



“Sense and Plant-Abilities”

That’s the Truth Episode #4 Backgrounder

Topic: Do Plants Have “Senses”?

CURRICULUM CONNECTIONS

Kindergarten: Environment and Community Awareness

Grade 1 Science Topic D: Senses

Grade 1 Science Topic E: Needs of Plants and Animals

Grade 4 Science Topic E: Plant Growth and Changes

Grade 6 Science Topic E: Trees and Forests

Quick Facts

- Plant senses don’t work the same as human senses, but generally speaking, plants can see, hear, smell, feel, react, and even think based on sensory input.
- Plants fight for territory, seek out food, evade predators and trap prey. They are as alive as any animal, and – like animals – they exhibit behaviour.
- As well as being able to hear approaching insects, some plants can either smell them, or else smell volatile signals released by neighbouring plants in response to them.

- Some plants can sense insects on their leaves and retract their leaves as a defense mechanism.
- Presence of electrical signalling in plants ie. Venus Fly Trap etc
- Despite lacking eyes, plants such as Arabidopsis possess at least 11 types of photoreceptors, compared to our measly four
- Plants are supremely adapted for doing exactly what they need to do
- As research into plant senses has progressed, researchers have begun to find repeating patterns that hint at deep parallels with animals.
- While it is useful to describe plants in anthropomorphic terms to communicate ideas, there are limits
- Similarities should alert us to plants' surprising complexity, and to the common factors that connect all life on Earth.
- Whether or not we can say that a plant sensing and processing light is seeing, or if reacting to sound waves is hearing, or processing the information at a cellular level is thinking is debatable. However, if we accept that plant senses are valid senses, then plants can sense much of the same electro-chemical signals we do... and even some we can't!

Discussion Questions

- Do you think plants *really* have feelings or senses?
- What adaptations do plants have that are comparable to our senses?
- What are photoreceptors?
- What plants have you heard of that can trap prey? And how?
- What do plants need to survive?

(Refer to quick facts above and articles below)

Plant Activity Ideas

- Become a Plant Watcher! (Citizen Science Activity)
<https://www.insideeducation.ca/learning-resources/classroom-learning-resources/elementary-school/#become-a-plant-watcher>
- Try vermicomposting and/or make a homemade planter
<https://www.greencalgary.org/green-kids/online-activities#cleangreen>

- Use the [Pl@ntNet](#) app to help to identify plants in your neighbourhood, local parks or on a hike using pictures
- Explore the process of potentially installing a “living wall” at your home or school. Consider starting a fundraiser! <https://verticaloxygen.com/>
- Check out these garden-based lessons and activities from Cornell University <http://gardening.cals.cornell.edu/lessons/>

Reference Source Articles & Links

Plants can see, hear, smell – and respond

Plants perceive the world without eyes, ears or brains. Understanding how can teach us a lot about them, and potentially a lot about us as well

Plants, according to Jack C Schultz, "[are just very slow animals](#)".

This is not a misunderstanding of basic biology. [Schultz](#) is a professor in the Division of Plant Sciences at the University of Missouri in Columbia, and has spent four decades investigating the interactions between plants and insects. He knows his stuff.

Instead, he is making a point about common perceptions of our leafy cousins, which he feels are too often dismissed as part of the furniture. **Plants fight for territory, seek out food, evade predators and trap prey. They are as alive as any animal, and – like animals – they exhibit behaviour.**

"To see this, you just need to make a fast movie of a growing plant – then it will behave like an animal," enthuses [Olivier Hamant](#), a plant scientist at the University of Lyon, France. Indeed, a time-lapse camera reveals the alien world of plant behaviour in all its glory, as anyone who has seen [the famous woodland sequence from David Attenborough's Life series](#) can attest.

These plants are moving with purpose, which means they must be aware of what is going on around them. "To respond correctly, plants also need sophisticated sensing devices tuned to varying conditions," says Schultz.

