# Photosynthesis and Respiration Lab Part 2

Follow the format and directions below to write and submit your lab report for the PnR Lab.

You will submit your paper to TurnItIn.com. Create an account if you have not already for another class. Then enroll in Biology by putting the class ID for your period (listed below) and the password **bioturner**. The same password works for all periods.

## Official **Due Date is Friday, December 19<sup>th</sup> at midnight**.

Papers will be accepted after the due date for reduced credit (be sure to email Ms. Turner if you turn in your paper late – [turnerm@issaquah.wednet.edu](mailto:turnerm@issaquah.wednet.edu)).

TurnItIn.com
Class ID by Period

| Period | Class ID |
|--------|----------|
| 1 | 8610748 |
| 2 | 8610760 |
| 3 | 8610773 |
| 5 | 8610780 |
| 6 | 8610788 |

Lab Format and Description: The lab sections must be in this order with clear formatting (titles for each section that are easily identifiable) and all items completed for each section.

# Title of Lab (Be sure to include MV, RV, and organism used)

**Investigative Question:** "What is the effect of _____(MV) on ____ (RV)?"

**Hypothesis:** If (MV), then (RV), because… (this is one option for formatting)

**Variables:**

1. **Manipulated Variable:**
2. **Responding Variable:**
3. **Controlled Variables:** (Need at least 3 and it must be CLEAR that they would have an effect on your data)

**Groups:**

**Experimental:** Set-ups with the manipulated variable (all three conditions represented)
**Control:** Set-up without the manipulated variable or the set-up you determined as the base-line

**Materials:**

- A complete bulleted list of the materials used during the investigation. Should always include sizes and quantities when appropriate.

## Procedure:

1. A numbered list of steps that represent all 8 of the attributes on our Bio EOC Procedure Rubric below.

**Scoring Rubric for: New Procedure**

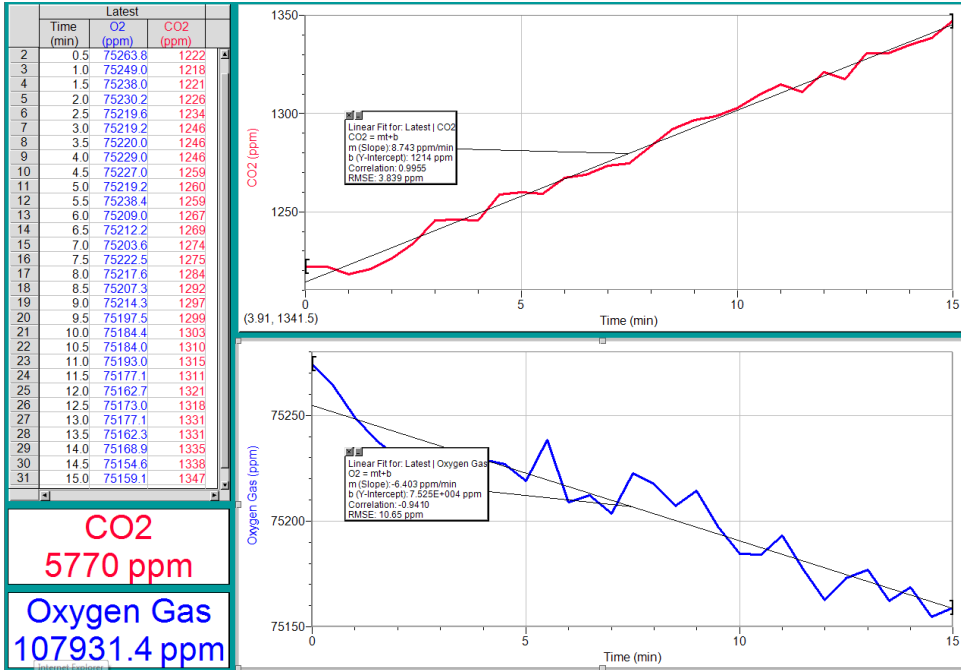| | Procedure Attributes | Description of Attribute | Attributes |
|---|---|---|---|
| **P1** | **Controlled Variables** | At least two controlled variable are identified or implied in the procedure or the materials list (e.g., *give examples*). | 1 |
| **P2** | **Manipulated Variable** | Only one manipulated variable (state variable from question) is identified or implied in the procedure or data table (if given). The manipulated variable must have at least three conditions to be credited. | 1 |
| **P3** | **Responding Variable** | The responding variable (state variable from question) is identified or implied in the procedure or data table (if given). | 1 |
| **P4** | **Record Measurements** | The procedure states or implies measurements are recorded periodically or gives a data table.<br>Attribute Notes:<br>1. If artificial data for the responding variable is given, this attribute cannot be credited.<br>2. The phrase *take measurement* cannot be used to mean *record*. | 1 |
| **P5** | **Trials are Repeated** | More than one trial for all conditions is planned, or implied in a data table, to measure the responding variable. | 1 |
| **P6** | **Experimental Control Condition** | The procedure includes an additional setup in which the manipulated variable is not changed and the responding variable is measured for each condition in the experimental setup(s) (e.g., *give example*).<br>Writing Note: This attribute is only credited for complicated investigations in which an experimental control condition is appropriate. | 1 |
| **P7** | **Extra Validity Measure** | The procedure includes a validity measure **not** included in the scenario experiment (e.g., more controlled variables, better measuring technique, increased range of conditions, control for sample bias). | 1 |
| **P8** | **Logical Steps** | The steps of the procedure are detailed enough to repeat the procedure effectively (examples of illogical steps: no ending time indicated; states *Set up as diagrammed,* but diagram is inadequate; recording vague data or results). | 1 |
| | | **Total Possible Attributes** | **8** |

