

# I bet you didn't know

## *Floral scents may be changed by air pollutants*



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Insect pollination of crops is important for farming and food production. However, scientists are concerned that increased air pollution changes the sweet smells (floral scents) that flowers make to attract insects.

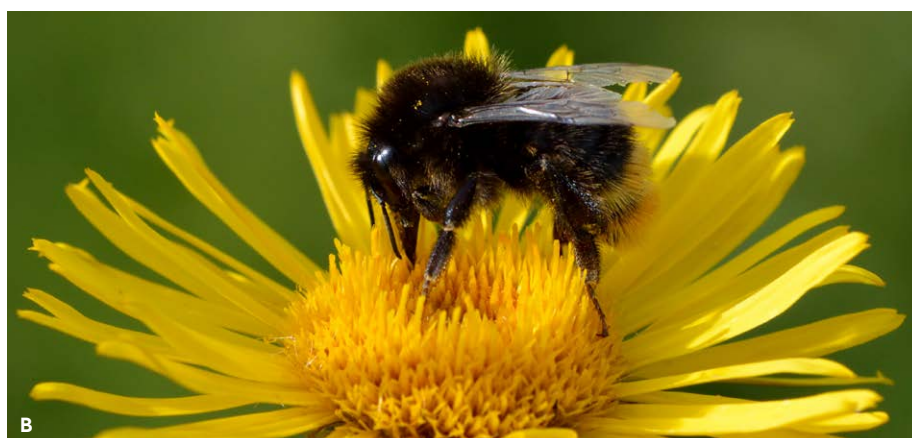


Figure 1.A: A garden bumblebee (*Bombus hortorum*) visiting the common toadflax which has petals that form long tubes.  
B: A red-tailed bumblebee (*Bombus lapidarius*) on Irish fleabane. © Ivar Leidus, licensed through Creative Commons and accessed via [Figure 1.A](#) and [Figure 1.B](#).

**T**he scientists carried out experiments to see whether insects were attracted to floral scents mixed with pollutants.

### Which types of flowers do insects prefer?

Insects visit flowers to feed on their nectar (a sugary liquid produced by the flower) and pollen to survive and grow. Most pollinating insects (pollinators) have preferred types

of flowers that they visit and may have specific adaptations to enable them to collect pollen and nectar efficiently.

For example, the garden bumblebee has a particularly long tube-like mouthpart (proboscis) that it uses to suck up the nectar from the base of the flower. It can reach deep within a flower so it can visit flowers with petals that form long tubes. The red-tailed bumblebee is a larger bee that likes to land on flowers with platforms, such as daisies (Figure 1).

### Children could carry out surveys in the school grounds or local parks to answer these questions:

- Can you identify the insects that visit the flowers in your local environment?
- Do different types of insects visit the same flower?
- What shape are the flowers that the insects visit?
- Are some coloured flowers more popular than others?



## How does an insect find nectar?

Many insects rely on the sweet smells produced by flowers (floral scents) to guide them, whilst others recognise brightly coloured petals or patterns on petals. The effectiveness of floral scents to attract insects depends on the surrounding environment.

## Why are scientists concerned?

Human activities such as burning fossil fuels have dramatically increased levels of pollutants released into the atmosphere. Increasing air pollution might reduce the attractiveness of the floral scents because some of these pollutants react easily with the natural substances (scents) released by flowers. This could change the floral scent.

Questions to discuss:

- What might happen to populations of moths, butterflies and other pollinators if they cannot locate flowers easily?
- What other living things do you think might be affected if insects cannot find their flowers? Why?

In a recent paper, Brynn Cook and his colleagues showed that ozone (a pollutant gas found in the air) altered the blend of substances in a floral scent. They compared how the tobacco hawkmoth (Figure 2) responded to one of its preferred floral scents and what happened when the scent was altered by adding ozone.

To find out which scent the moths preferred, the scientists put the moths in a wind tunnel with two artificial flowers, one flower with the natural scent and one with the altered scent. They observed which scent the moths flew towards (Figure 3). This experiment showed that hawkmoths prefer the natural scent over the ozone-altered floral scent.



Figure 2. A male tobacco hawkmoth (*Manduca sexta*).