So what is plant sense? Well, if you believe [Daniel Chamovitz](#) of Tel Aviv University in Israel, it is not quite so different from our own as you might expect.

When Chamovitz set out to write his 2012 book *[What a Plant Knows](#)* – in which he explores how plants experience the world by way of the most rigorous and up-to-date scientific research – he did so with some trepidation.

"I was incredibly wary about what the response would be," he says.

A Beethoven symphony is of little consequence to a plant, but the approach of a hungry caterpillar is another story

His worry was not unfounded. The descriptions in his book of plants seeing, smelling, feeling and, indeed, knowing have echoes of *[The Secret Life of Plants](#)*, a popular book published in 1973 that appealed to a generation raised on flower power, but contained [little in the way](#) of facts.

The earlier book's most enduring claim, perhaps, is the [thoroughly discredited idea](#) that plants [respond positively](#) to the sound of classical music.

But the study of plant perception has come a long way since the 1970s, and in recent years there has been an uptick of research into plant senses. The motivation for this work has not been simply to demonstrate that "plants have feelings too", but instead to question **why, and indeed how, a plant senses its surroundings.**

Enter [Heidi Appel](#) and [Rex Cocroft](#), colleagues of Schultz at Missouri who are searching for the truth about plant hearing.

"The main contribution of our work has been to provide a reason for why plants are affected by sound," says Appel. A Beethoven symphony is of little consequence to a plant, but the approach of a hungry caterpillar is another story.

[In their experiments](#), Appel and Cocroft found that recordings of the munching noises produced by caterpillars caused plants to flood their leaves with chemical defences designed to ward off attackers. **"We showed that plants responded to an ecologically-relevant 'sound' with an ecologically-relevant response,"** says Cocroft.

We have noses and ears, but what does a plant have?

Ecological relevance is key. [Consuelo De Moraes](#) of the Swiss Federal Institute of Technology in Zurich, along with collaborators, **has shown that as well as being able to hear approaching insects, some plants can either [smell them](#), or else smell [volatile signals released](#) by neighbouring plants in response to them.**

More ominously, back in 2006 [she demonstrated](#) how a parasitic plant known as the dodder vine **sniffs out a potential host**. The dodder vine then wriggles through the air, before coiling itself around the luckless host and extracting its nutrients.

Conceptually, there is nothing much distinguishing these plants from us. **They smell or hear something and then act accordingly, just as we do.**

But, of course, there is an important difference. "We don't really know how similar the mechanisms of odour perception in plants and animals are, because we don't know much about those mechanisms in plants," says De Moraes.

We have noses and ears, but what does a plant have?

The lack of obvious centres of sensory input makes it harder to understand plant senses. It is not always the case – the photoreceptors that plants use to "see", for example, [are fairly well-studied](#) – but it is certainly an area that merits further investigation.

For their part, Appel and Cocroft are hoping to track down the part or parts of a plant that respond to sound.

Researchers have begun to find repeating patterns that hint at deep parallels with animals

Likely candidates are mechanoreceptor proteins found in all plant cells. These convert micro-deformations of the kind that sound waves can generate as they wash over an object into electrical or chemical signals.

They are testing to see whether plants with defective mechanoreceptors can still respond to insect noise. For a plant, it seems, there may be no need for something as cumbersome as an ear.

Another ability we share with plants is proprioception: the "[sixth sense](#)" that enables (some of) us to touch type, juggle, and generally know where various bits of our body are in space.

Because this is a sense that is not intrinsically tied with one organ in animals, but rather relies on a feedback loop between mechanoreceptors in muscles and the brain, the comparison with plants is neater. While the molecular details are a little different, plants also have mechanoreceptors that detect changes in their surroundings and respond accordingly.

"The overarching idea is the same," says Hamant, who [co-authored a 2016 review of proprioception research](#). "So far, what we know is that in plants it is more to do with microtubules [structural components of the cell], responding to stretch and mechanical deformation."

