There are millions of different kinds of insects, tucked into every imaginable niche on this planet. How can the planet provide a living for so many different kinds? It seems like they would be stepping all over each other. That's not the situation, however. Each insect has some structure or behavior that makes it different from all other insects, and provides it with a unique way to get the resources it needs, find the space it requires, and reproduce its own kind. Some of the structures and behaviors that insects have evolved are really amazing, and there are undoubtedly many more that entomologists (scientists who study insects) have yet to discover.

What's That Sound?

An interesting characteristic that you are surely familiar with by now is the hissing sound made by the Madagascar cockroach. Scientists wondered why these roaches hiss and what advantages they would gain from hissing. Did you notice what moves them to hiss? Often they let out a hiss when they are harassed by another animal. You may have heard a hiss when you picked one up. But do they hiss at other times?

Scientists noticed that roaches sometimes hiss when there is no threat from another animal. They also observed that males, and only males, hiss in the presence of a female. This led the scientists to think that hissing might be involved in courtship behavior, perhaps used by males to establish their territory or to scare off other males.

Hissing cockroaches produce their hiss by forcing air out of the spiracles on both sides of their fourth segment. In order to test their ideas about hissing and mating behavior, scientists covered up the spiracles on the fourth segment of one male roach and left them open on another male.

Both male roaches were placed in a cage to see which would become the dominant male. The hissing male almost always became the boss.

In other experiments they also found that the male that hissed the loudest almost always drove off the other males. When a hissing and a nonhissing male were in a cage with a female roach that was ready to mate, the male roach that could hiss fought off the roach that couldn't. The hissing male was more likely to mate with the female, and pass on his "hissing" genes. In fact, the females would not mate with a male that couldn't hiss.

Little Drummer Wasp

Humans have been cultivating and storing grain for thousands of years. Insects have been sharing the annual harvest of grain for thousands of years as well. One insect in particular, a type of weevil, chews a tiny hole in a kernel of wheat and lays a single egg inside. When the egg hatches, the weevil larva eats its way into the kernel of wheat and consumes the inside of the kernel until it is hollow. By this time the larva is ready to pupate, and some weeks later the next generation of weevil emerges. A tidy little lifestyle.

It's never quite that simple, however. Also living in the same area is a tiny wasp whose larva eats the larva of the weevil. The female wasp lays one egg on the outside of a wheat kernel. When the egg hatches, the larva burrows into the kernel and devours the weevil living inside. How does this wasp know which wheat kernels contain weevil larvae when they are sealed inside of the kernel and there are literally millions of kernels to choose from?

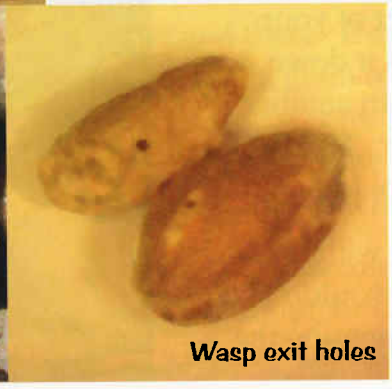
The mother wasp crawls around on the outside of the kernels and uses her antennae like drumsticks to beat on the kernels! Just as an empty barrel sounds different than a full barrel when you bang on the outside, a hollow wheat kernel with a weevil inside sounds different to the wasp than a wheat kernel that has not been hollowed out. This curious and effective behavior allows the female wasp to leave her eggs where they stand the highest probability of survival.

It may be that the human behavior of harvesting and storing wheat increases the survival potential of both the weevil and the wasp. Do you see why?


Female drummer wasp

Wasp pupa


Adult grain weevils


Wasp exit holes

Reproduction Strategies

Aphids are tiny insects that are sometimes considered pests because they literally suck the vitality out of plants. Aphids have mouthparts shaped like a straw that they insert into a plant's phloem and tap the sugar-rich

sap. If a large number of aphids descend on a plant, they can weaken or even kill it.

Aphids can reproduce very quickly because they give birth to live, fully developed babies. They do not lay eggs like virtually every other insect, so there is no larval or pupal stage to slow things down. This is almost like being born an adult, except for the fact that newborns are tiny. When an aphid is born, it can begin feeding *and reproducing* almost immediately. Talk about a head start!

Young aphids are clones of their mother, which means that all aphids are female. There are no male aphids. Not only do aphids have **asexual reproduction** (the creation of offspring by a single parent, without the union of a sperm and egg), they have also evolved another strategy for shortening the time between generations. Many aphids are born pregnant. Entomologists have dissected aphids under a microscope and found aphids ready to give birth to baby aphids that also had babies inside of them! It is easy to see how aphids could take over an entire field of plants in just days.

