Name: _____ Lab Section: _____

Genetics Lab Final Lab Project

Over the course of the next two weeks, you will be planning and executing an experiment relating to Genetics concepts from class and/or lab.

The goal of this task is to:

- Increase your confidence and independence in a laboratory setting.
- Allow you to explore organisms and techniques that interest you.
- Apply your knowledge and expand your understanding of genetics principles.
- Build your experience with conducting scientific inquiries and writing about it.

While it may be tempting to take on an extensive project, remember that this assignment will be happening during the end of the semester - do not overextend yourself! I recommend finding a protocol that already exists and then choosing a variable to manipulate.

Some procedures you can use as a starting point:

- GMO identification - uses PCR/gel electrophoresis
- PV92 human genotyping - another PCR/gel electrophoresis genotyping opportunity
- Transforming Bacteria with plasmids (pGLO) - work with E. coli and learn more about gene expression, operons, and transformation
- Yeast - expand on previous class activities
- Planaria - if bisected (cut in half), both halves can regenerate by expressing relevant genes and undergoing many rounds of mitosis

Consider:

- What organism will you be studying?
    - What does this organism need to survive?
- What technique(s) will be used?
    - What materials will be used?
    - Can materials be easily ordered/do we already have them?
- Will your experiment fit within the timescale (~2 weeks) and involve minimal commitment outside of your regular lab time? (i.e. you probably don't want to have to come in every day to maintain your experiment)

Planning

Research Question: Should NOT have a yes/no answer. Sample stems:

- How does _____ effect…?
- How does _____ correlate with…?
- What is the relationship between _____ and _____?
- What are the effects of _____ on…?

Variables: Fill in the table with the appropriate information for your own experiment

Independent Variable (the variable you will be changing in the experiment)	**Dependent Variable** (what you will be measuring/ looking for)	**Controlled Variables** (variables that should remain the same throughout the duration of the experiment; list as many as you can)

Hypothesis

The correct format to write a hypothesis: If the <u>independent variable</u> changes in *this* way, then the <u>dependent variable</u> will change in *this* way <u>because</u> of *this* reason.

Experimental Procedure

Materials
Be as specific as possible when creating your list of materials, including amounts of each material needed. (For example, do not just write “water”, write “50mL of deionized water). Include everything you will be using throughout the duration of the experiment so you can be prepared before you start experimentation.
I will need the following **materials** for my experiment:

Experimental Protocol (Procedure)
Describe in detail how you are going to conduct your experiment. Make sure that it explains the procedure in a way that anyone could replicate your experiment *exactly* how you do it. Make sure you include safety measures (e.g. goggles, gloves, fume hood)
Record your experimental procedure below. IF YOU ARE USING A BIORAD KIT, IDENTIFY THE KIT NAME AND PROTOCOL AND ONLY SAY HOW YOU PLAN TO DEVIATE FROM THAT PROTOCOL.

Results Part I: Data Collection and Observations

As you conduct your experiments, you should always be recording your data. Sometimes that involves writing down *qualitative* data that describes your observations (photos, adjectives, video, etc.). Most of the time it is *quantitative* data, which is measured in units (e.g. centimeters, minutes, milliliters, etc.) and then recorded in a TABLE. Every table should have the following:

- Independent Variable on *left* (Include UNITS)
- Dependent Variable on *right* (Include UNITS)
- Trials can be added to the right.
- Your final column may be used to show the average of trials
- In your lab report, you will need a legend that explains each table.

Table 1. This is an example of a data table that can be used to collect information during an experiment. In this table, the independent variable was type of pizza and dependent variable was number of votes.
Table Source: franklinscience.weebly.com

Most Popular Pizza	
Type of Pizza	# of votes
Pepperoni	10
Cheese	6
Hawaiian	7
Veggie	3
The Works	4

If completing this on a computer, you can add a table by doing the following:
Insert > Table > Select Sizing (can be changed later)

Results Part II: Data Analysis

After your procedure, you have a lot of "raw" data. Now it's time to figure out what all that information means. To show trends (patterns) in your data, put it in a chart or graph. **ALWAYS INCLUDE A FIGURE LEGEND** for each figure. You may need to transform (e.g. calculate average, percent change) your data first, depending on your experiment.

Most graphs included in biology reports and scientific papers are scatter plots, line plots, box plots, and bar graphs

- Scatter plots show correlation (or lack thereof) between two variables. There is commonly a trendline and R^2 value. R^2 does not evaluate the reliability of data - only how correlated the data is.
- Line graphs show how continuous data changes (usually over time).
- Box plots show the distribution of data collected by displaying the mean, range, and quartiles of data.
- Bar graphs compare categorical data.

