TEACHER PAGES: JIGSAW – LYSOSOMES SECTION CARDS

The body is divided into tiny cells, each containing an entire copy of the DNA for the whole body. Not all of it is used in each cell. Liver cells read only the bits about liver cells, muscle cells only the bits about muscle cells and so on. That's why there are different types of cells in the body. Cells themselves are banded together to form organs. Just as the body is divided into organs, each with its own specific function, the cells themselves are divided into compartments called organelles.

There are a number of different organelles in cells. Energy is produced in organelles called mitochondria; DNA, in the form of chromosomes, is kept in the nucleus; but our interest is in an organelle called the lysosome. Lysosomes are sacks (vesicles) of enzymes that have pinched off of the Golgi apparatus. Lysosomes are found in varying amounts in varying shapes but always consist of a central space filled with enzymes completely enclosed by a membrane.

Lysosomes act as tiny vacuum cleaners, tidying up the cell and ingesting anything that there is too much of such as complex sugars and proteins. The substances they ingest are then broken down and released into the cell as smaller units for re-use. Enzymes found only in the lysosomes facilitate this process. The environment inside the lysosomes is more acidic than that of the surrounding cell cytoplasm, so only acidic enzymes can function inside the lysosome.

Enzymes are very sensitive to acidity and so enzymes which work inside the lysosome would not work outside and vice-versa. That is why Pompe disease does not have the same symptoms of low sugar levels that some of the other glycogen storage diseases produce - glycogen continues to be broken down normally in the cells outside the lysosomes and blood sugar levels are maintained. It is the excess glycogen that is taken into the lysosome that creates a problem.

The reason that Pompe disease produces such severe symptoms is twofold. Firstly, the missing enzyme is one of the lysosomal enzymes. For this reason, Pompe disease is referred to as a lysosomal storage disease. There are around 50 known lysosomal storage diseases. In each case there is a common problem: the lysosomes take up a substance that they do not possess the enzyme to break down. This means that the lysosomes grow larger and larger until they disrupt cell function, and therefore, the function of the organ or tissue that the cells make up.

This leads us to the second reason that Pompe disease is so severe, even amongst lysosomal storage diseases. As glycogen is the energy storage compound for the body, there is a lot of it in muscle. This means that in Pompe disease, where there is no enzyme to break down the glycogen in the lysosomes, the lysosomes in the heart and skeletal muscle quickly accumulate large deposits of glycogen. As the lysosomes increase in size, the muscle cells are displaced. Additionally, when the lysosome bursts due to the large size, the acidic contents are released, degrading the surrounding tissue. The muscles are therefore progressively weakened.