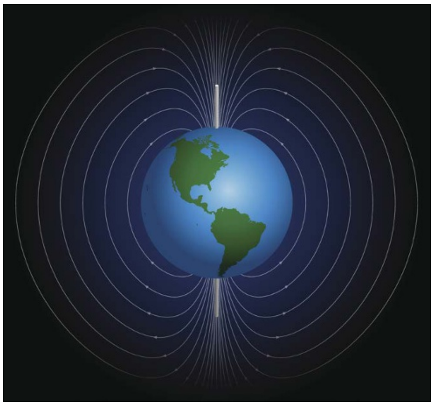
A mechanism for magnetosensing in animals

The Earth is enveloped in a protective magnetic field that emanates from the planet's core. This invisible field passes through our atmosphere, mountains, oceans, houses and even our bodies. Though it is concealed from human sensation, many organisms can detect and make use of magnetic fields to inform navigation and migration behaviors. This ability is known as magnetosensing, and it has been a topic of neurobiological intrigue for several decades. There are hypotheses to explain how magnetic sensing works, but there has been little scientific validation of any mechanism. However, a recent study now provides new evidence for a putative magnetoreceptor that might explain how biological cells detect magnetic fields.

Siying Qin (Peking University, China) and colleagues extensively screened the genome of fruit flies to identify a protein complex that is found in several species and is capable of interacting with magnetic fields (*Nat. Mater.* doi:10.1038/nmat4484; published online 16 November 2015). The protein complex they uncovered is composed of two main pieces. The first piece is a flavoprotein called cryptochrome that has long been implicated in magnetic sensing. The other piece is a novel component that the authors call MagR. MagR is a protein containing iron-sulphur clusters, which potentially act as the initial magnetosensors within the complex. Using imaging techniques and molecular modeling, the researchers determined that the protein complex appears as a rod-like string of MagR molecules surrounded by a double-helix of cryptochrome molecules.



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Most importantly, the authors' work provides the first direct observation of a protein complex within biological tissue that is capable of detecting magnetic fields. In experiments using imaging during application of an external magnetic field, the authors show that MagR-cryptochrome molecules display physical rotational changes in the presence of strong magnetic fields. The researchers also show that these protein complexes are found in multiple animal species, including the retinas of pigeons, which are known to use the earth's geomagnetic field during navigation.

The combination of techniques used by the authors provides the best evidence to date that a magnetoreceptor molecule exists within magnetosensitive organisms, and might provide a molecular mechanism for this mysterious sensory system. Future studies are needed to confirm this novel mechanism, including electrophysiology to demonstrate that these protein complexes actually function as true receptors in neurons. If these molecules do function as magnetoreceptors, then these results could open up an entire new area of sensory neuroscience.

James E. Niemeyer

SMELL CARRIES SOCIAL SIGNALS AMONG MACAQUES

Many mammals use olfaction to recognize important social cues, including territory markers, group status and individual familiarity. It is generally thought that most primates use olfaction to a lesser degree, relying chiefly on sight and sound as their primary senses; however, recent research has shown that even primate species that have reduced olfactory physiology and behaviors can produce and perceive complex distinct odor profiles.

Rhesus macaques (*Macaca mulatta*) are one such primate species that lacks scent glands and does not exhibit scent-marking behaviors, though they have been observed using smell to inspect food and body parts of other macaques. Rhesus macaques also participate in structured social groups and behave very differently toward familiar and foreign monkeys depending on their discernible group affiliation. Recently, a team of researchers led by Stefanie Henkel of University of Leipzig (Germany) investigated how macaques respond to body odors from individuals within and outside their social groups (*Behav. Ecol. Sociobiol.* **69**, 2019–2034; 2015). Henkel's team introduced both male and female macaques to odor samples swabbed from the genital region of female macaques; they presented these samples in metal tea eggs, and then recorded behavioral responses. This study took place on the research island Cayo Santiago, Puerto Rico, so Henkel's team was able to control for kinship and familiarity using contextual pedigree data, and the study took place during a non-mating season.

In this scenario both male and female macaques showed more interest toward the odors of unfamiliar females (from other social groups) than those of familiar females (from their own groups), placing their noses near unfamiliar odors for longer periods of time. Additionally, males and older macaques licked the tea egg more often than females and younger macaques, respectively, and individuals lingered at the odor longer when it came from a social group with a higher social rank.

Henkel *et al.* note that these findings are not surprising, as they comport with similar behaviors seen in other mammals that use olfaction similarly. However, these behaviors are still poorly understood in macaques, and these findings demonstrate the complex sensory signals that inform social behaviors in this common biomedical model. In a press release Henkel acknowledged that olfaction is only part of the story, noting that "the recognition of conspecifics might be a more multimodal process also including visual cues or a combination of olfactory and auditory signals. Further research is necessary to fully understand the underlying mechanisms of recognition processes".

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