**Key for Quiz 1:**

1a. A number of responses would have been worth 2 points. Here are some examples:

*“Higher temperatures negatively affect tadpole resistance to bacterial pathogens”.*

*“Tadpoles exposed to higher than normal temperatures are less resistant to bacterial pathogens”.*

Points were taken off primarily if the answer was re-stated as a prediction. Apply the “If (hypothesis) then (prediction)” test.

1b. Again, there could be different answers. A question is typically a more general statement than either the hypothesis or the prediction, about the two variables and phrased as a question (obviously!).

*“How does temperature affect tadpole survival when exposed to bacterial pathogens?”*

1c. *DV: tadpole mortality*

*IV: temperature*

1d. *I would compare the mean mortality rates (+/- 1 SE) of two samples of tadpoles, both exposed to bacterial pathogens. One sample would be incubated at 18 C and another at*

*23 C.*

2. *Increasing levels of CO2 are causing rising temperatures because CO2 is a greenhouse gas that contributes to the greenhouse effect. Radiant energy from the sun, is absorbed by the Earth, heating its surface, which in turn reradiates energy back to the atmosphere in the form of infrared (IR) radiation. Certain gases (CO2, methane, water vapor) in the atmosphere absorb this infrared radiation, resulting in the greenhouse effect which keeps Earth’s temperature in a range that is conducive for organismal survival in almost every habitat on earth. Humans are burning fossil fuels (amongst other things) that are contributing more CO2 to the atmosphere, resulting in a steady increase since the Industrial Revolution began more than a century ago. Temperature increases over this period are directly correlated with rising CO2 levels as shown by Fig. 1 in the Karl and Trenberth paper.*

3. *One could easily present an argument for each, suggesting that it might be more heavily impacted. For example, mammals have higher metabolic rates and may expend more energy during activity in extreme temperatures relative to reptiles. Reptiles, in contrast, have a lower metabolic rate, but their activity may also be more constrained by variation in the external environment, negatively affecting their ability to forage and interact.*

4. *When a protein is denatured due to exposure to high heat, the physical structure of the molecule is usually irreversibly lost. This physical structure is defined by 3-4 levels of structural complexity (primary, secondary, tertiary and quaternary), which are systematically disrupted by the heat which disturbs the complex bonding that occurs between R-groups (tertiary structure), between carboxyl and amino groups (secondary structure) and between individual amino acids (peptide bonds resulting in primary structure). Enzyme structure effectively defines the activity of that enzyme, with a very specific active site to which a single substrate will bind. If the active site is no longer available, then the enzyme can no longer catalyze its specific reaction.*

5a. *Measurement error, uncontrolled environmental variation and natural variation are key factors that can cause two or more means to differ. Variation in a particular independent variable of interest, which we manipulate experimentally, can also cause the observed means to vary. This is of course the variation of interest to us. Statistical hypothesis tests allow us to partition out the variation in our data that is caused by these various sources.*

5b. *Run a statistical analysis, such as an ANOVA for more than 2 groups (or a t-test for comparing two groups). From an ANOVA you will obtain a p-value reflecting the confidence you should have that your means are significantly different. If the p-value is <0.05 accept the alternative hypothesis that your means are different. If the p-value is >0.05 you cannot conclude that your means are significantly different.*

6a. What was my sample size? (1 point)

*7*

b. Does this study have a control? If so, what is it? (1 point)

*Yes, current CO2 levels*

c. What is the dependent variable? (1 point)

*Number of flowers/plant*

d. State the null hypothesis that my statistical test is testing. (1 point)

*Elevated CO2 levels do not enhance flower production*

e. Are there significant differences between the treatment means? How can you tell? (1 point)

*There are significant differences between the treatment means. Results from the ANOVA (F=31.56; p<0.0001).*

f. Which treatment means differ? How can you tell? (1 point)

*You can’t tell from simply looking at Means and SE alone. We would need to run post-hoc comparison tests (i.e. Tukey’s) to determine which means differ.*

g. Should I reject or accept my hypothesis based on these results? Why? (1 point)

*Based on these results (F=31.56; p <0.0001), I accept my hypothesis that elevated CO2 levels enhance flower production.*