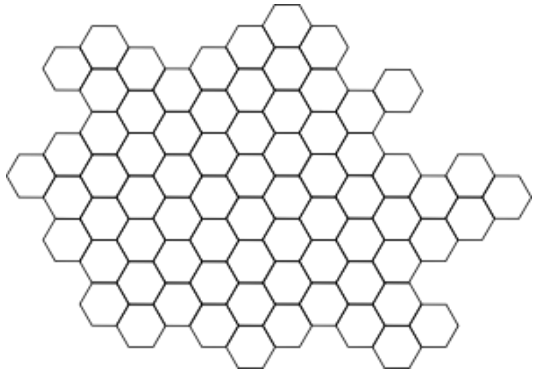
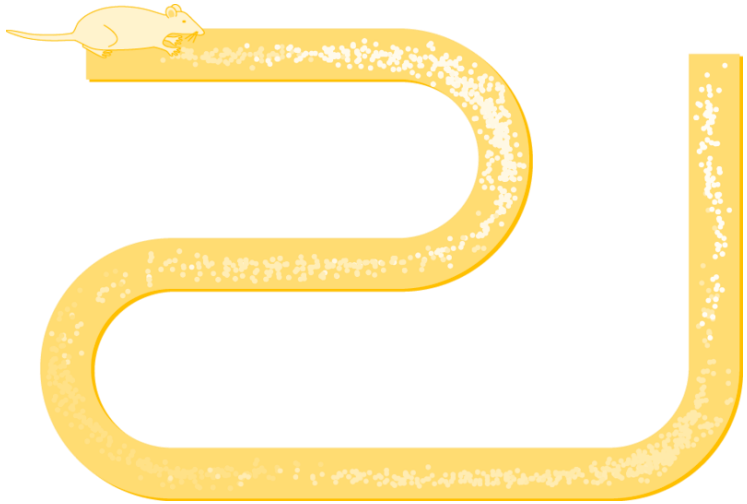


Navigation Cells: A Teaching Aid for Key Stages 1 and 2



Introduction for Parents / Educators

What are navigation cells?

Navigation cells are highly specialised neurons located in the hippocampus and illustrate specialised functioning within the brain. Broken down into Grid, Border, Place and Head Direction Cells, these neurons are responsible for interpreting the information that allows us to process our whereabouts at any given time and move through the world. As a result, our day to day functioning relies on navigation cells.

Why explore this topic with your children / pupils?

Navigation cells are an excellent example of how the brain receives and processes information from our external environment, as well as providing a fun introduction to the concept of brain regions and their specialist functions. They are straightforward in explanation and exciting to explore, as a range of hands on activities can be utilised in order to aid teaching. This document contains all the necessary information to explain navigation cells to pupils in Key Stages One and Two, with subsequent activities* adapted for each group. Additional resources required for lessons are listed below.

You will need…

- Photocopies of the following worksheets to be handed out to relevant to the age(s) of the child(ren) you are working with (age group indicated)
- Programmable Floor 'Bee Bot' Robots (Rechargeable), and a 'Bee Bot Mat' of choice (many design options), both available on Amazon, or https://www.tts-group.co.uk/bee-bot-programmable-floor-robot/1015268.html**
  Alternatively, Digital versions of the Bee Bot activities are available: Terrapin Bee-Bot Emulator https://www.terrapinlogo.com/emu/beebot.html, or the Bee-Bot® App on the Apple App Store and Google Play. Digital downloads of many maps are available on Twinkl.co.uk https://www.twinkl.co.uk/search?term=bee+bots**
- Scissors and coloured pencils / crayons if desired; for Key Stage One children, stickers may be rewarded for participation

*Note, activities illustrated are not an exhaustive list, but a framework upon which further teaching methods may be built. Key Stage One children may derive own routes from mats or maps provided, or be presented with list of destinations to reach. The latter is not included in this document, as this would be entirely dependent on the map being followed, of which there are many available.

**Available at time of publishing, March 2020.

Image Credits: Bee Bot © Bee Bot, Amazon 2020.

Navigation Cells

Bzzzzzz… it's the Bee Bots! These friendly faced fellows help us learn about navigation cells, the parts of our brain that help us find our way and keep us from getting lost! There are four different types of these cells, each with their own special purpose. Can you program the bee bots to go on a journey of their own?
Which of the navigation cells will they use on the journey you've sent them?

I tell you where you are!

Place Cell

Head Direction Cell

I tell you what way we're facing!

I tell you when we meet an object, so we don't bump into something!

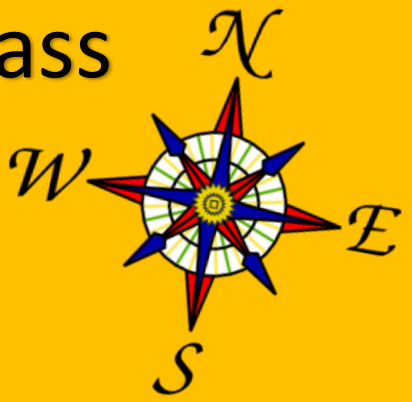
Border Cell

Grid Cell

I tell you how far we've travelled!