# Data Collection & Analysis:
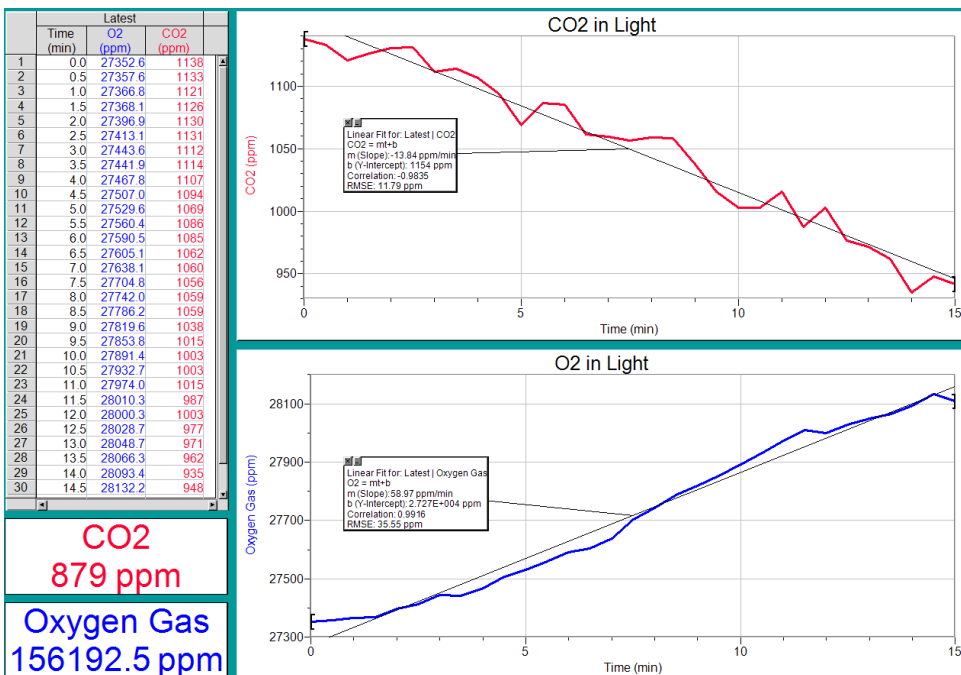
## Data Tables and Graphs:

These sections are combined for this lab as the data tables and graphs are taken together from the LoggerPro program on the computers. You should have 4 data tables + graphs ($CO_2$ and $O_2$ graphs for each) for each of your 3 conditions and your control set-up. If you need to use the opposite control set-up from what you did in PnR Part 1 you can copy and paste the data table and graph from below.

Each data table/graph needs to have a title that includes the RV and MV and specimen (test subject).

