**CELL POLARITY**

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Multicellular organisms are made up of a diverse array of cell types, each of which is specialised to carry out a certain set of roles. At a very basic level, a human body uses muscle cells to drive movement, white blood cells to fight infections, nerve cells to give us consciousness (and the list goes on). It is this variety of different cell types, and the interactions between, them that makes us capable of so much.

But functional segregation goes beyond the inter-cellular level. Not only are there differences between cells, but a look at any individual cells reveals that distinct differences and asymmetries exist within cells themselves.

The neuron shown in fig x is a striking example of this, having a distinct axis (a front and a back if you like) specialised to receive signals at one end and send signals towards the other end. We refer to this phenomenon as polarity (the same way that a magnet is polarised to have distinct positive and negative ends).

Polarity is a property that applies to nearly every cell that one might come across. Epithelial cells (fig x) are another example, where an axis is coordinated to define directional nutrient uptake. Migrating cells are polarised to allow them to move in a certain direction (fig x). A final example (and of particular relevance to this project) is seen in dividing cells, where asymmetries in a mother cell ensure that the two daughter cells are different from one another (fig x).

In all cases, polarity arises due to a series of orchestrated rearrangements of cellular components. Directed cell motion, for example, involves rearrangements of the contractile cytoskeleton along a certain axis. Asymmetric cell divisions generally involve the movement of fate determinants and the cell division machinery towards one end of the mother cell.

This begs the ultimate question of how such asymmetries arise in the first place. The diversity of contexts might suggest that many distinct mechanisms are at play. Remarkably, however, whilst some of the molecular details do differ between systems, many of the core aspects at play are conserved between systems.

In most cases, cell polarisation is driven by a small network of molecules, known as polarity proteins, that self-organise to form polarised patterns on the plasma membrane of cells (these are highlighted in green and red in fig x). Once in these arrangements, these proteins act as master regulators of cell polarity, driving a series of downstream processes to set up functional asymmetries in cells.

A particularly important set of proteins in this regard is the PAR network, which regulates polarity across metazoa in a range of contexts such as epithelia and stem cells. A whole field of research has emerged aiming to understand what these proteins are, how they regulate the downstream processes of cell polarity and, perhaps most importantly, how they become polarised in the first place.