Problem/Solution — Navigation by Magnetoreception

by Michael G. Windheuser, PhD

When he was 12, my youngest son won the local science fair using an observation about the ability of goldfish to sense and orient themselves in relation to the prevailing magnetic field. The initial observation was made by Vlastimil Hart using carp (*Cyprinus carpio*) held in live tanks at a European Christmas market. The fish oriented themselves in a preferential direction when at rest in the tanks (Hart, et al., 2012).

My son's project asked the question whether fan-tailed goldfish, also members of the cyprinid (carp) family, have a preferred direction when at rest, and whether that can be changed by 90 degrees through the use of a strong magnet placed outside the test bowl. It turns out that fan-tailed goldfish do have a preferred rest position, and the fishes' orientation at rest can be predicted when a strong, local magnet overwhelms the earth's magnetic field, changing the field axis by 90 degrees (Windheuser, 2014).

A number of animals exhibit magnetoreception, having the ability to sense the earth's magnetic field and navigate in relation to it. Some birds, like the Savannah sparrow, have both a magnetic sense, linked to its right eye, and a magnetic map sense resident in its brain (Denny and McFadzean, 2011). Sea turtles exhibit similar magnetoreception, returning to their breeding grounds each year. Pacific salmon apparently imprint on the magnetic field present where their freshwater breeding stream enters the ocean. And some sharks also have a similar ability which aids them in assembling for yearly gatherings.

It seems that magnetoreception is an elegant solution to the problem of navigation through an otherwise featureless environment like the ocean, but one that not all sea or land creatures share. Histologic analysis of brain sections of fish and other animals have demonstrated the existence of structures which are composed of tiny, iron-rich crystal cores that respond to the prevailing magnetic field. Movement of the cores within these cells in some way communicates the strength and direction of the magnetic field, and the animals' brains process this input into directional behaviors (Eder, et al., 2012).

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These observations belong to a broad category of examples in the natural world that match appropriate engineering solutions to biological problems, such as navigation, when other directional cues are absent. But did magnetoreception evolve independently several times in different animals in response to similar problems, or is it an example of selective and intelligent application by the Creator of a solution for a known biological need or "problem"?

For the scientist who is also a Christian, the latter case seems more likely, since the evolutionary explanation would require incremental, gradual changes, all of which would need to impact survival in a positive way for each change to be retained. What selective advantage would partial receptor cells have, and when would the animal develop the mental understanding of the meaning of the signals from them?

Both a functioning magnetoreceptive cell and the non-physical, mental program to interpret its signals must be present for there to be a selective value for the animal. This is similar to the idea of irreducible complexity described by Michael Behe for the bacterial flagellum (Behe, 1996), but adds the concept of a non-physical, mental program converting physical signals into three-dimensional movements as a requirement for full functionality.

Magnetoreception is an appropriate and functional solution to the navigational needs of some animals. Our all-wise Creator had foreknowledge of the navigational challenges some animals would face, and created a perfect solution to the problem, one that is exactly matched to the needs of the organism, and that is always "on" because it is linked to the earth's magnetic field.

References

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