

How do cells find their way through our body?

Tweedy L, Thomason PA, Paschke PI, Martin K, Machesky LM; Zagnoni M, Insall RH. Seeing around corners: Cells solve mazes and repond at a distance using attractant breakdown. Science. 2020 Aug 28;369(6507)eaay9792.doi:10.1126/science.aay9792.PMID: 32855311

Cells are able to navigate with surprising accuracy through quite complex environments by following the trace of an attractant. This is very important in cell migration (e.g. movement of neurons in a child brain) and for cells of the immune system. We present here the results of a research study investigating cell orientation by building little mazes and monitoring cells behavior in the maze.

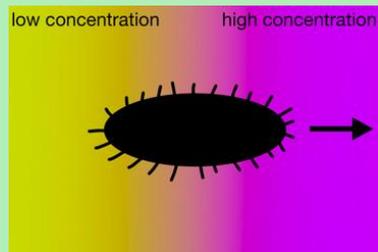


Figure 1: Cell follows attractant

Cells have a very special technique to orientate themselves. Their oval shaped body is covered with receptors, so they can perceive the presence of an attractant. But they can also distinguish differences in the concentrations of an attractant if it is more than 1% difference. Then, they turn around and move towards the attractant (see Figure 1).

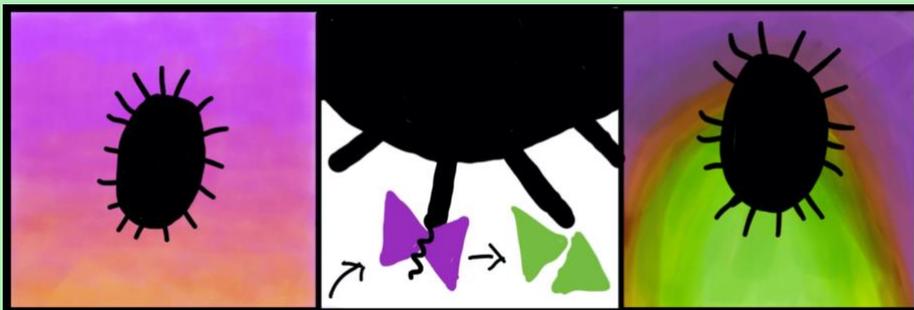


Figure 2: A cell breaks down attractant and creates a gradient

When a cell meets attractant, they also deplete the attractant by various mechanisms, like for example decomposition by enzymes on the cell surface (shown in figure 2). If a cell breaks down attractant, logically there is a lower concentration close to the cell than further away. This way, they create a very strong gradient at the exact spot where they are, which makes it easier to identify the direction of the attractant.

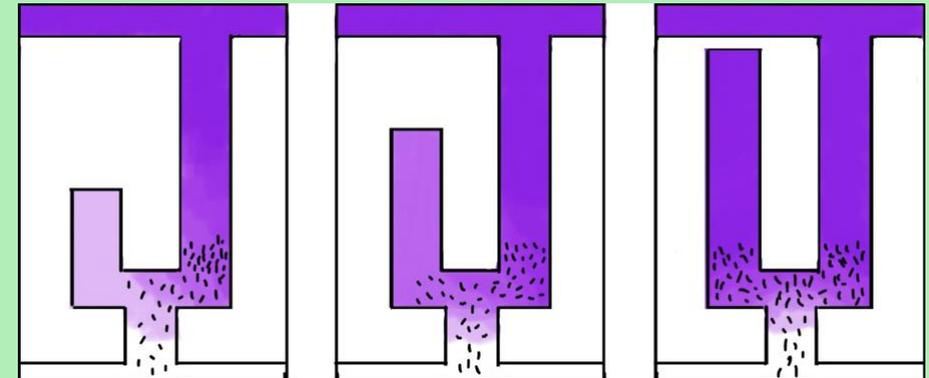


Figure 3: Number of cells choosing a dead end with varying length

While cells are at a junction, they deplete attractant and at some point, most of the attractant there is used up. There is always new attractant coming from a live end, but from a dead end nothing comes, so the cells know where to go. This depends of course on the length of the dead end (see Figure 3) because there is more attractant to deplete in a longer dead end than in a shorter one. Logically, if a group of cells already depleted all the attractant, cells following later have an easier choice.

Glossary	
Chemoattractant/Attractant:	A substance which fits the receptors of a specific cell species, so the cells can perceive its presence and follow it
Gradient:	Here: Attractant Gradient: When there is a difference in the concentration of attractant between two regions.
Receptor:	An extension on the outside of the cell membrane to which fitting substances can dock. The receptor then forwards a signal to the inside of the cell, where a decision on the basis of this signal may be made.