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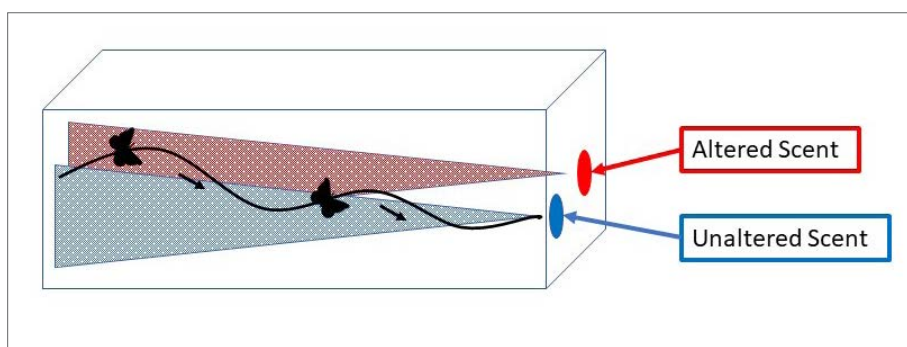


Figure 3. Hawkmoths choice test in a wind tunnel between two tubes emitting either unaltered or ozone-altered floral scents.

In a second investigation, to see whether the moths could learn to recognise a new scent, the moths were exposed to the altered scent (the one they did not prefer) and at the same time were given a sugar-reward on a visually attractive flower. When they were re-tested in the wind tunnel, the hawkmoths spent more time at the altered scent – they had learned that the altered scent gave a reward and were therefore more attracted to it.

In nature, the floral scent is altered as it travels away from the source flower and through a polluted atmosphere. Foraging moths will experience

greater quantities of altered scent when they are more distant from the plant and increasing natural scent as they move close to it to collect the nectar. The scientists simulated this in the laboratory. The moths preferred the ozone-altered floral scent to air after training with a sugar reward in three different situations: with the ozone-altered scent, with the natural scent, and after a sequence of scents (ozone-altered then natural). The scientists suggest that foraging moths could learn to recognise polluted scents, but they are yet to test whether this is the case in the natural environment.



## How will pollinators and flowers evolve in the future?

If an animal and plant depend on one another for their mutual survival, the link between them must be maintained. In an increasingly polluted environment, the plants that survive might be the ones whose pollinating insects learn to recognise altered floral scents. If insects cannot adapt to the modified scentscape, they may be unable to locate their food and populations of both insects and plants might be endangered.

It will be interesting to see whether, over the course of many generations, flowers evolve, through natural selection, to be more brightly coloured, have patterns on their sepals and petals to guide their pollinators to them, or use some other method to attract their pollinators. More work is needed to find out the real threat of pollutants on foraging insects.

➡ **The Teacher Guide that accompanies this article suggests how children could investigate how a particularly volatile smell affects their ability to smell other fragrances. They could also investigate which colours and patterns on petals are the best for catching the attention of passing insects.**

➡ **To find out more about air quality, air pollutants and climate change, you may be interested in PSTT's [Air Pollution Research](#) resources for children (ages 9-11).**

➡ **For teaching ideas and classroom resources to support climate science, teachers may be interested in PSTT's recorded sessions from the Primary Climate Science Symposium and articles from Why & How? magazine, which can both be accessed [here](#).**

## Glossary

**adaptations** – characteristics of living things that improve their chances of surviving and reproducing

**air pollution** – the contamination of the air by a mix of particles and gases that can be harmful to human health and the environment

**foraging** – searching for food in the wild

**fossil fuels** – a natural fuel formed in the past from the remains of living organisms that contains carbon and hydrogen that can be burned for energy, such as coal, crude oil or gas

**natural selection** – the process in which organisms better adapted to their environment survive and pass on their beneficial characteristics to their offspring

**ozone** – a colourless gas, made of three oxygen atoms bound together, that forms in the air when other pollutant gases (nitrogen oxides and volatile organic compounds) react in sunlight. Even at low levels it is harmful to humans

**pollination** – the transfer of pollen from the male part of the flower (anther) to the female part of the flower (stigma)

**pollinator** – an animal that moves pollen from the male anther of a flower to the female stigma of a flower. Examples include insects such as bees, butterflies, moths and beetles and also vertebrates such as birds, some small mammals and reptiles

**pollutants** – harmful materials that are released into the environment and damage the quality of the air, water and land

**scentscape** – the complex composition of smells in an environment

**simulated** – in science or industry, a method that copies actual events or processes under test conditions

## The research paper that inspired this work was:

*Pollination in the Anthropocene: a Moth Can Learn Ozone-Altered Floral Blends*

By Brynn Cook<sup>1,2</sup>, Alexander Haverkamp<sup>1,3</sup>, Bill S. Hansson<sup>1</sup>, T'ai Roulston<sup>2</sup>, Manuel Lerdau<sup>4</sup> and Markus Knaden<sup>1</sup>

Published in *Journal of Chemical Ecology* (2020) 46:987–996

<https://doi.org/10.1007/s10886-020-01211-4>  
Last accessed 23.5.22

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