Task 7: Producing a Scientific Report

Standards

Ability to write a scientific procedure.
Ability to use scientific information to draw conclusions.
Ability to write a hypothesis.
Ability to evaluate the validity of a scientific experiment.

During the course of the AP Environmental Science course, we will complete a number of scientific experiments. Depending on the activity, these experiments will ask you to demonstrate your skill in using all or part of the scientific method. There will be a number of questions on the AP test that ask you to apply or evaluate this skill. When I evaluate your experiments and reports, I will be both looking at the conclusions you reach and how you use the scientific method. In order to evaluate your use of the scientific method, I will be using the rubric below. For any individual experiment, I may use all or some of this rubric. This will be indicated before you write the report. I have also attached a general guide to the scientific method.

Rubric

	Poor 1 – 2 pts	Good 3 – 4 pts	Excellent 5 – 6 pts
Components of report	More than one is missing	One element is missing	All required elements are present
Question/Purpose	Not identified	Identified but relation to the rest of the lab is unclear	Identified and clearly relates to the rest of the lab
Experimental Hypothesis	Not present or incorrect format	Hypothesis is an if and then statement which connects the variables in the experiment but is not based on the question.	Hypothesis is an if and then statement which connects the variables in the experiment and is based on the question.
Materials	More than two materials missing or non scientific vocabulary used	One or two materials not listed or scientific vocabulary not used for all materials	All materials listed and identified using scientific vocabulary
Procedure	Procedures do not accurately list the steps of the experiment. Specific language is not used	Procedures are listed in a logical order, but steps are not numbered and/or are not in complete sentences. Specific language is used most of the time	Procedures are listed in clear steps. Each step is numbered and is a complete sentence. Specific language is used

Data	Data only in one format or many inaccuracies in the data presentations	Data is presented in a number of different formats, however there are some inaccuracies in the data presentations	Data is presented in a number of different formats each one is accurate and makes it easier to understand the date
Conclusion	Conclusion is unrelated to hypothesis or data	Conclusion is related to the hypothesis, and is accurate based on the data from the experiment. Possible sources of error are included. However, your conclusion is not a full explanation of the experiment	Conclusion is related to the hypothesis, and is accurate based on the data from the experiment. Possible sources of error are included.

THE SCIENTIFIC METHOD
SUGGESTIONS FOR WRITING A LAB ASSESSMENT

Formulating a question

- Read through the assignment and ask yourself—what is the assignment asking me to do?
    - What questions are you trying to answer?
- In the form of a question
    - Use a question mark: **?**
- Use clear language
    - Don't make the question so complicated that another reader would have trouble understanding it
        - Make sure the 2 variables are very clear and directly connected
    - Although it is not necessarily wrong to use a 2-part question, a single, well-worded question makes it easier to design your procedure
- **Make sure the question is actually something you can answer by performing the lab**
    - In addition, make sure that the lab will collect data that will answer the question
- Try to make a logical connection between the things you are testing, instead of simply stating random bits of information.
- Be specific! Name what you are testing.
- The **independent variable** is what you are changing or manipulating.
- The **dependent variable** is the value that changes as a result of the manipulation of the independent variable [is dependant on the independent variable]. The dependent variable is what you are measuring.

Hypothesis (if required)

- In the form of an "if…..then" statement.
- The "if…then" statement should be an attempt to logically answer your initial question
- "If" should be the independent variable and "then" should be the dependent variable
- Should be an informed guess, not an outrageous claim

Safety Precautions

- List in a category separate from the procedure.
- In addition, you may choose to repeat one or more specific precautions in the procedure in order to give more emphasis

Materials

- Organize list in such a way that the reader can easily interpret
- Make sure to include sizes of beakers, graduated cylinders, etc.
- Make sure to include units for measurement instruments
    - For example, "thermometer, °C"
- When you are performing the procedure, make sure that **every** piece of equipment and glassware that you use is on the materials list
- Use specific term for each material
    - "Apparatus" is NOT a material
- If you are using a unique or specialized apparatus, you need to list the pieces of the apparatus, explain how to assemble it, and draw a diagram to illustrate it if you think the diagram would clarify the situation

Procedure

- Number the steps.
- Use specific language—be careful not to use ambiguous terms.
    - For example: stir: how? How much? How fast? With what?
    - For example: chilled: to what temperature? How are you chilling it?
    - For example: "can"—what kind of can? What size?

