

THE SECRET

Think plants are just a bunch of wallflowers? Think again: They network, communicate, and even care for their families.



ESSENTIAL QUESTION:
How do plants interact with each other and their environments?

Let's face it: At first glance, plants don't seem to lead very interesting lives. How much can a brainless organism that's stuck in one place really do? Quite a lot, it turns out. Research shows that plants detect and respond to changes in the world around them. They maintain busy social lives, sharing resources and important news with others through complex networks. And they have highly developed senses much like our own.

"Plants can track almost everything happening in their environment," says Heidi Appel, an ecologist at the University of Toledo in Ohio. "This involves all the same basic senses we have—seeing, hearing, touch, taste, and smell—plus some others." Here's what Appel and other scientists have discovered about the secret lives of plants.

SENSITIVE BEINGS

Appel first became interested in whether plants could hear while talking with her colleague Rex Cocroft, who studies insect communication. He complained that the noisy chomping of a caterpillar was drowning out other bug sounds he wanted to record. "It was an 'Aha!' moment for us," she says. They wondered if plants could also hear and respond to the chewing.

To find out, the scientists recorded vibrations of a caterpillar eating leaves and played the recording back to some

plants but not others. Plants exposed to the munching sound produced more *chemical defenses*, substances that taste bad to bugs. Many plants use these chemicals to avoid being eaten. Other sounds, such as wind blowing, had no effect. "Plants respond selectively to sounds that are important to them," says Appel. They ignore sounds that don't pose a threat.

Plants are able to sense other things besides sound. "They don't have noses or tongues, but they're very tuned in to chemicals in their environment," says Rick Karban, an ecologist at the University of California, Davis. "And they don't have eyes, but they're very sensitive to light." Plant tissues contain *photoreceptors*. These molecules allow them to tell how bright the light is and which direction it's coming from.

PREPARE FOR ATTACK!

We may not think of plants as chatty, but they communicate in a complex language of chemicals. Karban studies what happens when hungry insects injure sagebrush plants. "When a plant is attacked, it emits chemical cues into the air," he says. "Its neighbors detect those cues and increase their defenses."

Plants can prepare for an onslaught of bugs with not only chemical

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LIVES OF PLANTS



NETWORK LINKS
Strands of fungus link the roots of different plants to one another.



ROOT CONNECTION
Through the fungus, plants can transfer chemicals to one another from their roots.

EMMANUEL LATTES/SALAWY STOCK PHOTO (FUNGUS), DR. JOHN RUMIONS/SCIENCE SOURCE (CHEMICALS)

defenses but physical ones as well. Their tissue becomes tougher, making it harder to chew. And they can grow stiff hairs that thwart insects.

Some plants can even tell what kind of insect is eating them based on chemicals in the bugs' saliva. Depending on the attacker, plants release different alarm signals and adjust their defenses.

THE WOOD WIDE WEB

Trees may seem like the most solitary and unchanging plants of all. But they busily interact with their environment and their neighbors.

Scientists in Austria and Finland recently used lasers to map the position of tree branches (see *Tired Trees?*, below). At night, branches drooped, as if the trees were sleeping. At sunrise, the branches perked up again as trees angled their leaves to catch sunlight.

Some of trees' most interesting behavior happens underground. In the soil, tree roots partner with fungi called *mycorrhizae* (my-koh-RYE-zee). The fungi provide nutrients, like nitrogen (N) and phosphorus (P), to trees in exchange for chemicals containing carbon (C).

Strands of fungi form a dense network beneath the forest floor, which researchers have

nicknamed the Wood Wide Web. It provides a physical connection linking trees and other plants to one another. "It's a highway for all kinds of chemicals," says Suzanne Simard, an ecologist at the University of British Columbia in Canada.

Trees can use the network to share nutrients or water with neighbors in need. Species whose roots extend deep into the ground, like Douglas firs, collect water for shallow-rooted companions during droughts. In exchange, the firs may receive nutrients or compounds that protect against disease.

The biggest, oldest trees have the most network connections. Simard calls them "mother trees." They help youngsters grow, and they take special care of their families. Networked trees can chemically identify relatives, such as siblings or offspring. They send those seedlings extra food, nutrients, and water. If a tree in distress signals for help, nutrients or defensive chemicals arrive within hours.

"We've barely scratched the surface of the language of trees," says Simard. "Their conversations and exchanges are so complex."

PLANT SMARTS?

Some researchers even think plants may be intelligent, in a way. "They're collecting information about their environment and using it to make decisions that benefit them," says Karban. "If that process counts as intelligence, there's more and more evidence that plants are exhibiting it."

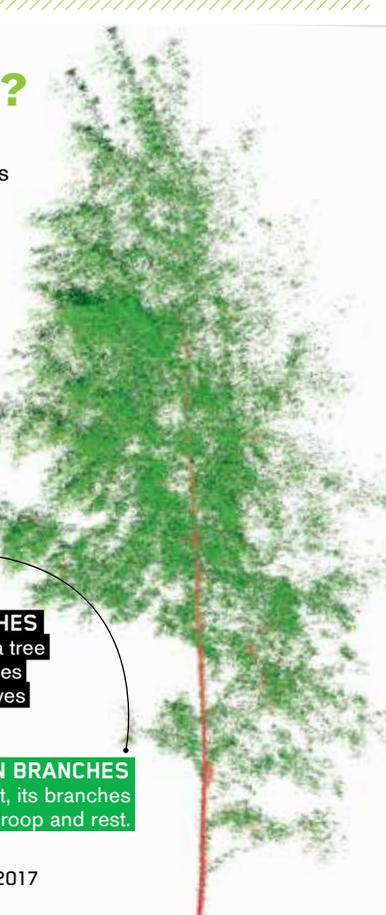
Some studies even suggest that plants may have a kind of memory of past events—such as bug attacks or cold snaps—that helps prepare them for future challenges. Plant scientists are still debating whether it makes sense to use terms like memory and intelligence for organisms without a brain. But there's one thing they agree on, says Appel: "Don't underestimate plants!" ❁ —Jennifer Barone

TREE TALK:
Suzanne Simard studies chemical communication among trees.



TIRED TREES?

New research shows that trees have a day and night cycle, just like animals.



BLACK BRANCHES
During the day, a tree raises its branches and turns its leaves toward the sun.

GREEN BRANCHES
At night, its branches droop and rest.

CORE QUESTION

How do trees benefit from being linked to an underground network? Cite two examples from the text.