follow the edge down 3 inches, the press the screen 1 to 4 inches to the right. A photo shows a dark brown cricket from above.
- Water Boatman: from the bottom left corner follow the edge up 3 inches, the press the screen 1 to 4 inches to the right. The photo shows an insect under water – it has a flattened, teardrop shaped body and is greenish with dark markings.
- Katydid: from the bottom left corner follow the edge up 1 inch, the press the screen 1 to 4 inches to the right. The video shows a bright green katydid, standing on a clear surface viewed from below, the abdomen squeezing and expanding as it calls.
- Spring Peeper Frog: from the top right corner follow the edge down 1 inch, the press the screen 1 to 4 inches to the left. The photo shows an orange and brown frog sitting on a light-brown tree trunk.
- Cone-Headed Grasshopper: from the top right corner follow the edge down 3 inches, the press the screen 1 to 4 inches to the left. The photo shows a green insect with yellow making facing forward – the roughly diamond shaped green head has a large mouth with black and orange triangular plates filling the bottom half. At the top center of the head a yellow horn reaches, and just below is a pair of white eyes that look like tiny ping pong balls glued to the side of the head.
- Cicadas: from the bottom right corner follow the edge up 3 inches, the press the screen 1 to 4 inches to the left. The video shows a black, yellow and red cicada standing on a tree branch, with a dark body, bulbous red eyes and clear, membranous wings yellow markings along the edge and veins. The cicada appears still as it calls until the very end when its abdomen expands briefly.

- Kingfisher: from the bottom right corner follow the edge up 1 inch, the press the screen 1 to 4 inches to the left. Two photos show the head of a bird facing to the left with their long beaks open slightly – the first bird is a light blue, with black markings around the eyes, and the second is a reddish-orange, and on the top of its head it has black feathers with small light blue dots.

Freshwater Pond Exhibit Text

At Home Everywhere

Insects have adapted extraordinarily well to constantly changing environments all over the earth—from the swamp to the desert to the tropical rainforest.

Specimen label

The aquatic immature forms of aquatic **dragonflies** and **damselflies**–often called **naiads** [NEYE-ad-s]–can stay underwater by bringing in oxygen from the water around them.

Divers, Diggers, Skaters, Swimmers

Do you see different kinds of insects in different areas of the pond?

Ponds offer insects many different living spaces, or microhabitats. They live on or hang from the pond's surface, swim freely, or burrow in the mud bottom.

Who said that?

Sometimes it's hard to pick out an insect's song from the sounds of other animals.

Touch the screen

to hear who's who.

How Do They Breathe?

Some aquatic insects trap a bubble of air on their abdomens, allowing them to breathe underwater. As oxygen is used up, more oxygen from the water diffuses into the bubbles.

Other aquatic insects—usually naiads, or immature insects—bring oxygen from the surrounding water into their gills.

Specimen label

Left to right: **Water boatmen, giant water bugs, backswimmers,** and **predaceous diving beetles** are all strong swimmers with powerful, oar-like middle and hind legs that propel them through the water.

Photo captions

Water striders (family Gerridae [JER-i-dae]) skate along the surface of ponds. Their modified leg tips work like water skis to prevent them from breaking the surface tension of the water.

Many beetles such as this **water scavenger beetle** (family Hydrophilidae [hi-dro-FIL-i-dae]) can stay submerged for as much as a day.

These **giant water bugs** (*Belostomatidae* sp. [bel-o-stow-MAT-i-dae species]) are fierce predators that feed on fish, amphibians, and crustaceans. Sometimes called toe-biters, they can deliver a painful bite!

Waterscorpions (*Nepidae* sp. [nep-**I**-dae species]) resemble scorpions, but the long tail-like structure is a breathing tube, not a stinger.

See if you can spot one holding the tube above water.

Whirligig beetles (*Gyrinidae* sp. [ji-RIN-i-dae species]) swim circles when alarmed, and the quick movement makes them easy to spot.

Whirligig beetles (family Gyrinidae) are strong surface swimmers that can watch for food from above and below the waterline, thanks to a set of divided eyes, shown here in a scanning electron microscope (SEM) image.

Interactive pullout

Did you know…some insects breathe from air bubbles trapped under icy ponds?

