Experiment Design

Objectives
Given a question and hypothesis, be able to choose experimental groups, variables, identify measurements, and set up a data table.

Example 1

Question:	Are German shepherds heavier than huskies, on average?		
Null hypothesis (H_0):	German shepherds have the same or smaller average weight compared with huskies.		
Alternative hypothesis (H_A):	German shepherds have a higher average weight than huskies.		
Experimental groups:	(1) German shepherds. (2) Huskies.		
Measurements:	Measure weight of each dog.		
Data table:	*Dog weight (kg)*	*German shepherd*	*Husky*
		_____	_____
		_____	_____
		...	...
	Average	_____	_____

Example 2

Question:	Can people smell genetic differences?		
Null hypothesis (H_0):	People are not able to smell genetic differences among mice.		
Alternative hypothesis (H_A):	Some people are able to smell some genetic differences among some mice.		
Experimental groups:	(1) Genetically-similar mice. (2) Genetically-different mice.		
Measurements:	Have people smell pairs of mice, and record whether the people can determine which mice are most closely related.		
Data table:	*Person's guess*	*True relationship between mice*	*Match (Y/N)*

Practice

Question 1: Does UV radiation cause skin cancer?
Null hypothesis (H_0): UV radiation does not increase the risk of skin cancer.
Alternative hypothesis (H_A): UV radiation can increase the risk of skin cancer.
Experimental groups? Measurements? Data table?

Question 2: Is texting while driving just as dangerous as driving while drunk?
Null hypothesis (H_0): Texting while driving is not as dangerous as driving while drunk.
Alternative hypothesis (H_A): Texting while driving can be as or more dangerous than driving while drunk.
Experimental groups? Measurements? Data table?

Graphing

Objectives
Given a question and a data table, be able to set up graph axes and choose a graph format (line, bar, etc.) to accurately represent the data.

Note: In this exercise we are ignoring several important elements, which you can assume are addressed elsewhere. One of the most important omitted elements is consideration of factors to control, such as age of dog in the first example, or time spent smelling the mouse in the second example.

Examples

Question: Are German shepherds heavier than huskies, on average?

Data table:

Dog weight (kg)	*German shepherd*	*Husky*
	45	30
	50	25
	75	20
	67	34
	32	17
	44	19
	23	29
	24	24
	21	20
	40	22
Average	_____	_____

Practice

Question 1: Do cyclists live longer than drivers?
Data table: Age at death (y) [0 - 120] Proportion of travel on a bicycle (%)

Question 2: Does fracking pollute groundwater?
Data table: Pollutant concentration (ppm) [0 - 1000] Distance from fracking well (km) [0 - 10]

Question 3: Do people who live near freeways have more respiratory diseases than those at a distance?
Data table: Rate of respiratory disease (%) Distance from freeway (m) [0 - 10000]

Question 4: Do people with darker skin receive unfair, disproportionate jail sentences?
Data table: Jail term for first non-violent felony (y) [0 - 100] Melanin index [0 - 100]

Cellular Respiration and Thermal Regulation

Objectives

- Become familiar with starting materials and products of cellular respiration.
- Be able to distinguish among the terms ectotherm, endotherm, poikilotherm, and homeotherm.
- Be able to predict how a particular metabolism type might react to a certain environmental temperature.

Instructions

1. Determine how to measure the metabolic rates of a fish, mouse, and frog.
2. Draw a diagram of the mouse metabolic chamber.
3. Measure metabolic rates at room temperature and at a colder temperature. (Do at least two trials at each temperature.)

   Tips: Only change the fish and frog temperatures by 5 degrees, and never make the water colder than 10 C.
   Do not handle or harm any animal.
   Soda lime is an irritant if it contacts skin.

4. Calculate the oxygen consumption of the mouse:
   (mL of air inserted) / (time to consume that volume of oxygen, in seconds)
5. Post your results, and record class averages. You will need both your own results and the averages for your assignment.

Lab 5 Assignment

Regarding Lab 5:

Cellular Respiration:

Reflect on the point of this lab exercise, the process by which you did it, your observations, and the outcome. Carefully compose a summary which addresses the following. Number each section.

1. Did our methods appear to do what they were designed to do? Explain. How would we know whether they did or didn't?
2. What were your results? How did our results compare to the class averages? Show your work.
3. How confident are you of those results? To what extent to you think they accurately reflect the animal's rates of metabolic activity? Explain.
4. Imagine that you had any technology you wish, and the means to use it, at your disposal. What would be your approach to measuring an animal's metabolic rate? Why would you prefer that method to the one you used in our lab?

Preparing for Lab 6:

5. What are the starting materials and ending products of photosynthesis?
6. How and where does a plant store its energy? Give some examples.