Go to this series by Khan Academy if you would like to know more about data presentation.

Discussion/Analysis

1. Summarize the results briefly.
2. What do the results mean? (What does the trend in data indicate about the relationship between variables studied?)
3. How do the results align to your hypothesis and research question?
4. Why are these results important for answering your research question?

Conclusion

1. What is the answer to your research question? Is the answer supported by your data?
2. What are the strengths and weaknesses of your project?
3. Were there any issues with your methods?
4. How was your experiment limited? What does that mean for the accuracy and validity of your experiment?
5. What are some realistic and relevant improvements to your experiment or extensions to your experiment?

Things to consider as you plan your experiment and write your report

- ❑ Format
  - No length requirements - remember to be concise!
  - Font options: 12-point font Calibri, Arial, Times New Roman, or Georgia
  - Double Spaced
  - APA Format (Go to **https://tinyurl.com/y7tk3zt9**)
  - One-inch margins on all sides
- ❑ Title
  - Name and Title
- ❑ Purpose
  - Why are you doing this research?
- ❑ Research Question and Introduction
  - What is the question you are trying to answer and why?
- ❑ Hypothesis
  - What do you think will be the result of this investigation, and why do you think this?
- ❑ Method (Materials, procedures, & risk assessment)
  - How do you plan to answer the question you have proposed?
  - What materials will you need?
  - Is this a safe way to do this, why?
- ❑ Method (Variables)
  - What are all the variables involved?
  - How will they be controlled or intentionally manipulated?
  - How will you be collecting your data?
- ❑ Results (Observations, data collected, & data transformed)
  - What raw data are you collecting?
  - How will you organize it for others to read?
  - How will you transform this data into visuals (graphs, charts, etc.)?
- ❑ Analysis
  - What do the results of your investigation tell you?
  - Explain how you came to this conclusion from this data.
  - Now that you have drawn your conclusions, was your hypothesis logically sound?
  - Did you learn things in this experiment that exposed logic errors in your prediction? What were these?
  - Now that you have drawn conclusions, do you think your procedure was the correct procedure to answer your research question?
  - Did you learn things in this experiment that exposed logic errors in your procedure? What were these?
- ❑ Future Steps
  - If you found any logic errors in your prediction or method, how would you correct them based on what you have learned in this experiment?
  - What new question(s) did this experiment raise that you would pursue if you continued this research?
  - How would you go about answering this new question?

Rubric

	5	3	1
Introduction, Research Question, and Hypothesis	**Explain** a **testable problem** or **question** to be **tested** by a scientific investigation **Formulate** and **explain** a **testable hypothesis** using **correct scientific reasoning**	**Outline** a **testable problem** or **question** to be **tested** by a scientific investigation Formulate a **testable hypothesis using scientific reasoning**	**State** a problem or question that is **somewhat aligned** to the procedure proposed **Outline** a hypothesis with **limited success**
Methods and Variables	Design a **logical**, **complete** and **safe method** in which they **select appropriate materials** and **equipment** **Explain how to manipulate** the **variables**, and explain how **sufficient**, **relevant data** will be **collected**	Design a **safe method** in which they **select materials** and equipment **Outline how to manipulate the variables**, and **outline** how **relevant data** will be **collected**	Design a **method** with **limited success** **Outline** the variables with **limited success**
Results	**Correctly collect, organize, transform and present data** in numerical and/or visual forms	**Correctly collect** and **present data** in numerical and/or visual forms	**Collect** and **present data** in numerical and/or visual forms with **limited success**
Conclusion	**Accurately interpret data** and **explain results** using **correct scientific reasoning**	**Accurately interpret data** and **explain results**	**Inaccurately interpret data**
Evaluation of Hypothesis and Next Steps	**Evaluate** the **validity** of the **hypothesis** based on the outcome of a scientific investigation **Explain improvements** or **extensions** to the method that would benefit the scientific investigation	**Outline** the **validity** of the **hypothesis** based on the outcome of a scientific investigation **Outline improvements** or **extensions** to the method that would benefit the scientific investigation	**State** the **validity** of the **hypothesis** based on the outcome of a scientific investigation **State improvements** or **extensions** to the method that would benefit the scientific investigation

References:

Neises, B. 2014. MYP Science Lab Report Guide. Middle Years Programme, International Baccalaureate (IB).

International Baccalaureate. 2014/2015. Sciences Guide. Middle Years Programme, https://www.ibo.org/programmes/middle-years-programme/curriculum/science/.