  Especially watch out for ambiguous verbs because the person performing the experiment may interpret them differently than you intended. For example: "put", "take", "get" etc.
- Describe, diagram, and label any apparatus that you use. Refer to the apparatus by page number or figure number. "Apparatus" is a general term that can mean just about anything, so you have to be specific. If you are using an apparatus that is not widely familiar, describe how to build it and what materials are needed to build it.
- Do not use pronouns!
- Most of the time, the steps provided are not optional; otherwise, it would be difficult to reproduce the experiment. Therefore, write it exactly as you want it done.
- Units---always specify!!
- If you are measuring something, make sure to mention to record the number as well (in the data table).
- Amounts…..be as specific as necessary. If exact amounts are not required, you still have to provide some guideline about how much is needed.
  For example, is the amount needed closer to a mL or a L?
  Use the term "approximately", and then give an amount.

- Make sure that your use of units is consistent throughout the procedure.
  For example, don't switch from tsp to ml….in general, **use scientific units**.
- Make sure that your instructions are clear enough that the step can be done exactly the same every time.
  For example: "put it under the can"—where under the can? How far from the can? What is "it"?
- This is a formal document. Do not use slang or jokes. Avoid use of words like "stuff", "thing". Don't make up terms or names of items.

PERHAPS THE BEST WAY TO CHECK YOUR PROCEDURE IS TO ACTUALLY USE IT. HAVE YOUR PARTNER TRY TO USE IT!

Data Table

- Make sure your data table has a title that is appropriate to the procedure being performed
- The data table needs to be simple enough for another person to interpret
- The data table MUST include the data you are collecting while performing your procedure
- Make sure to include units
- Record observations directly into your data table
- Group **trials** of like substances together
  - It might be sensible to make separate data tables for different groups of trials--- remember, the goal is to make the data table(s) easily interpretable by another person
- If you incorporate any calculations into your data table, make sure that you supply a general formula

Calculations

- **Make sure that you have supplied a general formula for performing a calculation**
  - Formulas may be incorporated directly into the data table, but this is not required
- Averages do not need to be done on all data
- You need to document any constant values that you use.

Graphing Results

- Make sure that the graph is done on graph paper (with a ruler to make the lines straight) or on the computer
- Graph should have a title, and axes need to have labels and units.
- Independent variable is on the X axis, dependent variable on the Y axis
- Graph should depict the result that answers your question
  - Do not graph individual measurements—use the average
  - Make sure that you understand the question that you are trying to answer
  - The graph and your data may not support your hypothesis, and that is OK
- Graph should be on a separate sheet of paper, placed after the calculations but before the conclusion

Conclusion

- Proper grammar and spelling is important
  - Use scientific language wherever possible

    - This is a more formal document, so it shouldn't be written like an informal letter or diary entry
- ANSWER THE QUESTION YOU ORIGINALLY POSED in the first sentence of your conclusion—go back and read the question again
    - Do not simply list your results for each substance
- Use the actual numbers you obtained in the experiment to support your statements
    - You may want to refer to your graph, either by page number or "figure x"
    - You may just refer to the calculations that you performed rather than all of the individual data
- Sources of error
    - Mention more than one
    - If your results are inconsistent, document that and then try to explain why there were inconsistencies
    - In this particular experiment, using substances with different starting masses is NOT a source of error---why?
    - How could error have affected your results? Be specific—are results higher or lower because of the error?
- Suggest ways to improve your procedure techniques
    - Change in method or set-up
- Suggest ways to extend the experiment
    - Make rational, not outrageous, suggestions

State why your idea may be valid