### Rate of $CO_2$ and $O_2$ Production and Consumption in Spinach in the Dark

| | Time (min) | O2 (ppm) | CO2 (ppm) |
|---|---|---|---|
| 2 | 0.5 | 75263.8 | 1222 |
| 3 | 1.0 | 75249.0 | 1218 |
| 4 | 1.5 | 75238.0 | 1221 |
| 5 | 2.0 | 75230.2 | 1226 |
| 6 | 2.5 | 75219.6 | 1234 |
| 7 | 3.0 | 75219.2 | 1246 |
| 8 | 3.5 | 75220.0 | 1246 |
| 9 | 4.0 | 75229.0 | 1246 |
| 10 | 4.5 | 75227.0 | 1259 |
| 11 | 5.0 | 75219.2 | 1260 |
| 12 | 5.5 | 75238.4 | 1259 |
| 13 | 6.0 | 75209.0 | 1267 |
| 14 | 6.5 | 75212.2 | 1269 |
| 15 | 7.0 | 75203.6 | 1274 |
| 16 | 7.5 | 75222.5 | 1275 |
| 17 | 8.0 | 75217.6 | 1284 |
| 18 | 8.5 | 75207.3 | 1292 |
| 19 | 9.0 | 75214.3 | 1297 |
| 20 | 9.5 | 75197.5 | 1299 |
| 21 | 10.0 | 75184.4 | 1303 |
| 22 | 10.5 | 75184.0 | 1310 |
| 23 | 11.0 | 75193.0 | 1315 |
| 24 | 11.5 | 75177.1 | 1311 |
| 25 | 12.0 | 75162.7 | 1321 |
| 26 | 12.5 | 75173.0 | 1318 |
| 27 | 13.0 | 75177.1 | 1331 |
| 28 | 13.5 | 75162.3 | 1331 |
| 29 | 14.0 | 75168.9 | 1335 |
| 30 | 14.5 | 75154.6 | 1338 |
| 31 | 15.0 | 75159.1 | 1347 |

CO2
5770 ppm

Oxygen Gas
107931.4 ppm

Linear Fit for: Latest | CO2
CO2 = mt+b
m (Slope): 8.743 ppm/min
b (Y-Intercept): 1214 ppm
Correlation: 0.9955
RMSE: 3.839 ppm

Linear Fit for: Latest | Oxygen Gas
O2 = mt+b
m (Slope): -6.403 ppm/min
b (Y-Intercept): 7.525E+004 ppm
Correlation: -0.9410
RMSE: 10.65 ppm

### Rate of $CO_2$ and $O_2$ Production and Consumption in Spinach in the Light

| | Time (min) | O2 (ppm) | CO2 (ppm) |
|---|---|---|---|
| 1 | 0.0 | 27352.6 | 1138 |
| 2 | 0.5 | 27357.6 | 1133 |
| 3 | 1.0 | 27366.8 | 1121 |
| 4 | 1.5 | 27368.1 | 1126 |
| 5 | 2.0 | 27396.9 | 1130 |
| 6 | 2.5 | 27413.1 | 1131 |
| 7 | 3.0 | 27443.6 | 1112 |
| 8 | 3.5 | 27441.9 | 1114 |
| 9 | 4.0 | 27467.8 | 1107 |
| 10 | 4.5 | 27507.0 | 1094 |
| 11 | 5.0 | 27529.6 | 1069 |
| 12 | 5.5 | 27560.4 | 1086 |
| 13 | 6.0 | 27590.5 | 1085 |
| 14 | 6.5 | 27605.1 | 1062 |
| 15 | 7.0 | 27638.1 | 1060 |
| 16 | 7.5 | 27704.8 | 1056 |
| 17 | 8.0 | 27742.0 | 1059 |
| 18 | 8.5 | 27786.2 | 1059 |
| 19 | 9.0 | 27819.6 | 1038 |
| 20 | 9.5 | 27853.8 | 1015 |
| 21 | 10.0 | 27891.4 | 1003 |
| 22 | 10.5 | 27932.7 | 1003 |
| 23 | 11.0 | 27974.0 | 1015 |
| 24 | 11.5 | 28010.3 | 987 |
| 25 | 12.0 | 28000.3 | 1003 |
| 26 | 12.5 | 28028.7 | 977 |
| 27 | 13.0 | 28048.7 | 971 |
| 28 | 13.5 | 28066.3 | 962 |
| 29 | 14.0 | 28093.4 | 935 |
| 30 | 14.5 | 28132.2 | 948 |

