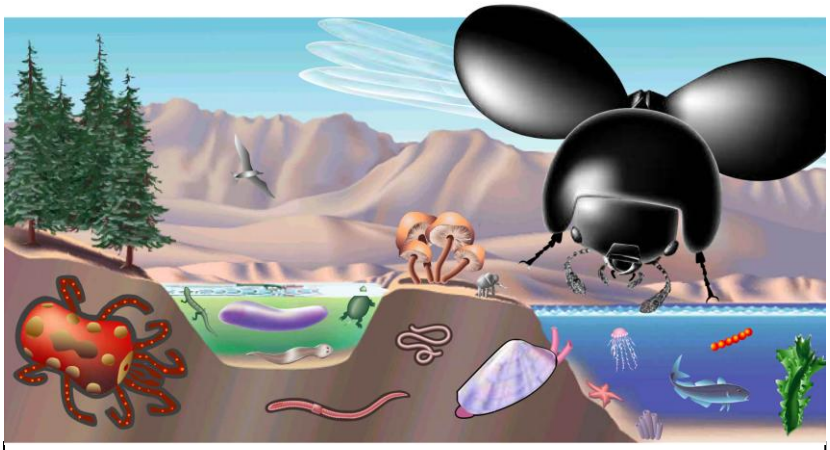
The Wild World of Insects

What's the buzz about bugs?



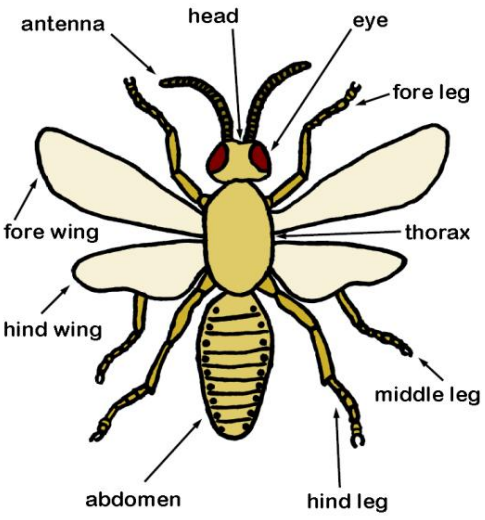
Diversity of Life. The size of each organism is in proportion to the number of species in the group. Compare the huge beetle (representing insect diversity) in the upper right-hand corner to the tiny elephant (representing mammal diversity) below.

Insects are one of the most diverse animal groups on the planet. There are over 1,000,000 species of insects in the world and they are adapted to living in every environment on earth, except the ocean. Some groups of insects are particularly diverse. In fact, approximately one out of every four animals on earth is a beetle!

Insects are also incredibly abundant. For example, in many tropical rainforests, ants and termites are thought to have a greater biomass than all the vertebrates combined. The main reasons that insects are so diverse and abundant are due to morphology, mode of development, and ecology.

Morphology: The Insect Body Plan

Insects are in a group called **arthropods**, which also include spiders, scorpions, millipedes, centipedes, crabs and lobsters. Arthropods have an **exoskeleton** (a hard skeleton that surrounds their body), a segmented body plan, and jointed body parts (legs, antennae, and mouthparts). Insects have three body segments: the head, thorax, and abdomen. They have compound eyes and antennae on their heads. On the thorax are three pairs of legs and wings. Insects usually have two pairs of wings but some groups have one or none. For example, all flies have just one pair of wings and ants don't usually have any wings (except for the queen).



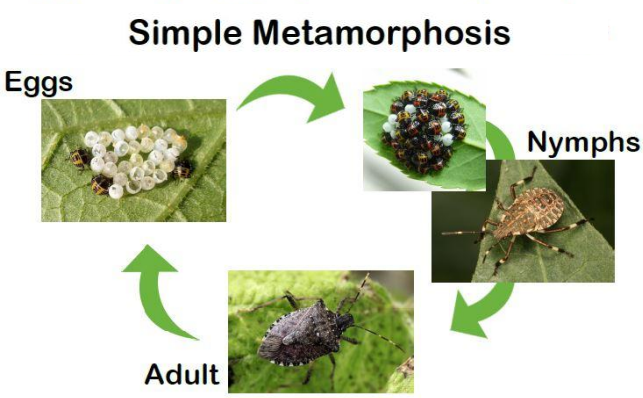
Parts of an Insect

The small size and hard exoskeleton of insects allow them to live in habitats where other animals cannot. The body plan of insects has been adapted for the specific environment where each species lives and also for its specific lifestyle.

