

# Bees don't just make honey — they solve basic math problems

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A honey bee visits a purple cornflower blossom in Santa Fe, New Mexico. Photo by: Robert Alexander/Getty Images

We know bees are good at making honey. Turns out they aren't bad at math, either.

Cognitive scientists study the brain and how it processes information. A group of scientists are training bees to perform simple addition and subtraction.

A team led by cognitive scientist Scarlett Howard of RMIT University recently did a study. It was published February 6 in *Science Advances*.

Scientists used to believe that just humans and a few primates could understand numbers in a complex way, said Adrian Dyer. He's a scientist from RMIT University in Melbourne, Australia. Dyer helped author the study.

More recent research has shown that a very intelligent bird can solve these kinds of problems. Another study found evidence that spiders can count.



Dyer said that now it seems that many animals may be able to develop these skills. Bees are one of them.

### **Bees Are Small, But They Can Learn Complicated Behaviors**

Humans have kept and benefited from Western honeybees for more than 3,000 years. They're great study subjects, says Dyer.

Honeybees have fewer than a million neurons. These are cells in the nervous system that send signals throughout the body. Cells are the building blocks of life, each with a specific duty. By comparison, humans have closer to 100 billion neurons.

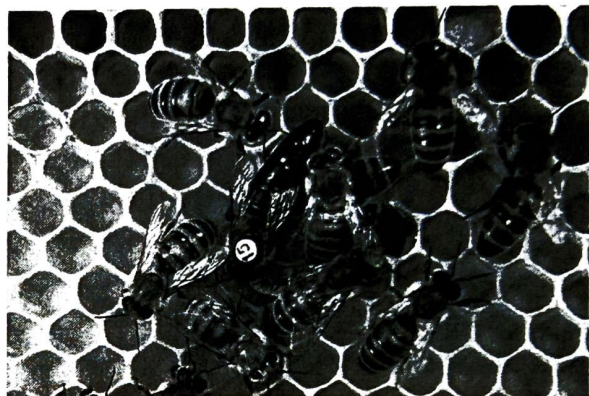
Still, bees can learn some very complicated behaviors. Karl von Frisch studied the bees' ability to communicate the location of food to companions through dance. More recent research has looked into bees' complicated group decision-making. Bees can even recognize individual human faces.

Working with any animal is difficult, Dyer said. However, bees have an unusual motivation. A bee collects food not for herself, but for the entire hive.

### **The Rules Of The Experiment**

For the experiment, the scientists baited individual bees with sugar water.

"She flies back to the hive, gives it to the other bees, and two minutes later she'll come back and do it again," Dyer said. They could test the same individual for six to eight hours straight in a single day.



The researchers taught and tested 14 bees over the course of the experiment — one bee at a time.

To learn the rules, a bee first would be shown cards. Each was printed with a number of shapes in one of two colors. It was blue if they were supposed to add one to the shapes on the card. Another was yellow if they were meant to subtract one shape.

Then, the bee would choose an answer to the problem by flying to one of two possible solutions. If it chose well, it found itself near some delicious sugar water. If it chose poorly, however, it would be "punished" with quinine. That's the same stuff that makes tonic water taste bitter.

To make sure the bees couldn't cheat, the scientists printed different shapes on each card. They also changed up the math problems and cleaned the testing chambers between experiments. They wanted to make it impossible for the bees to follow each others' scent trails.

### **Problem-Solving Comes Easy**

The researchers found that each bee often picked the correct answer in both addition and subtraction trials. They were right about 7 out of 10 times.

Dyer said that kind of problem-solving requires both long-term memory and short-term memory. Long-term memory allows the bees to remember that blue and yellow are separate mathematical rules. Short-term memory lets them recall the numbers in a particular problem.

Honeybees live complicated lives. Still, Muth said, it's hard to say when they would need to add or subtract.

### **Bees, Like Humans, Change Over Time**

One possibility is that bees weren't always good at addition and subtraction. They just evolved, or changed, to be smart enough to figure it out.

Humans never needed to play complicated music or ride surfboards, Dyer said. "We're just highly intelligent, and that has allowed us to survive in a whole heap of different environments."

Honeybees might be similarly adaptable.

Dyer said that observing a tiny animal with an even tinier brain learn a very complex task makes him think, "Wow, what can humans achieve?"