Group Members _____

Period_____

IA Report Rubric

PIB Biology

Looks Good	Could Use Some Work	Missing	Advice
Exploration/Design (6 points total)			
			• The research question should be clearly identified and carefully worded. • Write a ***one paragraph*** background/introduction to frame your research question and establish its relevancy. Paragraph must enhance the understanding of the context of the investigation • If a living organism is involved, identify it by name. Include the species name in parentheses and Italics after the first mention of the common name. For example, scarlet tanager (*Piranga olivacea*). After that first mention, you can use just the common name. • Clearly identify your generalizing or explanatory hypothesis if your investigation is hypothesis testing. If your investigation is not a test of a hypothesis, then write a specific purpose statement. • Clearly identify your independent variable and dependent variable. All units must be identified and all levels of the independent variable must be specified. • List all variables you will attempt to control, that if uncontrolled, they may affect your dependent variable in a way that will compromise your ability to assess the effect the independent variable has on the dependent variable. • Labeled as Figure 1, include a labeled graph of your ***predicted results***. Add a detailed figure caption across the bottom of this figure (and all other figures in your paper).
			• This section follows from the list above and should be a titled section. This is a detailed discussion about why each listed variable (that you mentioned in the list above) must be controlled (i.e. how it could affect your dependent variable) followed by an explanation about how you will guarantee the control of those listed variables. For example, temperature can affect the growth rate of plants. If temperature is not your independent variable, you must explain how you will guarantee that temperature remains constant across all of your groups (both experimental and control groups) and then show evidence in your raw data that temperature was in fact controlled (e.g. a table of the temperature measurements you took during the experiment). • Thus, the only difference between your experimental group(s) (your treatment) and control group(s) should be your independent variable. • Ultimately, your dependent variable should be a valid way of measuring the effect of the independent variable.
			• The best experimental designs have a quantitative independent variable chosen at regular, fixed intervals and also a quantitative dependent variable.

			• Choose an appropriate sample size/# of replicates that will help you confidently answer your research question and explain why your sample size/# of replicates is enough. Your sample size and/or number of replicates should be clearly stated in your design procedure. • Your design should be ***in list form and written in past tense***. Do not write the design like a recipe. However, the design should be written in enough detail that another researcher could replicate your experiment by reading your design. • Include an annotated photo (or photos; labeled as Figure 2, Figure 3, etc.) of your design set-up or your sampling site, or at the very least, include an annotated drawing of your design. • End with a description of any statistical tests you used to analyze your data and why the test(s) was/were chosen.
Analysis (6 points total)			
			• Raw data are the **qualitative** data you record with your senses and the **quantitative** data that you record directly from measuring devices. Qualitative data include observations like the color of the leaves on your plants, even if you are recording plant height as your response/dependent variable, or the weather during data collection at a field site. • All data tables should be numbered Table 1, Table 2, etc. and include a detailed table caption across the top of the table. • All columns should be labeled and include the **unit of measurement** and the **measurement precision uncertainty**. • Each measuring device has a degree of precision equal to ± the smallest division of the device (e.g for a mm ruler, your measurement precision uncertainty is ±1 mm). For electronic devices, your precision is ± the last measured digit (e.g. for an electronic balance that measures to the nearest hundredth of a gram, a mass of 5.64 g is ± 0.01 g). • All measurements in each column should have the same level of precision (Don't: 4, 3.4, 4.12; Do: 4.0, 3.4, 4.1). If means are reported in your data table, the number of significant digits should equal your least precise measurement that went in to the mean calculation. • Include a table or tables of the data you recorded that shows that all controlled variables did not vary throughout the duration of the experiment. If any of the controlled variables did vary, you will discuss them in your conclusion as possible sources of experimental error.
			• Include a data table (numbered and with a caption above the table) of descriptive statistics (i.e. sample sizes, means, medians, modes, variances, standard deviations, percentages). • Include sample calculations of more complex analyses. Provide a table of your statistical output (e.g. a table of t-Test results with critical t-values, alpha levels, and p-values; an ANOVA table).
			• Create one or more carefully labeled graphs (with figure captions below) that summarize your data and show uncertainty and error. Error bars of standard deviation or 95% confidence intervals should go on bar graphs, if the bars are of means, trend lines should go on scatterplots, etc. .

Evaluation (6 points total)			
			• Start this paragraph by reminding the reader of your original research question (and hypothesis or purpose). • Describe the pattern(s) revealed by your processed data. This includes trends and differences between means. Describe whether or not the processed data are consistent. • Use statistics to justify any patterns or lack of patterns. Include actual calculated statistics (e.g. observed and critical F-values and p-values). Discuss uncertainties revealed by the analyses. • Make sure your conclusion stays within the boundaries of what the data show. • Provide an alternative explanation for the results.
			• Provide a description of your major assumptions you were making when designing your experiment—assumptions that if violated, may in fact make it difficult or impossible to come to any reliable conclusions. • Critique the experimental design and the quality of your data. • Describe three relevant weaknesses in the design that could have introduced *experimental* error to your dependent variable. Experimental error does not include human error. • You may include limitations of the equipment used, the process employed, and the time available for experimentation.
			• Given what you described above, suggest any thoughtful, specific, and reasonable modifications that could be made to the experimental design or analysis that could improve the ability to come to conclusions and answer your original research question. • **Do not** include statements like, "should have collected more data points," or "should have used better equipment." Your suggestions should be specific. Instead, describe exactly what the better equipment should be, why, and how the better equipment will help reduce error and increase confidence.
Communication (4 points total)			
			• Include at least one citation from a scientific article (a primary source). Within the report, summarize/paraphrase the relevant information from the scientific paper (do not write it in quotation marks). Write the last names and year of the paper you have cited at the end of the sentence that includes information from the scientific paper. For example, (Ludlow and Smith 2012) or (Granger *et a*l. 2005). Include a full citation of the paper you have cited information from at the end of your report. Use the "works cited" section from the scientific article we analyzed in class (the respiration article) as a model for how to write the full citation. • There should be no spelling or grammatical mistakes. • Your report should follow the order of the items on the checklists. • Tables should never be divided between pages. Table and figure captions should never be on a separate page from the table or figure they are describing. • The report should be written using scientific language (not the language of a creative or persuasive report). • All scientific symbols and notation are used correctly. For example, the symbol for carbon dioxide is **CO_2, not CO2.**

Exploration		Analysis		Evaluation		Communication		Total	
Poss	Score	Poss	Score	Poss	Score	Poss	Score	Poss	Score
6		6		6		4		22	

(pink) = fluff

(green) = improper language for a scientific report (also used to show grammatical errors)

(blue) = meaningless sentence

(yellow) = incorrect assumption

(orange) = not specific enough