

Q₁₀ Value Calculation for Daphnia Part C Experiment:

A Q₁₀ is the factor by which the rate of a reaction or process increases for every 10 degree rise in temperature. Therefore, it measures the progress of a process. If the rate of the reaction is completely temperature independent, then the Q₁₀ value will equal 1. The more temperature dependent a process is, the greater the Q₁₀ value. Very often, biological processes have a Q₁₀ value of 2 or greater.

$$Q_{10} = \left(\frac{k_2}{k_1} \right)^{10/(T_2 - T_1)}$$

- **Q₁₀** is the *factor* by which the reaction rate increases when the temperature is raised by ten degrees. Q₁₀ is a unitless quantity.
- **K₁** is the measured reaction rate at temperature T₁ (where T₁ < T₂). Note that K₁ and K₂ must have the same unit.
- **K₂** is the measured reaction rate at temperature T₂ (where T₂ > T₁). Note that K₁ and K₂ must have the same unit.
- **T₁** is the temperature at which the reaction rate K₁ is measured (where T₁ < T₂). The temperature unit must be either the Celsius or the Kelvin, and may not be any other unit, such as the Fahrenheit. Note that T₁ and T₂ must have the same unit. T₁ and T₂ do not need to be exactly 10 degrees apart.
- **T₂** is the temperature at which the reaction rate K₂ is measured (where T₂ > T₁). The temperature unit must be either the Celsius or the Kelvin, and may not be any other unit, such as the Fahrenheit. Note that T₁ and T₂ must have the same unit. T₁ and T₂ do not need to be exactly 10 degrees apart.

- 1) Graph the class data and draw a best fit line.
- 2) Using your graph make an estimate of Q_{10} . Select two temperatures which are not 10° C apart; use the upper Q_{10} expression (shown previously).
- 3) Why is it reasonable to assume that heartbeat reflects temperature's influence on the metabolism (enzyme catalyzed reactions) occurring in the body of the Daphnia.
- 4) Why would one expect the Q_{10} of an ectotherm to be around 2?
- 5) Suppose we conducted a similar experiment (albeit with a different set- up) on an endotherm such as a mouse. What would you predict to be the Q_{10} ? Describe how the changes in temperature would influence the metabolism (enzyme catalyzed reactions) and heart rate of the body of the mouse.