AP BIOLOGY SUMMER HOMEWORK 1: DATA SKILLS, MATH, AND STATISTICAL ANALYSIS

Background:

Graphing is an important procedure used by scientists to display the data that is collected during a controlled experiment. **Line graphs** must be constructed correctly to accurately portray the data collected. Many times the wrong construction of a graph detracts from the acceptance of an individual's hypothesis. A graph contains five major parts:

- a**. Title:** depicts what the graph is about. By reading the title, the reader should get an idea about the graph. It should be a concise statement placed above the graph.
- b. **Independent variable:** variable that can be controlled by the experimenter. It usually includes time (dates, minutes, hours, etc.), depth (feet, meters), and temperature (Celsius). This variable is placed on the X axis (horizontal axis).
- c. **Dependent variable:** variable that is directly affected by the independent variable. It is the result of what happens because of the independent variable. Example: How many oxygen bubbles are produced by a plant located five meters below the surface of the water? The oxygen bubbles are dependent on the depth of the water. This variable is placed on the Y-axis or vertical axis.
- d. **Scales for variables:** In constructing a graph one needs to know where to plot the points representing the data. In order to do this a scale must be employed to include all the data points. This must also take up a conservative amount of space. It is not suggested to have a run on scale making the graph too hard to manage. The scales should start with 0 and climb based on intervals such as: multiples of 2, 5, 10, 20, 25, 50, or 100. The scale of numbers will be dictated by your data values.
- e. **Legend:** is a short descriptive narrative concerning the graph's data. It should be short and concise and placed under the graph. See attached sheet for TAILS and DRY MIX.

Problem 1:

In an experiment about photosynthesis, an underwater plant produces oxygen during the process.

Depth in meters	Number of Bubbles / minute Plant A	Number of Bubbles / minute Plant B
2	29	21
5	36	27
10	45	40
16	32	50
25	20	34
30	10	20

a. Plot a graph representing the data on a separate graph paper. Be sure to give it a title, correct X and Y axis with correct variables and scales, and legend.

b. What is the dependent variable and why?

c. What is the independent variable and why?

d. What title would you give the graph?

e. What are the mean, median, and mode of all 3 columns of data? Use http://www.purplemath.com/modules/meanmode.htm to help you calculate the 3 M's.

- Depth: Mean_____ Median_____ Mode_____
- Bubbles Plant A.: Mean _____ Median_____ Mode_____
- Bubbles Plant B: Mean _____ Median_____ Mode_____

Problem 2:
Diabetes is a disease affecting the insulin producing glands of the pancreas. If there is not enough insulin being produced by these cells, the amount of glucose in the blood will remain high. A blood glucose level above 140 ml/L for an extended time after eating is not considered normal. This disease, if not brought under control, can lead to severe complications and ultimately death.

Time After Eating (hours)	Blood glucose ml/L of person A	Blood glucose ml/L of person B
0.5	170	180
1	155	195
1.5	140	230
2	135	245
2.5	140	235
3	135	225
4	130	200

a. Plot a graph representing the data on a separate graph paper. Be sure to give it a title, correct X and Y axis with correct variables and scales, and legend.

b. What is the dependent variable and why?

c. What is the independent variable and why?

d. What title would you give the graph?

e. Which, if any, of the above individuals (A or B) has diabetes?

f. What data do you have to support your hypothesis?

g. If the time period were extended to 6 hours, what would be the expected blood glucose level for Person B?

h. What is the mode, range, mean, median, standard deviation, and standard error of the mean for each Person? Show your work. Use this website to calculate SD and SEM:
http://www.endmemo.com/math/sd.php

