The importance of water in plant growth

Water is a vital component to the survival of every plant in the world as it is aids in the way that they obtain their food (through the process of photosynthesis), grow (cell division, mitosis), respire (cellular respiration) and how they keep their formation (rigidity). Water helps plants maintain their formation by transporting dissolved nutrients, amino acids and sugars from the soil to areas where it is of high demand. It flows through cell membranes from an area of high concentration to an area of low concentration (osmosis) (A Sanders, 2010). Water allows plants to survive by being one of the vital reactants in the chemical reaction of photosynthesis.

Every molecule of water contains two hydrogen atoms and one oxygen atom which are tightly held together by covalent bonds. This molecule contains 10 protons, 10 electrons and 8 neutrons (refer to fig 6) (Answers Cooperation, 2010). Water has a boiling point of 100°C and a freezing point of 0°C. In our world water is found in three different states; ice, liquid and as steam or water vapour. Due to cohesive forces, the molecules of water are strongly attracted to each other and therefore the surface tension (the charge of the water molecules attract eachother to form a ‘ skin’ across the surface of the water) that is created is vital to the survival of many animals (e. g. pond skater). Water molecules have dipoles due to the electrons being shared from both hydrogen atoms to the oxygen atom (refer to fig 6). This means that the electrons spend more time near the oxygen atom then near the hydrogen atoms resulting in a slight negative charge on the side of the molecule which contains the oxygen atom and a slight positive charge on the side of the molecule which contains both hydrogen atoms (A Capri, 2010) (Chemistry, MJones, GJones, DAcaster).

Fig 6: Basic Water Molecule.

Fig 7: Root Structure of a Plant.

The main area of plants which absorb water from their surrounding environment is the root hair zone. Inside the ‘ zone’, are the roots hairs of the plants which are found growing parallel to the roots. The root hairs (refer to fig 7) of the plants have fragile like characteristics so they are replaced every day at an average rate of 100 million. The root hairs are slender and are present in hefty sizes so they are able to cover enormous amount of surface area therefore absorbing maximum water (containing nutrients, amino acids and sugars from the soil. From the roots hairs, the water (and what contained in the water) travel through the tissues found within the roots, stems and leaves of plants called xylem and phloem. (B Dery, 2009) (TutorVista. com, 2010) (R Bailey, 2010).

Fig8: Xylem and Phloem Structures.

The transport system of vascular plants is made up of the xylem tissue and the phloem tissue, two different tissues which run through the roots, stem and leaves of plants (refer to fig 8) (Andrew Rader Studios, 2010) (SlideShare Inc, 2008). These two tissues are shaped like tubes and due to this characteristic, are easily able to transport water from the soil to the areas of the plants where it is needed most. There are three main differences between the two tissues with the first one being that the tubes of xylem transport water and dissolved nutrients throughout the plant whilst the tubes of the phloem transports amino acids and sugars (N Neezal, 2010). Secondly the cells within the xylem tubes are dead whilst the cells within the phloem tubes are living and thirdly the xylem tissue only allows a one-way flow whilst the phloem tissue allows a two-way flow (refer to fig 10).

Fig 10: Characteristics of Xylem and Phloem Vessels.

The xylem tubes are long and thick and are made of vessels and tracheids (Harun Yahya International, 2004). The tubes are attached from end to end allowing the water to reach maximum speed throughout its journey of the plant (Andrew Rader Studios, 2010).

The phloem tubes are made up of sieve and

companion cells which run parallel to each other. They are long and thin also joined from end to end. Located on the end walls of the tubes are large pores which allow amino acids and sugars to enter and flow out of the tubes throughout the plant to areas of high concentration to areas of low concentration (Tiscali UK Limited, No Date).

Fig 9: The Transpiration Process of Plants.

From the xylem and phloem tissues, water, dissolved nutrients, amino acids and sugars are transported up through the plant due to a process called transpiration. Transpiration (refer to fig 9) is the evaporation of water generally from the leaves of plants (Refer to reference 12, 13). The process of transpiration allows all the dissolved nutrients contained in the water molecules to move from the roots to the leaves, allowing them to be rehydrated due to the water loss experienced from transpiration. The process of transpiration is a continuous cycle allowing the leaves of plants to transpire yet still allowing them to rehydrate from the nutrients, amino acids and sugar contained in the water molecules.

Fig 12: Evenly Transferred Molecular Motion of Kettles/Stoves.

Water is water; fresh, boiled, heated, cooled, frozen, it’s all the same or so it is thought. The way in which water is heated and/or boiled by common household appliances for example a kettle or a microwave, may change the function and the way of which water molecules are designed to work. By boiling water in a kettle (or on a stove), water is heated evenly (refer to fig 12) due to the continuous cycle that occurs in this particular way of heating. The warmer water molecules rise and the cooler water molecules descend until they are warm therefore resulting in evenly heated water. The process of how water heats up in a microwave is completely

different to how it heats up in a kettle. In a microwave,

random parts of the water are chosen from the various angles within the microwave, therefore heating up minimal surface area compared to a kettle which heats up the complete area (refer to fig 11). This is the reason why sometimes when heating food up in a microwave some areas are hot whilst others are cold (Wimpy, 2010).

Fig 11: Random Microwave Waves.

The aim of this extended experimental investigation is to investigate what effect, if there is an effect, water that has been heated up in a microwave has on Petunia x hybrida and Tagetes patula plants. What effect will water heated up in a microwave have on the growth and development of Petunia x hybrida and Tagetes patula plants?

It was hypothesized that water that is heated up in a microwave will somehow (due to the components of the microwave) be unable to pick up essential nutrients such as amino acids and sugar from the soil. By the hypothesis stated, it is evident to see that the reason for investigating and performing this experiment is to discover whether or not plants are still able to grow and develop to their full potential using water that has been heated up in a microwave.