In fact, [a study published in 2015](#) appears to show similarities that go even deeper, suggesting a role for actin – a key component in muscle tissue – in plant proprioception. "This is less supported," says Hamant, "but there has been some evidence that actin fibres in tissue are involved; almost like muscle."

These findings are not unique. **As research into plant senses has progressed, researchers have begun to find repeating patterns that hint at deep parallels with animals.**

Today there are plant researchers investigating such traditionally non-plant areas as memory, learning and problem-solving

In 2014, a team at the University of Lausanne in Switzerland [showed that](#) when a caterpillar attacks an *Arabidopsis* plant, it **triggers a wave of electrical activity. The presence of electrical signalling in plants is [not a new idea](#)** – physiologist [John Burdon-Sanderson proposed it as a mechanism](#) for the action of **the Venus flytrap** as early as 1874 – but what is surprising is the role played by molecules called glutamate receptors.

Glutamate is the most important neurotransmitter in our central nervous system, and it plays exactly the same role in plants, except with one crucial difference: plants do not have nervous systems.

"Molecular biology and genomics tell us that plants and animals are composed of a surprisingly limited set of molecular 'building blocks' that are very much alike," says [Fatima Cvrčková](#), a researcher at Charles University in Prague, Czech Republic. Electrical communication has evolved in two distinct ways, each time employing a set of building blocks that presumably pre-dates the split between animals and plants around 1.5 billion years ago.

"Evolution has led to a certain number of potential mechanisms for communication, and while you can get to that in different ways, the end point is still the same," says Chamovitz.

The realisation that such similarities exist, and that plants have a far greater ability to sense their world than appearances might suggest, has led to some remarkable claims about "[plant intelligence](#)", and even spawned a new discipline. Electrical signalling in plants was one of the key factors in the birth of "plant neurobiology" (a term used despite the lack of neurons in plants), and today [there are plant researchers](#) investigating such traditionally non-plant areas as memory, learning and problem-solving.

Despite lacking eyes, plants such as Arabidopsis possess at least 11 types of photoreceptor, compared to our measly four

This way of thinking has even led to law makers in Switzerland setting guidelines designed to protect "the dignity of plants" – [whatever that means](#).

And while many consider terms like "plant intelligence" and "plant neurobiology" to be metaphorical, they have still been met with [a lot of criticism](#), not least from Chamovitz. "Do I think plants are smart? I think plants are complex," he says. Complexity, he says, should not be confused with intelligence.

So while it is useful to describe plants in anthropomorphic terms to communicate ideas, there are limits. The danger is that we end up viewing plants as inferior versions of animals, which completely misses the point.

"We plant scientists are happy to talk about similarities and differences between the plant and animal lifestyles when presenting results of plant research to the general public," says Cvrčková. However, she thinks reliance on animal-based metaphors to describe plants comes with issues.

"You want to avoid [such metaphors], unless you are interested in a (usually futile) debate about a carrot's ability to feel pain when you bite into it."

Plants are supremely adapted for doing exactly what they need to do. They may lack a nervous system, a brain and other features we associate with complexity, but they excel in other areas.

We are more plant-like than we would like to think

For example, despite lacking eyes, plants such as *Arabidopsis* possess at least 11 types of photoreceptor, compared to our measly four. This means that, in a way, their vision is more complex than ours. Plants have different priorities, and their sensory systems reflect this. As Chamovitz points out in his book: "light for a plant is much more than a signal; light is food."

So while plants face many of the same challenges as animals, their sensory requirements are equally shaped by the things that distinguish them. "The rootedness of plants – the fact that they are unmoving – means they actually have to be much more aware of their environment than you or I do," says Chamovitz.

To fully appreciate how plants perceive the world, it is important that scientists and the wider public appreciate them for what they are.

"The danger for the plant people is that if we keep comparing [plants] with animals we might miss the value of plants," says Hamant.

