# I BET YOU DIDN'T KNOW...

## Can plants hear and respond to sounds?

**Dr Julia Nash,** PSTT College Fellow, links **cutting-edge research** with the **principles of primary science**

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In recent years, scientists have revealed that plants respond to sound and that they can make sound too. In this article, we find out about work that scientists are undertaking to understand more about whether a plant can 'hear' (sense and respond to) sound. Itzhak Khait and three other scientists have worked together to explore and review this phenomenon and recently published what they found out.

**Questions to discuss with children:**

- Do you believe that plants make sounds or can hear and respond to sound? Why do you think this?
- Why do you think it might be useful for a plant to be able to hear?

Khait and his colleagues reviewed the current scientific literature (research papers published by other groups of scientists) and they considered the advantages that plants may have if they could 'hear' and communicate *acoustically*. They looked at how plants make sound, how plants respond to sound (*physiological* responses), and examined any *adaptations* plants might have made to improve their *sensitivity* to sound. Their review concluded with a discussion on how sound may affect a plant and change the way it grows. A new term, *phytoacoustics*, was created to describe this new and growing research field. Scientists believe that *phytoacoustics* could be important for plants. That is, if plants possess hearing, this could improve their chances of survival. What do you think?

### How do plants make sound?

Plants have been shown to make sounds themselves. These sounds may be caused by a process called *cavitation*, where air bubbles form in the tubes that transport water and nutrients from the roots up to the rest of the plant. If the bubble rapidly collapses this causes a shock wave. These sounds have been detected remotely which suggests that the sounds produced by plants can travel through the air. Not only that, but these sounds also varied in *intensity* and *frequency* depending on the state of the plant (dry, cut, or not stressed). Such sounds could carry important information to other plants nearby, possibly so that other plants can prepare themselves for the arrival of a predator or changes in the environment.

### How do plants respond to sound?

Like all living *organisms*, plants move, *reproduce*, require *nutrition*, *excrete* waste products, *respire*, grow and sense their surroundings. These characteristics are often hard to detect in plants. So, can plants respond to sound (hear)?

Sound is caused by vibrations. Scientists have shown that when some plants are exposed to vibrations (where the source of the vibration touches the plant) such as when caterpillars are chewing leaves (Figure 1), the leaves responded by releasing more of the chemicals that caterpillars do not like to eat. This certainly suggests that the plants can detect vibrations – so it could be considered that the plants 'hear' them.

*Figure 1. The caterpillar (larva) of the Mullein moth which feeds on buddleia leaves in gardens.*

Plants have also been shown to respond to vibrations in the soil. For example, in different studies scientists demonstrated that plant roots grow towards the sound of flowing underground water and towards an artificial source of sound (at a similar frequency to the sound of running water). This suggests that plants respond to sounds in their natural environment.

Over the last 11 years (research takes a long time and 11 years is not a long time for collecting evidence to prove or disprove a theory), it has been shown that different plants can respond to airborne sound vibrations in different ways such as stimulating seed germination and encouraging plant growth.

However, many of these studies used long and constant sounds which are not typical in nature. Khait's review mentions one study, which showed that evening primrose plants (Figure 2) produced sweeter nectar after exposure to just 3 minutes to playback of bee buzzing. This could be an advantage to the plant because more insects might visit the flower with the sweeter nectar and they might stay for longer, increasing the chance of pollination by the insect. Khait and his colleagues suggest that future research should use sounds that can be found in the plant's environment and that are played back at intensities that a plant would experience in nature, which they call *ecologically* relevant sounds.

*Figure 2. Evening primrose (Oenothera drummondii) flowers are pollinated by insects such as moths and bees.*

**Questions to discuss with children:**

- How do you think the ability to sense tiny vibrations could be beneficial for a plant?
- What do you think would be the most advantageous response?
- What sounds (music) do you think plants would prefer? How could you investigate this?

