Daphnids (*Daphnia sp.*) are crustaceans known as water fleas. They are aquatic invertebrates that live anywhere water is found, filter feeders, and reproduce parthenogenetically.

**Purpose:** to investigate the effect of water salinity on the heart rate of the *Daphnia.*

**Hypothesis:** Water fleas (*Daphnia*) have been observed to live in ponds with optimum salinity level of 1.5 to 3.0 ppt (parts per thousand mL), I predict that the heart rate of *Daphnia* will increase at a linear rate with an increase in salinity.

**Results:**

![](image)

**Conclusion:** The data in Figure 2 shows a positive, near linear direct relationship between heart rate and water salinity in Daphnids. An increase in water salinity causes an increase in heart rate.

Water salinity is the result of dissolved salts in a body of water. Possible salts include sodium chloride, bicarbonates of magnesium and calcium sulphates. *Daphnia* is sensitive to metal ions such as Na⁺ present in water to the point of immobility or death if extended exposure occurs. Salinity is an abiotic stressor that can radically alter freshwater community structures. *Daphnia* lives in optimum salinity levels of 1.5 to 3.9 ppt, optimum temperatures of 18 – 22 °C and a pH between 6.5 and 9.5. These conditions allow it to develop and reproduce at a critical rate to ensure an extended survival not only for individuals, but also for the population.

*Daphnia* is poikilothermic, which means that its body temperature and therefore the temperature of the environment directly affects its metabolic rate. The change in metabolic rate is reflected in the rate at which the heart beats (cardiac frequency). *Daphnia* have an open circulatory system where a simple heart pumps around blood cells. The heart is at the top of the back, just behind the head. The *Daphnia*’s heart is a sinoatrial node, which is a collection of spontaneously active nerves called the cardiac ganglion. The metabolic rate,
and therefore the heart rate increases in proportion to the salt concentration in the body of water. This is due to the need for more oxygen for anaerobic respiration to produce ATP. The salt level in water also affects the amount of dissolved oxygen. As salt levels increase, the amount of dissolved oxygen decreases. This means that Daphnia need to breathe more to get enough oxygen, and this means an increase in heart rate (Tan, 2015). Kikuchi (1983) stated that the gills and digestive tracts of crustaceans are their basic osmoregulatory organs, with changes in salinity capable of modifying gill morphology in Daphnia. These changes affect the so-called dark cells, these being rich in mitochondria, possessing an elaborate tubular system and modified cell membrane. It is probable that they play an important role in osmoregulation. Aladin (1991) described round nuchal (neck) organs in Daphnia magna embryos, whose cytoplasm is seen to be very condensed and capable of intensive cellular absorption of salt because of high permeability to ions. Adult Daphnia do not rely on such neck organs, relying instead on the absorption of salt with food. High concentrations of salt can affect the reproductive and growth rate of Daphnia. From Figure 1 (not shown) pregnant Daphnids were investigated. This condition alone can lead to a slight increase in heart rate. Considering its tolerance to salinity, Green et al. (2005) concluded that the reproductive and/or survival rates of cladocerans are reduced at higher water conductivities. They demonstrated that a strain of D. magna acclimated to thrive at the upper salinity values. Baillieut and Blust (1999) found that a high salinity level reduced swimming speed in D. magna. Grzesiuk and Mikulski (2006) stated that the effect of salinity can be modified by other abiotic factors. A strong interaction between effects of temperature and salinity on survival of Daphnia magna was shown, a high temperature compounding the harmful effect of the salinity (Casey et al. 2000). Even where it does not reduce lifespan, salinity may limit individuals’ growth rates, with freshwater animals transferred to a brackish environment found to grow more slowly: as with D. carinata (Hall and Burns 2002) and D. magna (Teschner 1995, Arner and Koivisto 1993).

The investigation was carried out to control other key variables like temperature, the volume of deionised water used, the concentration of ions in solution using non-iodised table salt to reduce sampling bias and sources of errors. Cross contamination was avoided by using plastic food wrap to immediately cover over the flasks containing Daphnia when they were not involved in the testing. This restricted any free ions or particles from settling into the solutions.

The range of the independent variable, salinity, was kept consistent throughout the investigation by using electronic scales to measure the mass of salt; namely 0.0g, 0.19g, 0.38g, 0.57g and 0.76g of salt per 250mL of de-ionised water. A magnetic stirrer was used for five minutes to dissolve the salt to ensure consistency. Due to their small size, an equal number, size, and gender of Daphnia were investigated by using a pipette to transfer them into each saline solution. Fresh pipettes and slides were used for each value of the independent variable (salt concentration) to prevent contamination. Three trials were carried out at each saline concentration, and averaged to improve the reliability of the heart rate calculation.

Daphnia were left to acclimatise in each saline solution for ten minutes before heart rate was measured and calculated using a light microscope, cell counter and depression slides. The dependent variable, heart rate, was calculated by using a light microscope, cell counter and stopwatch. An LED light was used reduce the effect of temperature from the light source as a source of error.