- Person A:
  Mode_____ Range _____ Mean _____ Median_____ SD_____ SEM _____

- Person B:
  Mode_____ Range _____ Mean _____ Median_____ SD_____ SEM _____

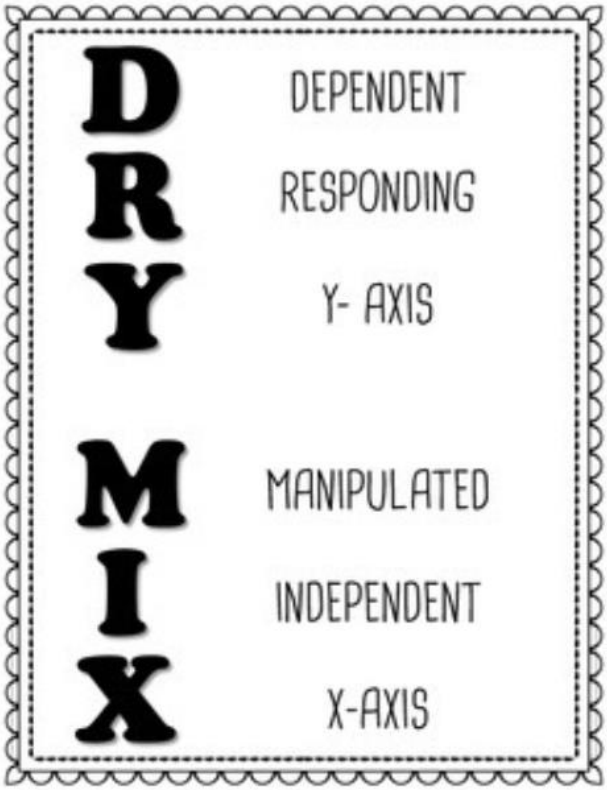
GRAPHING HELPFUL HINTS: USE TAILS AND DRY MIX

D.R.Y.

Dependent – Responding – Y Axis

M.I.X.

Manipulated – Independent – X Axis



AP Biology Summer Homework 2: Chi Squared Test

Part One Directions: Go to http://www.youtube.com/watch?v=WXPBoFDqNVk and watch the video tutorial on how to perform a Chi-Squared statistical test. Answer the questions below while you watch the video tutorial.
Identify what these symbols represent from the Chi-Square Stats Test:

χ_c^2 = _____

$\sum$ = _____

O_i = _____

E_i = _____

$$\chi_c^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

1) Why do you perform a Chi-Square test?

2) What is the null hypothesis for the Chi-Square test?

3) How do you calculate your degrees of freedom?

4) What critical value is always used in AP Bio?

5) When do you reject your null hypothesis?

6) When do you accept your null hypothesis?

Part Two: Practice performing the Chi-Squared test with the problems below. Show your set up.

Problem 1: We collected data by flipping a two-sided coin 200 times. The coin landed heads-up 108 times and tails-up 92 times. Perform a Chi-Square test to see if there is any statistical difference between our results and the expected results. Accept or reject the null hypothesis.

Null hypothesis: _There is no statistical difference between the number of heads and the number of tails. _____

Outcomes	Observed Outcome	Expected Outcome	O-E	$(O-E)^2$	$(O-E)^2/E$
				χ^2 Chi Square Value:	

Degrees of Freedom: _____

Accept or Reject Null Hypothesis: _____

Problem 2: We collected data by flipping a two-sided coin 200 times. The coin landed heads-up 120 times and tails-up 80 times. Perform a Chi-Square test to see if there is any statistical difference between our results and the expected results. Accept or reject the null hypothesis.

Null hypothesis: _____

Outcomes	Observed Outcome	Expected Outcome	O-E	$(O-E)^2$	$(O-E)^2/E$
				χ^2 Chi Square Value:	

Degrees of Freedom: _____

Accept or Reject Null Hypothesis: _____

Problem 3: After 60 roles of a di, a student collected this information in regards to the landing of the rolled di: 1 (16 times), 2 (5 times), 3 (9 times), 4 (7 times), 5(6 times), 6(17 times). Perform a Chi-Square test to see if there is any statistical difference between our results and the expected results. Accept or reject the null hypothesis.

Null hypothesis: _____

Outcomes	Observed Outcome	Expected Outcome	O-E	$(O-E)^2$	$(O-E)^2/E$
1					
2					
3					
4					
5					
6					
				χ^2 Chi Square Value:	