Development: The Ultimate Makeover

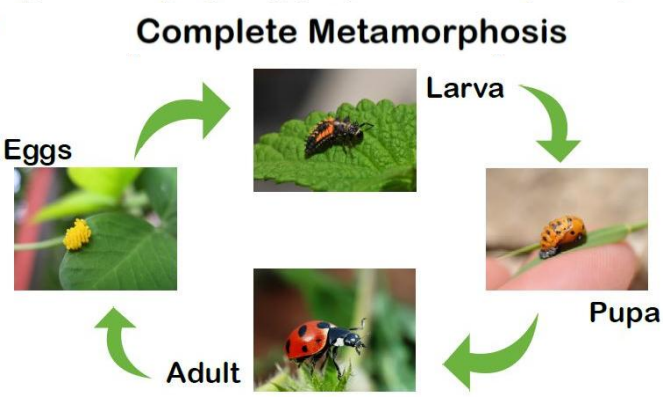
Insects have a life cycle that is very different from the way that mammals grow. Their hard exoskeleton acts like a suit of armor – it provides great protection, but it doesn't expand as they grow. Insects need to shed their exoskeleton in a process known as **molting**, which allows them to grow larger by expanding their body into a newly grown exoskeleton.

In the spring and summer, the mass emergence of cicadas offers a great opportunity to find molts.



All insects begin their life as an egg, but the rest of their life cycle can be very different. Some insects undergo **simple metamorphosis**, meaning that when the egg hatches, the young **nymph** looks similar to the adult. The nymph then undergoes several molts, and during the final molt develops wings and reproductive structures, transforming it into an adult. Many insect groups have simple metamorphosis, like cockroaches, preying mantids, and grasshoppers.

Other insects undergo **complete metamorphosis**, meaning that when the egg hatches, the young **larva** looks very different from the adult. The larva then undergoes several molts and when it's ready to develop into an adult, it forms a **pupa**, which has a hard outer casing. Inside the pupa, the larva transforms into an adult and eventually emerges.



Complete metamorphosis has been extremely important for insects because it allows larvae and adults to take advantage of different resources in the environment, so that they don't need to compete with each other for food. These insects then have more resources to better compete with other species. The most diverse groups of insects (flies, beetles, butterflies, and wasps) all have complete metamorphosis.

Ecology: You Are What You Eat

The specialized body parts and unique life cycles of insects have helped them to assume many roles in the ecosystem. In particular, insects have become specialized to eat almost anything you can imagine! Each food source comes with its own challenges, but insects have specialized characteristics that help them meet these challenges, often in really different ways. You can take advantage of these characteristics to help you identify what they eat.

Predators


Preying Mantis

Predators like the preying mantis use a “sit and wait” strategy to catch prey. They wait motionless on plants, blending into their surroundings, until a prey animal gets very close and then they quickly snatch it up with their grasping, or **raptorial**, forelegs. Other predators, like tiger beetles, will actively pursue their prey. These predators have long legs adapted for running, called **cursorial** legs. Predators often have **chewing** mouthparts that they use to crunch through the hard exoskeleton of their prey.


Aphid

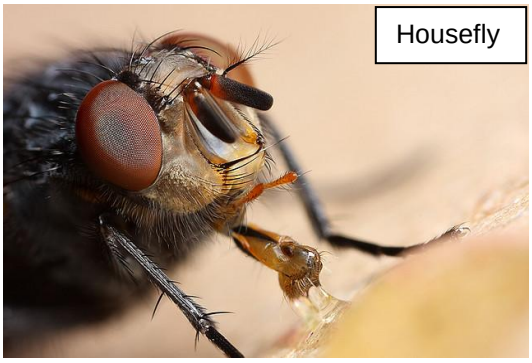
Plant-feeders

Many insects, like caterpillars, feed on plants. They use chewing mouthparts to tear bits from leaves and other plant parts. Insects like aphids feed on the liquid inside a plant, using **piercing and sucking** mouthparts that resemble a straw with a sharp pointy end. Many of these insects spend their entire life on plants where predators can easily find them, so they often have methods of **camouflage**. Stick insects mimic leaves and twigs so that predators don’t recognize them as potential prey.

Flower-feeders

Butterflies, moths, bees, wasps, and even some flies will eat the nutritious nectar and pollen of flowers. Butterflies and moths have straw-like, **siphoning** mouthparts for sucking nectar out of the bottom of flowers. Bees have a long tongue that they use to lap up nectar, but they need to be much closer to the source than butterflies do.


Butterfly



Housefly

Scavengers

Scavengers like cockroaches will eat most dead and decaying plant and animal matter that they can find. They often have chewing mouthparts and legs adapted for running. Houseflies are scavengers that feed on the liquid from decaying food sources using their **sponge-like** mouthparts.

Habitats: Seek and You Shall Find

Just as insects have special characteristics that are adapted to their food preferences, they are also adapted to the environments they live in. Unique conditions in each habitat have encouraged insects to develop different survival strategies.