The Big Aphid Roundup

Imagine a life where you never drank water. Instead, every time you were thirsty you reached for a big liter-sized Quenchmaster of your favorite cola and gulped it down. Then you followed it with another and another and another...That's basically the life of an aphid.

If you maintained a diet with that much sugar, your body wouldn't be able to use it all, not to mention the fact you'd be heading for the bathroom every 5 minutes. Where would all the excess sugar go? A good bit of it would probably end up in your urine. That's how your body gets rid of wastes, and in this case, that extra sugar would be a waste product. This same thing happens to aphids.

Instead of drinking cola all day, they drink the sap from plants, which has a large amount of sugar in it. The aphids can't digest it all, so the extra sugar comes out the back of the aphids as a sticky sweet substance called honeydew.

At some point this honeydew came to the attention of a particular kind of ant. In time the ants came to rely on it as their only source of food. They have developed an

Ants herding aphids

amazing way to guarantee a steady supply of honeydew for themselves. They created ranches! The aphids are their stock, and plants with a good supply of sap are their ranges.

Every morning the ants round up the aphids and drive or carry them out to feed on plants. While they are feeding, the ants make sure that the aphids don't wander off or get rustled by an outsider. If a ladybird beetle (a voracious predator that eats six times its own weight in aphids every day) comes by, the ants herd the aphids into small groups and defend their stock from attack. At the end of the day the ants take the aphids back to the anthill,


Female silk moth


Male silk moth

where they spend the night, and the whole thing happens again the next day.

In exchange for this protection and care from the ants, the aphids have no problem with letting the ants harvest the honeydew for food. This benefits the ants (because they get an easy source of great food) and the aphids (because they get a place to live and protection from predators). If you ever get a chance to watch this happen, you'll be amazed at how much it resembles cowboys herding cattle on a ranch! Except the ants don't wear boots or holler "Yee-haw."

Pheromones: Insect Calling Cards

Ants are social insects. Social insects live together and rely on each other for survival. They work together to raise the young, construct and maintain the living quarters, defend the colony, and obtain food.

Acquiring food is always a challenge. To locate food the foragers leave the colony and strike out into the environment, looking for something good to eat. They wander out without a plan and without a guidance system. The path they follow is random as they search here and there. If an ant runs across a scrap of seed or a grain of sugar, she will eat it, but her quest is for something good that is way more than she can eat herself. She is foraging for the whole colony.

When she does come across a dead moth, piece of donut, or chunk of cheese, she pries off a crumb and heads back to the nest.

She keeps an antenna to the ground to pick up the faint scent laid down by other ants to guide her home. As she advances toward home, she lowers her abdomen to leave a minute drop of a powerful chemical on the ground. This is a **pheromone,** a chemical message that other ants will follow to relocate the food source.

Back at the nest the ant shows the sample of the prize she has located. The other foragers note the particular pheromone smell of the ant that brought in the food, and follow her smell back to the bounty. The other foragers retrace the path of the first one, each leaving additional pheromone markers on the path. In a short time a wide stream of thousands of ants is hurrying in both directions over the invisible but vividly marked (if you are an ant) trail. Pheromones are very effective agents of communication for ants, both to assist with the business of the colony and to identify intruders from rival colonies.

Trail marking and identification are two ways ants use pheromones. Moths have another use. Because moths are active at night, it's not so easy to find things. And one thing that must be found to ensure the survival of the species is a mate. Moths use a pheromone, or rather, the female moth uses a pheromone. The male responds.

When the time of year is right, the female moth flies out, parks on a tree limb or rock, and starts to advertise her availability by releasing a bit of her irresistible perfume. Any male moth 2 kilometers downwind who happens to encounter a molecule or two of the heavenly scent on his antenna will start to fly toward its source. If he is fortunate enough to find the source he may mate, reinforcing the effectiveness of the scent to bring the male and female moths together.

Every insect has a story to tell about how it survives and reproduces. The stories above are just a few of the astonishing adaptations of insects. There are thousands more. For instance, how do mosquitoes find you in the dark when you are the only person around for miles? Why do moths fly around your porch light? What are the leaf-cutter ants doing underground with all those circles of leaf? Imagine how many more tales there are and how many more natural history stories there will be when scientists are able to study *all* the species of insects!

Think Questions

1. **When does a hissing cockroach hiss? How does the hissing benefit the cockroach?**

2. **The wheat weevil and the drummer wasp may benefit from the activities of humans. Can you think of another insect that may benefit from living around humans? Explain the benefit.**

3. **If you bother a wasp, you might find yourself pursued by the whole colony. What do you think makes them all so aggressive?**