Degrees of Freedom: _____

Accept or Reject Null Hypothesis: _____

Degrees of Freedom (*df*)	**Probability** (ρ)										
	0.95	0.90	0.80	0.70	0.50	0.30	0.20	0.10	0.05	0.01	0.001
1	0.004	0.02	0.06	0.15	0.46	1.07	1.64	2.71	3.84	6.64	10.83
2	0.10	0.21	0.45	0.71	1.39	2.41	3.22	4.60	5.99	9.21	13.82
3	0.35	0.58	1.01	1.42	2.37	3.66	4.64	6.25	7.82	11.34	16.27
4	0.71	1.06	1.65	2.20	3.36	4.88	5.99	7.78	9.49	13.28	18.47
5	1.14	1.61	2.34	3.00	4.35	6.06	7.29	9.24	11.07	15.09	20.52
6	1.63	2.20	3.07	3.83	5.35	7.23	8.56	10.64	12.59	16.81	22.46
7	2.17	2.83	3.82	4.67	6.35	8.38	9.80	12.02	14.07	18.48	24.32
8	2.73	3.49	4.59	5.53	7.34	9.52	11.03	13.36	15.51	20.09	26.12
9	3.32	4.17	5.38	6.39	8.34	10.66	12.24	14.68	16.92	21.67	27.88
10	3.94	4.86	6.18	7.27	9.34	11.78	13.44	15.99	18.31	23.21	29.59
11	5.58	5.58	6.99	8.15	10.34	12.90	24.73	17.28	19.68	24.73	31.26
12	6.30	6.30	7.81	9.03	11.34	14.01	26.22	18.55	21.03	26.22	32.91
13	7.04	7.04	8.63	9.93	12.34	15.12	27.69	19.81	22.36	22.69	34.53
14	7.79	7.79	9.47	10.82	13.34	16.22	29.14	21.06	23.69	29.14	36.12
	Nonsignificant								Significant		

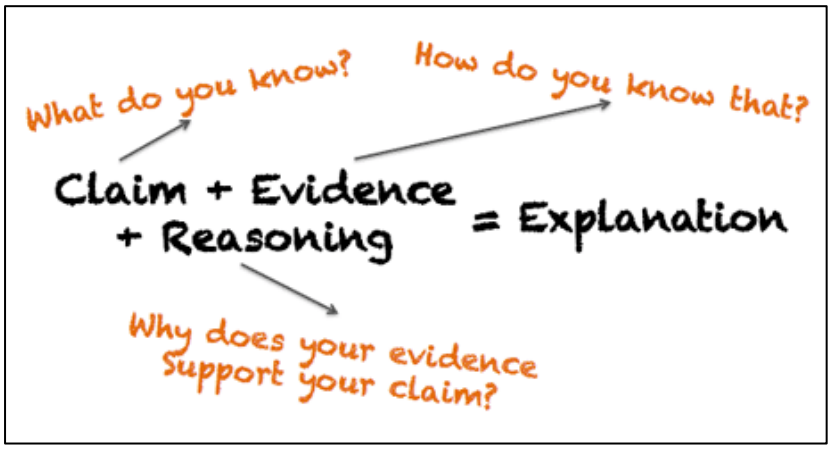
AP BIOLOGY SUMMER HOMEWORK 3: HOW TO WRITE A SCIENTIFIC EXPLANATION

Components of a Scientific Explanation

- Make a *claim* about the problem.
- Provide *evidence* for the claim.
- Provide *reasoning* that links the evidence to the claim.

Definitions for CER

- **Claim**: An assertion or conclusion that answers the original question. The claim is in present/past tense, never future (do not use the words "will" or "would"). Also, this is not a hypothesis statement (no "if, then" statements).
- **Evidence**: Scientific data that supports the student's claim that must be appropriate and sufficient. Can come from an investigation or other source such as observations, reading material, archived data, or other source.
- **Reasoning**: Justification that links the claim and evidence. Shows why the data counts as evidence to support the claim, using appropriate scientific principles. Also shows the importance and connection to a scientific principle.



Qualities of Communication

Write the explanation so others can understand it.

- ✓ Use precise and accurate scientific language.
- ✓ Write clearly so that anyone interested in the explanation can understand it.
- ✓ Explain your logic to help share your knowledge.

Explanation Tool Layout

The Question: *Initial question based on an observed phenomenon or situation.*	
Our Claim: *Your claim is a statement that expresses the answer or conclusion to the question.*	
Our Evidence: *Your evidence should always include collected data (Numbers!) and/or observations*	**Our Justification (Reasoning) of the Evidence:** *Your justification explains why the evidence supports the claim. Provide a logical connection between the evidence and claim.*

CER Example for Biology

The Question:	
What do plants need to grow?	
Our Claim:	
Plants need water, carbon dioxide, and light to grow.	
Our Evidence:	**Our Justification of the Evidence:**
On average, for the six plants that received constant light, carbon dioxide, and water, they grew 20 cm, had six yellow flowers, had fifteen leaves, and they were all bright green. On average, for the six plants that received 12 hours of light, limited carbon dioxide and water, they grew 8 cm, had two yellow flowers, and had four leaves. Also, two of the plants had zero flowers. These plants were still bright green, but they were smaller and with fewer flowers and leaves.	*Photosynthesis is the process during which green plants produce sugar from water, carbon dioxide, and light energy. Producing sugar is essential for plant growth and development. That is why the plants that received a constant source of water, carbon dioxide, and light grew the most.*