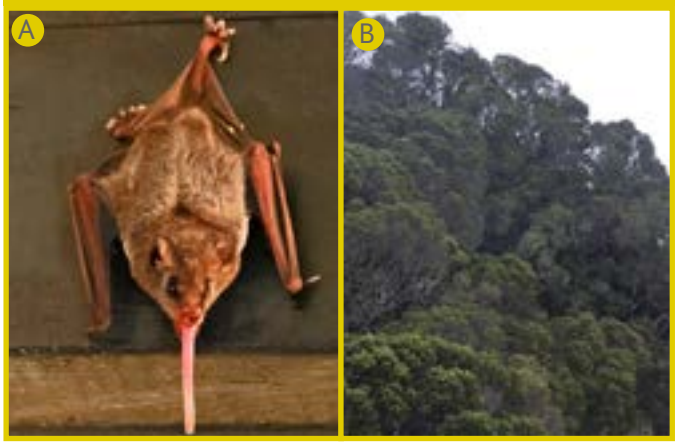
The Teacher Guide which accompanies this article suggests other possible advantages for hearing plants and investigations which children could carry out to find out how plants respond to sound.

## How have plants adapted to improve their sensitivity to sound?

Researchers still have a lot to discover about plant behaviour and continue to question how and why plants might be able to respond to sounds. Plants do not have an eardrum to collect sound vibrations, or a brain to convert the vibration into something that is heard and understood. To 'hear', what would a plant need? Might there be some sort of plant ear? How could a plant create an ear? What plant structure looks like an ear?

If there are benefits for a plant being able to detect and respond to sound, over time, the parts of a plant that assist in the process (shape, size and structure of parts that turn vibrations into the signals that trigger other parts to respond) may become more widespread through a process of *natural selection*. Perhaps flowers could help *amplify* sounds to 'alert' plants to the approach of a *pollinator*, the plant's response could be to make sweeter nectar or to open its petals to receive its pollinator. As yet, only a few research groups have worked on this. An example of how plants may have changed their physical structure over time to benefit their survival is seen in two types of Central American rainforest vines that are pollinated by bats (Figure 3). These vines have two types of leaves, flat leaves and dish-shaped leaves just above the flowers. The dish-shaped leaves reflect the bats' calls at very wide angles and this helps the flying bats to locate the flowers among the clutter of the forest.

*Figure 3. A, Pallas's long-tongued bat feeds on nectar. B, Central American rainforest (Cuba).*






**Questions to discuss with children:**

- What adaptations do you think a 'hearing' plant might have?
- How might the structure of a 'hearing' plant change over time?

## Future Research

Research in this field is just beginning, but it may provide a clearer understanding into how a plant interacts with its environment, how it could change in the short term and how it could adapt in the long term.

## GLOSSARY

**acoustic**
describing sound or the sense of hearing

**adaptations**
the process of change by which an organism becomes better suited to its environment

**amplify**
make sound louder

**cavitation**
occurs in plants when dissolved air within the water inside the tubes (xylem) expands to fill the tube

**ecological**
concerned with the relationship between living organisms and their surroundings

**excrete**
separate and give off waste material (from a living thing)

**frequency**
the number of times in one second that a sound pressure wave repeats itself (measured in Hertz) which determines the pitch ('higher' and 'lower' sounds associated with music)

**intensity**
relates to the loudness of the sound (measured in decibels) that depends on the energy or power of the sound wave and how far the sound wave travels from its source

**natural selection**
the process where those organisms better adapted to their environment survive and pass on their beneficial characteristics to their offspring

**nutrition**
the process of obtaining food necessary for health and growth

**organism**
a living thing capable of a separate existence

**physiological**
related to the way in which a living organism or bodily part functions

**phytoacoustics**
related to sounds produced by plants and sound detection by plants

**pollinator**
an animal that moves pollen from the male anther of a flower to the female stigma of a flower. Some birds, bats, butterflies, moths, flies, beetles, wasps, small mammals, and bees are pollinators

**reproduce**
produce offspring

**respire**
use oxygen in the breakdown of food to release energy and carbon dioxide

**sensitivity**
the ability of an organ or organism to respond to an outer stimulus, such as sound

**The paper that inspired this work was:**

*Sound perception in plants.*

*By I. Khait[1], U. Obolski[2], Y. Yovel[3], L. Hadany[1].*

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