***Temperature and Invertebrate Respiration Lab***

**Hypothesis**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Materials and Procedure** (draft done before day of lab)

* List all materials
* Write out a step-by-step description of your procedure. Be sure to describe experimental set-up.

**Results**

* Create a data table (complete before day of lab)
* Graph respiration rate at two different temperatures
* Show your rate calculations
* Calculate the temperature coefficient for your cricket respiration.
* Include a brief paragraph describing your data

**Analysis**

* Restate your hypothesis
* Interpret your data—did it support your hypothesis? Why or why not?
* Somewhere in your discussion, you should address the following:
	+ Explain what an ectotherm is (see p. 863 in textbook)
	+ Explain how you controlled for differences in body mass
	+ Interpret Q10 for your crickets
	+ Speculate as to how your results might be different if you did the same experiment with an endotherm

**Temperature Coefficient (*Q*10)**

The **temperature coefficient (*Q*10)** represents the factor by which the rate (*R*) of a reaction increases for every 10-degree rise in the temperature (*T*). The rate (*R*) may represent any measure of the progress of a process. For example, the rate may be the velocity of action potential propagation along a nerve fiber (e.g., m/s), or it may be the rate at which the heart contracts per minute (i.e., beats per minute, bpm). In a typical experiment, the rate of the physiological process under investigation is measured at two different temperatures, *T*1 and *T*2 (where *T*2 > *T*1), thus yielding the rate measurements *R*1 (measured at *T*1) and *R*2 (measured at *T*2), respectively. The *Q*10 equation (see below) is then used to estimate the *Q*10 for the process. The temperature unit must be either the Celsius or the Kelvin, and may not be any other unit, such as the Fahrenheit. Note that *T*1 and *T*2 do not need to be exactly 10 degrees apart in order to use this equation. Keep in mind that the same unit must be used for the two temperatures (*T*1 and *T*2) at which the rate measurements are obtained. Moreover, the rate measurements (*R*1 and *R*2) must have the same unit. *Q*10 values are useful because they may be used to infer mechanistic insight about the physiological process under investigation (see below).

**Temperature coefficient (*Q*10) equation**



* ***Q*10** is the *factor* by which the reaction rate increases when the temperature is raised by ten degrees. *Q*10 is a unitless quantity.
* ***R*1** is the measured reaction rate at temperature *T*1 (where *T*1 < *T*2). Note that *R*1 and *R*2 must have the same unit.
* ***R*2** is the measured reaction rate at temperature *T*2 (where *T*2 > *T*1). Note that *R*1 and *R*2 must have the same unit.
* ***T*1** is the temperature at which the reaction rate *R*1 is measured (where *T*1 < *T*2).
* ***T*2** is the temperature at which the reaction rate *R*2 is measured (where *T*2 > *T*1).

**Interpretation of *Q*10**

*Q*10 is a unitless quantity. It is the *factor* by which the rate increases when the temperature is raised by ten degrees. If the rate of the reaction is completely temperature independent, it can be seen from the equation above that the resulting *Q*10 will be 1.0. If the reaction rate increases with increasing temperature, *Q*10 will be greater than 1. Thus, the more temperature dependent a process is, the higher will be its *Q*10 value. *Q*10 is ~1 for diffusion of ions and molecules in bulk solutions. For typical chemical reactions, *Q*10 values are ~2. For many biological processes, particularly those that involve large-scale protein conformational changes, *Q*10 values are greater than two. Thus, *Q*10 values may be used to infer mechanistic insight about the physiological process under investigation.

Although the *Q*10 is a convenient way to examine and report the temperature dependence of a process, it must be kept in mind that a thorough examination of the temperature dependence of a process requires that the rate be measured at more than two temperatures. Typically, the rate of the reaction is measured at multiple (5 or more) temperatures that reasonably represent the relevant physiological temperature range.