Image Credits: https://scratch.mit.edu/studios/1356244/ 2020.

Navigation Cells: Our Inner Compass



What are they?

Navigation cells are a specialised type of neuron in our brains that feed us information about our environment. They are responsible for helping us get around and find our way, just like an internal compass!

Wait, what's a neuron?

Neurons can be described as the most basic unit in the nervous system, but there's nothing basic about their function! We rely on these tiny information carriers to send and receive signals from one part of the nervous system to another, or from the brain to the rest of the body. They do this using electrical impulses that they pass along from one neuron to the next, like a never-ending pass the parcel *(exhausting, eh?).*

So… where are they, exactly?

Navigation cells are located in your hippocampus, which is a very tricky part of the brain to spot! Humans *technically* have *two hippocampi*, one in each hemisphere (half) of the brain. They are located in the medial temporal lobe of the brain, which is a fancy way of saying sort of in the lower middle part.

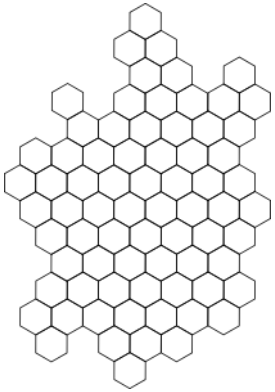
And what makes them so special?

These cells are referred to as specialised because there are four types which make up this group of navigators, each with their own unique function. They work together to keep us on track! They are the *place cell, grid cell, border cell* and *head direction cell.* Incredibly, they are just a small part of what the hippocampus can do; it also does a lot for our memory!

Fun fact: the word hippo-campus comes from the Ancient Greek word for seahorse! (ιππόκαμπος).

Place Cells

The first type of navigation cell to be discovered were lace cells in 1971; not in humans, but in rats! Place cells let us know where we are in the space we occupy; they are your *"I'm here!"* signal.



Head Direction Cells

You've probably guessed it, head direction cells activate when we turn are head and tell us what direction we're facing. No prizes for guessing that one!

Grid Cells

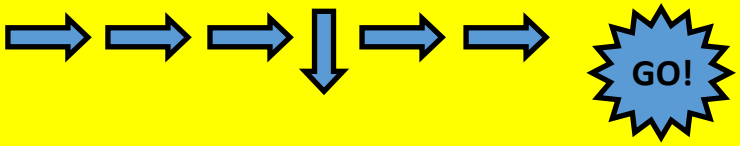
Grid cells tell how far we've travelled, like counting your steps.

Border Cells

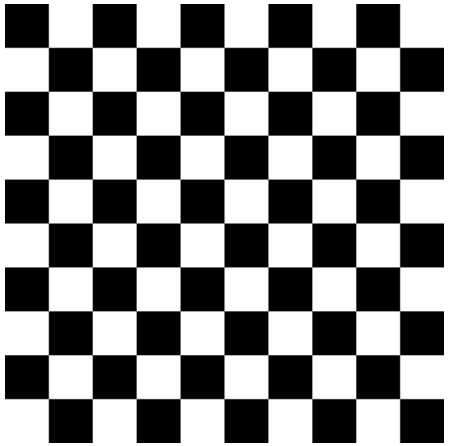
Border cells let us know when something is in our way, so we don't bump into boundaries in our environment. We can't walk through walls (yet).

Bee Bots: Navigation Cells in Action

Bee Bots were developed to show how navigation cells work together to guide us in our everyday lives. You can use the Bee Bot Robots or online Bee Bot equivalent to program a journey for the bee to travel on. Make a note of which of the navigation cells that your bee would use and when. *For example: forward x3, turn x1, then forward again x2.*
The cells used: grid to count, head direction to turn, grid again, and place when we've reached our destination. If we turned because of a street corner, then border cells are used too!

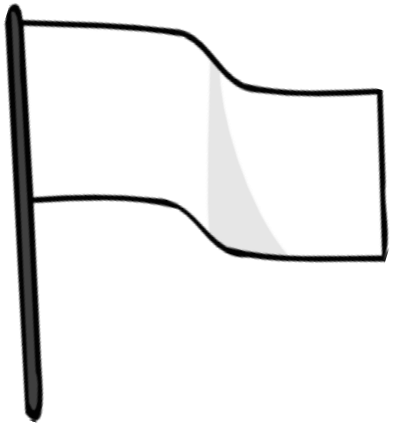


Can you design some more maps for your friends to follow? Work out what the answers would be to your map and test them! **NEXT:** can you cut out the cells overleaf and in your own words, describe what they are and an example of when you would use each?



Grid Cell

Head Direction Cell



Place Cell

Border Cell

Final Note for Parents / Educators

This document was compiled using activities conducted in the University of St Andrews Baby and Child Lab.
If these exercises were helpful or stimulating for your child(ren) / pupils, please consider visiting the Baby and Child Lab's website for more information on further activities and how to get involved with similar projects.

http://developmentlab.wp.st-andrews.ac.uk/

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