CO2
879 ppm

Oxygen Gas
156192.5 ppm

**CO2 in Light**

Linear Fit for: Latest | CO2
CO2 = mt+b
m (Slope): -13.84 ppm/min
b (Y-Intercept): 1154 ppm
Correlation: -0.9835
RMSE: 11.79 ppm

**O2 in Light**

Linear Fit for: Latest | Oxygen Gas
O2 = mt+b
m (Slope): 58.97 ppm/min
b (Y-Intercept): 2.727E+004 ppm
Correlation: 0.9916
RMSE: 35.55 ppm

Complete the following table for your data. Use this information and your graphs to answer the analysis questions below.

**What is the effect of ___ on the rate of $CO_2$ and $O_2$ production and consumption in Spinach?**

| | Rate of Consumption or Production of Gases | |
|---|---|---|
| *Manipulated Variable* | **Slope for $CO_2$ (ppm/min)** | **Slope for $O_2$ (ppm/min)** |
| *MV condition 1* | | |
| *MV condition 2* | | |
| *MV condition 3* | | |
| *Control* | | |

**Analysis Questions:** (Must answer the question using a complete sentence. Please use the numbers as shown.)

1) What does it mean for our graphs in this lab to have a positive slope? A negative slope?

2) From which of your graphs could you infer that photosynthesis is happening? How do you know?

3) From which of your graphs could you infer that respiration is happening? How do you know?

4) Are there any graphs in which it doesn't seem like either is occurring? Which graphs? Why do you think so? (What do they look like?)

      (a) ***Propose a possible explanation for what could be happening to show data such as this.

5) Compare the slopes of the 4 set-ups.

    a) Carbon Dioxide: (address each of your graphs if they apply to the question)

        i) Which one produced the most $CO_2$? The least?

        ii) Which one consumer the most $CO_2$? The least?

    b) Oxygen: (address each of your graphs if they apply to the question)

        i) Which one produced the most $O_2$? The least?

        ii) Which one consumer the most $O_2$? The least?

6) Describe your control set-up. Why did you decide to use this as your control? Do you think it is the best choice for your control or is there a better set-up? Why do you think so?

**\*\*These questions are meant to help you to think about your data and what it means. This**

**information will be useful when you do your conclusion next!**

# Conclusion:

Write your conclusion as a paragraph that includes the 5 attributes from the Bio EOC Conclusion Rubric below. When you use data, it is most appropriate to use the SLOPES from the graphs. It does not matter what the ending concentration of gas is – instead it matters how much it changed during the time you measured because you can potentially attribute that change to your manipulated variable.

**Scoring Rubric for: Write a Conclusion Attribute**

| | Attributes of a Conclusion<br>Note: The italicized print is the part of the "Example" credited for the attribute. | |
|---|---|---|
| | **Description** | **Attributes** |
| **C1** | **Conclusive statement** correctly answers the experimental question (or correctly states whether the hypothesis/prediction was correct): *As the manipulated variable increased, the responding variable increased.* | 1 |
| | **Supporting data should <u>at least</u> be over the entire range of the conditions investigated. Thus the minimum reported data are the lowest and highest conditions of the manipulated variable for quantitative data (responding variable when the manipulated variable information is descriptive).** | |
| **C2** | **Supporting data for lowest condition:** *When the manipulated variable was $X_{lowest}$, the responding variable was the lowest, $Y_{lowest}$* | 1 |
| **C3** | **Supporting data for highest condition:** *When the manipulated variable was $X_{highest}$, the responding variable was $Y_{higher}$* | 1 |
| **C4** | **Explanatory language,** <u>separate</u> from the conclusive statement, is used to connect or compare the supporting data to the conclusive statement: *So changing the manipulated variable by X caused the responding variable to increase/decrease by Y.*<br><br>*\*Be sure to use the data* | 1 |
| **C5** | **Scientific Explanation** provides a plausible scientific reason that explains the trend seen in the data table in terms of established scientific knowledge. | 1 |
| | | 5 |