Problem 1:

Laura went into the tundra biome to record polar bear population numbers. She visited two places to make her observations: Katchumuk National Park and Wallopeg National Park. She spent 7 days at each location and recorded how many different polar bears she saw at each location. Her data can be found in the table below. Construct a CER table using the data below to make a scientific claim, backed in evidence and reasoning.

Day	Katchumuk National Park # of Polar Bears in a 24 hr period	Wallopeg National Park # of Polar Bears in a 24 hr period
1	10	24
2	2	23
3	23	26
4	4	19
5	7	32
6	7	26
7	11	25
Average # of Polar Bears over 7 Days	9.14	25.0

Problem 2: Lactose Intolerance CER

Lactose intolerance means the body cannot easily digest lactose, a type of natural sugar found in milk and dairy products. When lactose moves through the large intestine without being properly digested, it can cause uncomfortable symptoms such as gas, belly pain, and bloating. Some people who have lactose intolerance cannot digest any milk products. Others can eat or drink small amounts of milk products or certain types of milk products without problems.

Lactose intolerance occurs when the small intestine does not make enough of an enzyme called lactase. Lactase catalyzes the reaction that separates the disaccharide lactose, which is comprised of glucose and galactose.

Two people are given a glass of milk and have their blood drawn every 15 minutes for 1 hour. Their results are listed in the table to the right.

a) Graph the data using the box below. (Use TAILS)
b) Construct a CER table addressing the guiding question: Which person, Steven or Rachel, is lactose intolerant?

Glucose concentration in mMol/Liter

Time	Steven	Rachel
0	4.5	4.6
15	4.8	7.5
30	4.6	8.3
45	4.5	9.4
60	4.6	10.2

Graph: Title _____

CER:

The Question:	
My Claim:	
My Evidence:	**My Justification of the Evidence:**

AP Biology Summer Homework 4: Review of Cells and Cell Function

Part One: Match the cell part with the appropriate function in the cell. Draw a line between the two.

Cell Part	Function
Nucleus	A large/small storage sac that holds food, water, and waste.
Vacuole	Cellular respiration occurs here. Double membrane organelle that makes ATP.
Cell Membrane	Photosynthesis takes place here. Double membrane that makes glucose.
Cell Wall	Brain of the cell. Controls the cell's activities. Has pores in the envelope to allow for mRNA to leave.
Cytoplasm	Smooth and Rough types and helps synthesize lipids.
Mitochondrion	Packages and moves protein in vesicles throughout the cell.
Chloroplast	Clean up crews of the cell. Contains digestive enzymes to break down work out organelles
Golgi apparatus/Body	Site of translation. Made of two subunits that translates mRNA into protein.
Endoplasmic Reticulum	Jelly-like material that holds and protects the cell's organelles
Lysosome	Outer layer of the plant cell which protects the cell.
Ribosome	Made of two phospholipid layers which allow movement of materials in and out of the cell (with the use of proteins).