Underground

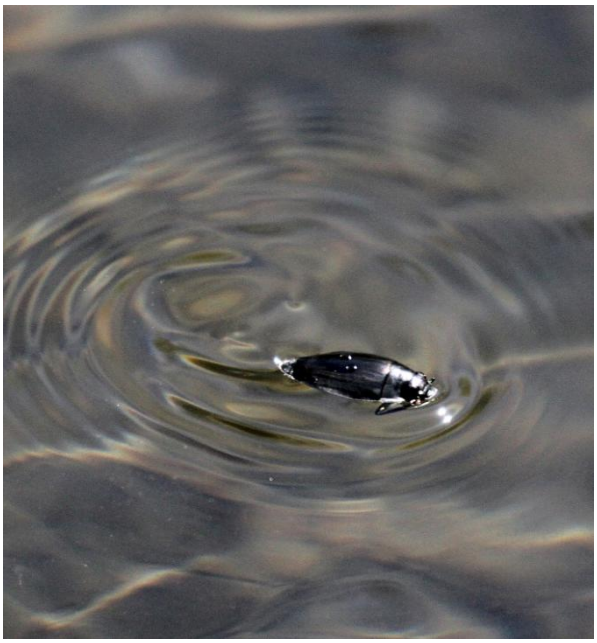
Soil is a common feature of all habitats so many insects are found living here. Insects that live underground often have expanded or shovel-shaped front legs, called **fossorial** legs, which are adapted for digging and burrowing. Wings are too fragile to drag through tunnels, so soil insects often are wing-less. Beetles are an important exception to this rule, because their hind-wings are protected under the hard **elytra**, which in fact are modified fore-wings.

Meadow/Grassland

Grassland habitats get a lot of sun, so they have many types of plants, which are a great source of food for herbivores, which in turn are a great source of food for predators. This habitat is characterized by vast open spaces making it easier for insects to see each other, resulting in many species using camouflage to remain hidden. Meadows are a great place to find “sit and wait” predators, like the preying mantis, as well as flower-feeders, like bees and butterflies. These large open spaces are also great for fast flyers, like dragonflies and damselflies, and insects that have enlarged hind legs for jumping, called **saltatorial** legs, like grasshoppers.

Forest

Trees are the defining feature of the forest habitat and many insects can be found living in or on trees. There is less open space, so forest insects need to be very agile flyers. Forest insects can also often be found living in rotting trees or in dead animals on the ground, so there tends to be a lot of insect scavengers in the forest.



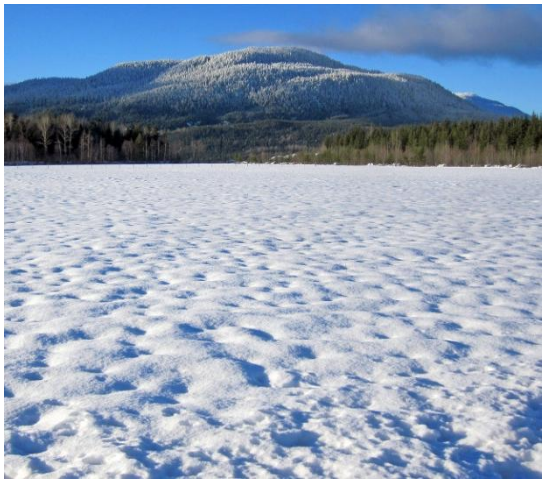
Aquatic

Some aquatic insects live at the water surface, while some live underwater. Insects that live at the surface need to watch out for predators from the air, like birds, and predators from the water, like fish. Whirligig beetles have divided eyes with a section above and below the water surface, so that they can keep an eye out for predators in both environments! Insects that swim underwater still need to breathe, so they have developed different ways of doing this. Some insects carry an air bubble with them as they swim and return to the surface periodically to replenish it. Most aquatic insects have **natatorial** legs that are flattened, broadened, and fringed with dense hairs, which function like oars or flippers to make them better swimmers.

Desert

Desert habitats are hot and dry, so insects need to have adaptations to conserve water. Beetles do well in deserts because their elytra help them to keep the water in their bodies from evaporating. Insects also have many behavioral characteristics that help them conserve water. Desert insects are often active at night to avoid the hot daytime sun. When it does rain, some darkling beetles will stick their abdomen up in the air and special grooves on their elytra will catch rainwater and funnel it down behind their head, where they can easily drink it.

Cold/Snowy



Insects can live even in very cold environments. One way that they survive the winter is to enter diapause, which is similar to hibernation. The insect becomes inactive and can survive long periods without food. Some insects overwinter as eggs or pupae, which are already inactive stages, but others overwinter as diapausing adults. Some insects remain active throughout the winter, either by remaining in the small warm layer of air underneath the snow, or by living on top of it. Many winter-active insects can produce an antifreeze chemical in their body, which prevents them from freezing.

One million ways to be a bug!

These are just a few of the amazing things that insects can do. The best way to discover more about insects is to catch some. Luckily, insects are everywhere! Grab a net and explore a few different habitats. You'll be surprised at how many you can find!

Recommended Resources:

BugGuide

A community of insect enthusiasts who share information and observations of insects, spiders, and other arthropods through photographs.

http://www.bugguide.net

The Center for Insect Science Education Outreach

Educational materials involving insects developed by the University of Arizona.

http://insected.arizona.edu/home.htm

BioKids Critter Catalog

Insect information for kids.

http://www.biokids.umich.edu/critters/Insecta/

The New York State 4-H Entomology Program

Insect learning materials for kids.

http://blogs.cornell.edu/ent4h/

Penn State Entomology

Resources for educators.

http://ento.psu.edu/public/resources-for-educators

What's that Bug

Resource for identifying bugs.

http://www.whatsthatbug.com/