"I would like to see plants acknowledged more as the amazing, interesting, exotic living beings they are," agrees Cvrčková, "and less as a mere source of human nutrition and biofuels." Such an attitude will benefit everyone. Genetics, electrophysiology and the discovery of transposons are just a few examples of fields that began with research in plants, and they have all proved revolutionary for biology as a whole.

Conversely, the realisation that we have some things in common with plants might be an opportunity to accept that we are more plant-like than we would like to think, just as plants are more animal-like than we usually assume.

"Maybe we are more mechanistic than we think we are," concludes Chamovitz. For him, the **similarities should alert us to plants' surprising complexity, and to the common factors that connect all life on Earth.**

"Then we can start to appreciate the unity in biology."

<http://www.bbc.com/earth/story/20170109-plants-can-see-hear-and-smell-and-respond>

The Secret Life of Plant Perception: Plants Can See, Hear, Smell, Feel, React, and Think

Plant senses don't work the same as human senses, but generally speaking, plants can see, hear, smell, feel, react, and even think. Below we discuss plant senses and plant perception.

Understanding Plant Senses, Plant Intelligence, and Plant Perception

Plants have a wide range of senses and can react to phenomena like chemicals, gravity, pressure, light, moisture, infections, temperature, oxygen and carbon dioxide concentrations, parasite infestation, disease, physical disruption, sound, and touch.^[1]

Plants use their cells the way we use our eyes, ears, mouth, and nose. They pick up electrochemical signals from the environment (feeling and sensing) and then process that information (thinking), releasing hormones and electrochemical signals, which causes the plant to react.

In other words, plants can sense, feel, think, and react based on sensory input. That process doesn't work exactly the same as it does with humans, but it is analogous in many ways.

FACT: All organisms have senses, not just plants. Mushrooms and bacteria are also living organisms with sensory perception.

Examples of Plant Senses:

Some plants can use one cell to focus light into another cell, and then process that information and use it to react to the environment (for example to grow toward the sunlight).^[2] Is that "seeing"? **Speaking loosely, we can argue yes, even though [photoreceptors](#) don't work the same way in humans and plants.**

We have the same argument for **smells, sounds, and touch**.

- For example, some plants can sense insects on their leaves and retract their leaves as a defense mechanism.
- Likewise, [some small flowering plants can “hear” themselves being chewed by sensing vibrations](#), triggering a chemical defense as a response.^[3]
- Likewise, fruiting plants can “smell” the chemical pheromone ethylene (a small hydrocarbon gas) produced by rotting fruit and react by ripening its fruits faster, so all fruits ripen at the same time.^[4]
- Plants can even communicate with other organisms, like the mushroom. For example, trees communicate with each other across distances by passing messages through their roots and along underground webs of fungal growth. So, not only is a plant reacting to its environment via its senses, some are capable of interspecies communication.

Why Do Plants Have Senses?

This behavior and technology of plants serve the same general function of those of any organism, to aid in survival.

Thus, it is all likely plant sense can be explained in the same way any organism’s senses can be explained, **as being a product of evolution**.

Those plants which can react to the sun and grow toward the light survive and thrive; those which can communicate with trees via a mushroom web and sense far-away danger survive, etc.

The better an organism can react, the better it can survive. The better an organism can cooperate, the better it can survive. As we know from toxic plants and people, sometimes the better a thing can defend itself or go on the offense, the better it can survive too.

FACT: Plants can also respond to pain. When grass is cut, it sends out a distress hormone to tell other grass to watch out. Yes, the smell of fresh cut grass is the smell of fear and terror. Why does it smell so good you ask? I think you know the answer. It’s the same reason you like a salad; you are a bad person.

Conclusion:

Whether or not we can say that a plant sensing and processing light is seeing, or if reacting to sound waves is hearing, or processing the information at a cellular level is thinking is

debatable. However, if we accept that plant senses are valid senses, then plants can sense much of the same electro-chemical signals we do... and even some we can't!

<http://factmyth.com/factoids/plants-have-senses/>