Section 15: Insect Touch Cart and Tarantula Feeding

Insect Touch Cart and Tarantula Feeding Core Track

This section describes a set of activities located in the large open area at the end of the exhibit.

There are two large carts that may be set up in this area and attended by volunteers or stored off to the side when not in use. They are both 3 feet wide, 3 feet tall and 2 feet deep. Be aware that each has a signpost on one corner with a solid sign at head level that extends out to the side 9 inches, with the lower edge 4.5 feet off the ground.

The Insect Cart features live insects that visitors can examine up close, touch or hold, with the assistance of volunteers. The insects on the cart will vary. Commonly available species are the Madagascar Hissing Cockroach, a long wing-less cockroach, and Eastern Lubber Grasshoppers.

The arachnid cart has specimens of different types of arachnids including mites, ticks, harvestmen, amblypygids [AM-blee-PIIG-ids], and wind scorpions, in addition to spiders and true scorpions. Live specimens may be on the cart, though none can be handled by visitors.

Tarantula feedings occur three times a day - at 10:30, 11:30 and 1:30 on weekdays and 11:30, 12:30 and 1:30 on weekends. The presenter will bring out the tarantula in a clear box on a cart, to the middle of the space, marked by the outline of a tarantula in the carpet – visitors can gather outside the outline. A video screen up on the wall near the model tree shows an overhead view. The presenter will share information, give the tarantula a cricket, and then put the box on the cart to allow visitors to look, ask questions and check out other objects (sometimes including molted exoskeletons that can be handled). These often last 10-25 minutes from when the tarantula is brought out to when it is returned.

Some additional information about the insect cart contents is available in the detailed descriptions track. For information about what is currently available, ask the volunteers.

Insect Touch Cart and Tarantula Feeding Detailed Descriptions

The insects available at the Insect Cart rotate. Some common species are:

Tobacco hornworm, Carolina Sphinx moth

Three stages of this species life cycle may be found on the cart. The larvae, green caterpillars with thin red horns at one end. The pupae, brown, leathery capsules. A preserved adult, a mottled brown and grey moth, is in a small clear box. It is also found in section 3, Thriving through Change.

Madagascar Hissing Cockroach

A large cockroach, 5-7 centimeters long, in shades of brown, from an almost black, to reddish brown. The cockroach is a long oval shape, and the segments of its abdomen are clearly visible, as it has no wings. From above, the head is covered by a broad plate on the back of the thorax. This plate has small bumps on either side of the midline near the front in females, and short nub-like horns in the males.

Macleay's [ma-CLAY-s] Spectre

The female of this species may be available on the cart. They are long and rough looking, resemble rough bark, and are generally a tan color. Its abdomen may be curled up like a scorpion's tail. These are also found in Section 4, Dealing with Danger.

Eastern Lubber Grasshopper

These are large colorful grasshoppers, 5-7 centimeters long. Their bodies have black markings over a mix of yellows, oranges and reds with black markings. These are also found in Section 4, Dealing with Danger.

Death Feigning Beetles

These beetles are about 2 centimeters long, and their bodies usually dusty bluish-grey color with a rougher exterior. They have a small head and rounded thorax, from which hardened forewings covered in tiny raised dots, fold back over the rest of the body, giving it a domed appearance. These are also found in Section 12, Sonoran Desert Dwellers, in the Darkling Beetle enclosure.

Arthropod chart

This chart shows several boxes with types of arthropods listed, organized into an inverted tree to indicate how they are related. Each box has the formal name of the group, the English translation of that group, and the common names of the group. Some boxes have photos below them. Lines reach down starting with the top box, labeled "Arthropoda" [ar-thro-PO-da]. Each line down splits in two, with a horizontal line to the left and right, and then turns down into another box or splits again. Each junction indicates a common ancestor. The top box, that includes the common ancestor of all the other groups, is Arthropoda "Jointed foot" (Arthropod)