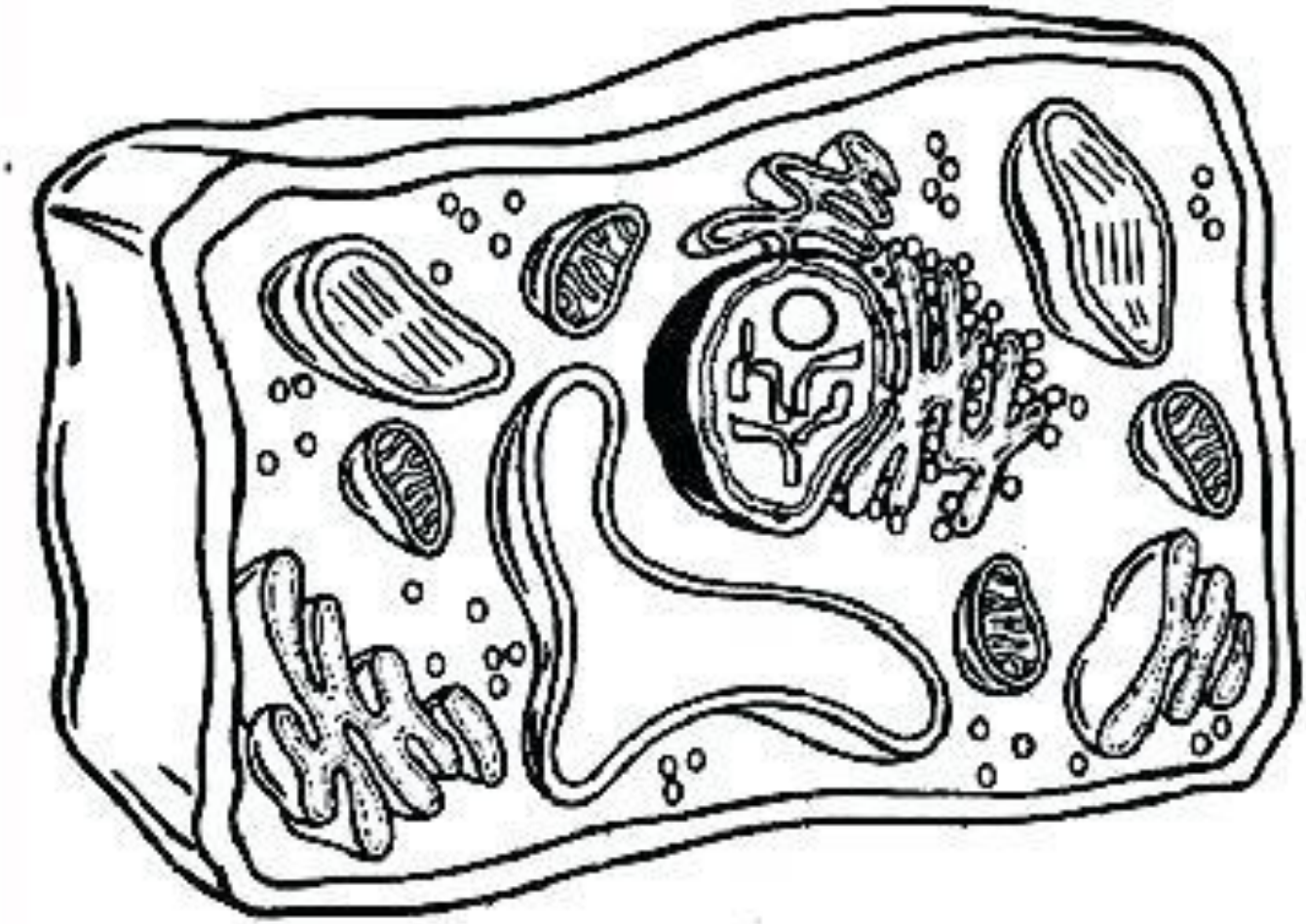
Part Two: With the cell parts above, identify if they are found in prokaryotes, eukaryotes, or both types of cells.

Cell Part	Types of Cells?
Nucleus	
Vacuole	
Cell Membrane	
Cell Wall	
Cytoplasm	
Mitochondrion	
Chloroplast	
Golgi apparatus/Body	
Endoplasmic Reticulum	
Lysosome	
Ribosome	

Part Three: Color the plant eukaryotic cell accordingly.

Plant Cell Coloring

- Cell Membrane (orange)
- Nucleoplasm (yellow)
- Mitochondria (red)
- Vacuole (lt. Blue)
- Chromatin (gray)
- Cell Wall (dark green)
- Nucleolus (brown)
- Chloroplasts (light green)
- Smooth Endoplasmic Reticulum (pink)
- Rough Endoplasmic Reticulum (pink)
- Ribosome (purple)
- Cytoplasm (white)
- Golgi Apparatus (dk blue)



Part Four: Color the animal eukaryotic cell accordingly.

Animal Cell Coloring

I. Directions: Color each part of the cell its designated color.

Cell Membrane(light brown) ☐
Cytoplasm (light yellow) ☐
Nucleoplasm (pink) ☐
Nuclear Membrane(dark brown) ☐
Nucleolus (black) ☐
Golgi Apparatus (pink) ☐
Flagella (red/blue striped) ☐
Rough Endoplasmic Reticulum (dark blue) ☐
Smooth Endoplasmic Reticulum(light blue) ☐
Mitochondria (orange) ☐
Lysosome (purple) ☐
Microtubules (dark green) ☐
Ribosome (red) ☐