Magnetic Worms! Kind of...

Did you know that some animals can detect magnetic fields? Scientists have studied how birds and whales detect and use the Earth's magnetic field to help them navigate for years. These animals can travel thousands of miles during migration, so it makes sense that they would use Earth's magnetic field to navigate as they cross so much during their travels. But recently, scientists discovered that a small worm, known as *Caenorhabditis elegans* or *C. elegans* (see **Figure 1** below) can detect magnetic fields, too. What advantage does this ability give to a microscopic worm?

Figure 1. Magnified *C. elegans*. A microscope image of a *C. elegan*. *C. elegans* are only about 1 mm or 0.1 cm long and live between 2–3 weeks.
Source: Wikimedia Commons/Bob Goldstein, UNC Chapel Hill

C. elegans live primarily in the soil, where they feast on bacteria. Recently, scientists found they use what is known as the AFD sensory neuron pair, shown in **Figure 2**, to navigate within a pile of soil. This structure is in the worm's head and is used to detect Earth's magnetic field. The worms then use that information to determine which direction is up and which is down. To study this in a lab setting, scientists had to create an artificial magnetic field that they could adjust the strength and direction of in order to mimic the magnetic field a worm would feel in its natural habitat. Because different varieties of these worms are found all over the world, and the Earth's magnetic field differs in different places, worms from different locales were expected to respond to the same field differently.

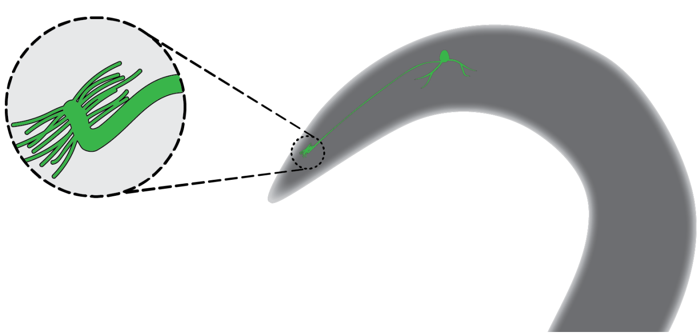

Figure 2. AFD Sensory Neuron Pair. Located in the head of the worm, the AFD sensory neuron pair (in green) was found to sense the Earth's magnetic field.

Scientists found that worms naturally preferred to burrow downward, but when an artificial magnetic field was applied to trick the worms that caused a local reversal of Earth's magnetic field, they burrowed upward. Worms from different places around the world traveled at specific angles to the magnetic field that the scientists applied that would have optimized travel upward and downward if they were in their native area. For example, worms from Australia and England went in opposite directions given the same magnetic field because while the magnetic fields in Australia and England are of similar strength, they have the opposite polarity. Similarly, since the Earth's magnetic field is not as strong at the equator as it is at the poles, worms from countries on the Equator were not as sensitive to the applied magnetic fields as worms from closer to the poles. That makes sense from the perspective of biological evolution: the stronger the magnetic field is in the local environment, the stronger the advantage would be to worms with the ability to sense it.

Researchers are still trying to determine how the AFD sensory neurons work. They hope that a better understanding of how *C. elegans* detect and respond to magnetic fields will give them insight into how magnetic fields affect other animals and allow scientists to better predict animal behavior.

Reference

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BiteScientist Profiles

Erin Dahlstrom received her doctorate degree from Harvard University in 2018. Her research used *C. elegans* to study how cells respond to stress, such as high temperature. Her hope is that by studying the cell's "stress response" at a basic level, we can find new applications to treat diseases like cancer and Alzheimer's. In her free time, Erin likes to hike and sing.

At Brookline High School, **Tyler Wooley-Brown** integrates critical thinking skills, inquiry-based investigations, and scientific reasoning into each of his physics classes. He also works to promote the idea that *all* students can and should participate in science (not just white men). Tyler is currently working toward an advanced degree in curriculum and teaching at Boston University. Tyler is a lover of media, especially music. He plays bass guitar.