- Crustacea [crus-TAY-sheea] "Hard Shelled ones" (Crustaceans) – shares a common ancestor with the Hexapoda [hex-ah-PO-da]. Below is a photograph of a stout purple and orange crab, facing forward with pinchers raised, and a photograph of a shrimp, orange against the black background and facing to the right.
- Hexapoda "Six foot" (Insects) – shares a common ancestor with the Crustacea. Below is a photo of an orchid mantis – white with pink and yellow, mimicking a flower on a branch, and a photo of a monarch butterfly, standing with wings closed on the side of a piece of fruit, with a black body with white spots, and orange and black wings.
- Trilobitomorpha [tri-LOW-bit-o-MOR-pha] "Three lobe" (Trilobites [TRI-low-bite-s] – Extinct) – shares a common ancestor with the Chelicerata. The photo shows a fossil trilobite – dark grey fossilized body embedded in a light gray material.
- Chelicerata "Claw horn" (Arachnids and Horseshoe crabs) – this group shares a common ancestor with Trilobitomorpha. A line descents and splits into Arachnida [a-rack-NI-da] and Merostomata [mer-o-sto-MA-tah].

- Arachnida “Spider” (Arachnids) – shares a common ancestor with Merostomata. Below is a photo of a tarantula, dark brown with white markings on the body, and white rings around the joints of the legs.
- Merostomata “Thigh mouth” (Horseshoe crabs) – shares a common ancestor with the Arachnida. Below is an image of several horseshoe crabs – shiny dark brown shells with armored domes and along narrow tail-like spike. On has the dome-like carapace up, and another is flipped to show the legs and book gills below, and others are in side profile or head-on.
- Myriapoda “Ten thousand foot” (Centipedes and Millipedes) – shares a common ancestor with the common ancestor of the chelicera and trilobitomorpha. A line descents and splits into the Diplopoda [dip-low-PO-da] and chilopoda [ki-law-PO-da].
- Diplopoda “Double foot” (Millipedes)- shares a common ancestor with the Chilopoda. Below a photo shows a dark brown millipede with thin segments crawling on a chunk of wood.
- Chilopoda “Lip foot” (Centipedes) – shares a common ancestor with the Diplopoda. Below a photo shows a dark bow centipede on a white background. Each segment has a pair of legs out to either side, each about as long as the body is wide.
- All the groups share a common ancestor within the Arthropoda.

Insect Touch Cart and Tarantula Feeding Exhibit Text

Cart sign frame

Smithsonian

National Museum of Natural History

Q?rius [”curious”]

Unlock your world.

Insect cart

Tree chart of arthropod groups – check the detailed descriptions for groupings

- Arthropoda [ar-thro-PO-da] “Jointed foot” (Arthropod)
- Crustacea [crus-TAY-sheea] “Hard Shelled ones” (Crustaceans)
- Hexapoda [hex-ah-PO-da] “Six foot” (Insects)
- Myriapoda “Ten thousand foot” (Centipedes and Millipedes)
- Diplopoda [dip-low-PO-da] “Double foot” (Millipedes)
- Chilopoda [ki-law-PO-da] “Lip foot” (Centipedes)
- Chelicerata “Claw horn” (Arachnids and Horseshoe crabs)

- Arachnida [a-rack-NI-da] “Spider (Arachnids)
- Merostomata [mer-o-sto-MA-tah] “Thigh mouth” (Horseshoe crabs)
- Trilobitomopha [tri-LOW-bit-o-MOR-pha] “Three lobe” (Trilobites [TRI-low-bite-s] – Extinct)

Arachnid cart

Insect Zoo Tarantula Feeding Times:

Monday-Friday: 10:30 a.m., 11:30 a.m. and 1:30 p.m.

Saturday and Sunday: 11:30 a.m., 12:30 p.m. and 1:30 p.m.

Feedings are located near the windows in the Insect Zoo- Look for the Tarantula Outline on the Carpet!

Conclusion

This concludes the audio tour of the Insect Zoo. If you want to check out the Butterfly Pavilion, walk along the Sonoran Desert Dwellers section, past the rainforest entrance on the left. Continue for several yards to the ticketing desk on the right. To reach other exhibits or the exit, you can either continue past the ticketing desk to reach the rotunda or retrace your steps to the Ancient Egypt exhibit. The Mall exit is on the first floor, and the Constitution Avenue exit is on the Ground Floor.

Thank you for visiting the National Museum of Natural History's Insect Zoo. We hope that you have had an enjoyable and interesting visit with this audio described tour. This tour was produced by the American Council of the Blind's Audio Description Project and supported by a grant from the Aid Association for the Blind of the District of Columbia. It was written by Sarah Studer with voicing and editing by Joel Snyder.

(Return to the Insect Zoo Audio Description Tour web page.)

This is the end of the document.