Investigation to find the water potential of a root vegetable (carrot)

Introduction

Water potential is the tendency of water molecules to move from one place to another. Osmosis is the movement of water molecules from a region of higher water potential to a region of lower water potential through a partially permeable membrane. I will be investigating the water potential of a carrot to find out at what concentration of salt solution (molar dm^{-3}) equilibrium can be sustained between the net movement of water molecules in to the carrot cells, and the net movement of water molecules out of the cells, therefore finding out the water potential of the carrot, and at what concentration of salt solution the movement of water molecules ceases, and what concentration the water is at inside the carrots cells. I will need to include and explain the relevant AS knowledge demonstrated by this investigation. This includes ideas about osmosis, explaining also how this can affect the structure of plant cells, and showing extremes such as plasmolysis.

Sill P - Planning

Prediction

I predict that as the concentration of salt solution (molar dm^{-3}) is increased, meaning that the water potential outside the carrot decreases, the water potential inside the carrot will decrease. As the water potential outside of the carrot cell is decreased, the water potential inside the carrot will increase, when the salt solution is more dilute. This change in water potential will occur because of a net movement of water molecules called osmosis.

Osmosis is; The movement of water molecules from an area of high water potential to an area of low water potential, down the concentration gradient, across a partially permeable membrane.

A partially permeable membrane, which is found in plant cells, such as the ones in a carrot, is a membrane that only allows certain molecules to pass through it, in this case, the membrane will allow water molecules to pass through it, but will not let the salt molecules pass through. Therefore, I predict that; when the water potential is higher outside of the carrot, than inside, the carrot will gain mass because of the extra water molecules moving into the carrots cells, with no salt molecules leaving the cells. For that very same reason, I also believe that the carrot specimen will expand slightly and become turgid when there is higher water potential outside of the carrot, or, in contrast, the specimen will become flaccid and may shrink slightly when there is higher water potential inside the carrot cells than in the solution surrounding it. The reason for this is that; when a plant cell has high water potential outside of it, the water is caused to enter the cell, this fills the vacuole, causing it to expand, and also causes the protoplast (the living part of the cell) to expand, meaning that the cells will be turgid, but prevented from exploding by the cell wall. In reverse, the protoplast and vacuole shrink and shrivel in an area of low water potential, however, the cell itself does not shrink too much, it becomes flaccid instead, due to the inelasticity of the cell wall.

If the concentration of salt solution were to range from 0-1 molar dm^{-3} I would predict that the water potential would lie in the 0-0.5 range, as a carrot is made up mostly of water, especially the cortex (inside layer of the carrot). However, it is difficult to make an accurate prediction without the use of preliminary experiments and results.