

## Effects of Pollution on Algae Growth

### Objective:

Develop a testable hypothesis and design an experiment to determine how a specific type of pollution affects algae growth in pond water.

Handwrite a complete laboratory report using a provided template on a separate sheet.

### Algae Characteristics:

Algae are simple plants that can range from the microscopic, to large seaweeds, such as giant kelp more than one hundred feet in length. Microalgae include both cyanobacteria, (similar to bacteria, and formerly called “blue-green algae”) as well as green, brown and red algae.

Most algae grow through photosynthesis – by converting sunlight, CO<sub>2</sub> and a few nutrients, including nitrogen and phosphorous, into material known as biomass. This is called “autotrophic” growth. Other algae can grow in the dark using sugar or starch (called “heterotrophic” growth), or even combine both growth modes (called “mixotrophic” growth).

Algae are very diverse and found almost everywhere on the planet. They play an important role in many ecosystems, including providing the foundation for the aquatic food chains supporting all fisheries in the oceans and inland, as well as producing about 70 percent of all the air we breathe.

Question: How does pollution affect algae growth?

### Materials Available for Use:

- 4 Clear cups w/ lids
- Beaker
- Measuring spoons
- Sharpie
- Pond Water w/ Algae
- Dish detergent
- Laundry detergent w/out phosphates
- Multipurpose fertilizer
- Acetic Acid (Vinegar)

### Directions:

1. Develop a **hypothesis** to answer the proposed question. Write an “If, then” statement.  
(Include quantity of independent variable that will be used)
2. Create a step-by-step **procedure** for testing hypothesis. Write in third person, present tense.
3. Create a list of all **materials** needed to complete the experiment, including specific amounts used.
4. Collect four (4) samples of pond water containing algae, making sure to keep the same volume of water and algae in each testing container.
5. Set up a control group plus three (3) test groups using one specific independent variable, as outlined in the hypothesis.
6. Develop a data table for collecting daily qualitative and quantitative **data** for the two weeks of the experiment.
7. Properly label the jars then set them in a place with warmth and sunlight for 1-2 weeks and observe the growth.
8. Observe the different amounts of growth by eye for the growth period.
9. At the end of the growth period, strain out and weigh the algae to check the differences.

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### **Data:**

Here is an example data table and types of data that may be collected daily:

Day/Observations	Control Group	Test Group 1	Test Group 2	Test Group 3
Day 1 – 13 (daily record) - Color - Volume - Visual differences				
Day 14 - Color - Volume - Visual differences - <b>Mass of strained algae</b>				

- After all data is collected, **graph** any numerical data collected in the lab.

### **Analysis Questions:**

Answer each question in complete and detailed sentences.

1. What role does algae play in the ecosystem of a pond?
2. What affect does rampant algae growth have on a pond or a lake environment?
3. What does too little algae growth mean for a pond or lake environment?
4. Which conditions, if any, created greater algae growth? Which, if any, created less?
5. How might the specified pollutant enter into an aquatic ecosystem?
6. How might one prevent the pollutant from entering the aquatic ecosystem?
7. Do you think all types of algae would respond the same way to pollutants that your variety did?
8. How is the environment of the jar different from the environment in a pond? Do you think that affected your experiment?

### **Conclusion:**

Write a paragraph analyzing your overall results of the lab based on the collected data. Determine if the hypothesis was supported or refuted by the results. If refuted, revise a hypothesis for further experimentation.

### **Sources of Error:**

Identify 2-3 sources of error that may have affected your results (human or measurement errors cannot be a source of error) and could be corrected in further experimentation.

## **Instructions for Writing Lab Reports:**

Top right corner: **name, date, class, and period**

Top of the first page: **Title of the investigation**

*Each of the following sections should be clearly labeled on your lab report.*

**Statement of Problem:** Define the problem.

**Background/Research:** This is where you explain what the investigation is about and why you are doing the lab. You should give some background information, explaining what is already known about this problem. Teacher/class discussion and your notes should be a valuable resource to support your writing. If you use a resource, cite your sources (MLA). Your paragraph should be written in complete sentences.

**Hypothesis:** Your hypothesis is a statement that tells what you expect to happen AND why. It is very important to explain your reasoning! Otherwise, your hypothesis is just a random guess. Scientific hypotheses are based on solid knowledge.

**Materials:** In a neat column, list the materials that were necessary to carry out the investigation. Include values if necessary (i.e. 2 - 50ml beakers).

**Procedures:** Using a numbering system, list all the steps in the procedure. This should be written in present tense and be complete enough that someone else could follow your instructions to do the same lab. It must be written in third person, present tense.

**Data:** The numerical data/quantitative observations that you collect should be presented in a very neat, easy to read data table/chart that you prepare in advance. Other qualitative observations may be presented as descriptions, diagrams or drawings. Graph your data when applicable.

### **Analysis/Conclusions:**

1. Answer any questions that have been presented in the Analysis/Conclusion section of your lab instructions. Your answers to these questions should be written in complete sentences.
2. State whether your hypothesis was supported or refuted; incorporate your data from the above data section as evidence.
3. Write a final summary paragraph (or more) to draw conclusions. This is where you synthesize all the data, mentioning trends, discuss what the data seems to suggest. This is also where you mention questions or areas for further study.

**Sources of Error:** You should describe all of the ways that error might have been introduced into the procedure and caused your results to be less likely to fit the expected results. You should try to explain whether the source of error would be likely to increase or decrease the numbers you collected. In some labs, you might calculate percent error.

**Bibliography:** Cite any sources used in the laboratory report (MLA format).

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### Grading Rubric:

<b>INTRODUCTION TO REPORT</b>	Problem is clearly identified and stated	Problem is identified and stated	Problem is stated	Superficial statement not directly tied to investigation	No problem is stated
<b>NECESSARY BACKGROUND INFORMATION</b>	Physical, chemical and biological factors are addressed, showing an in-depth understanding of the connection to the problem	Physical, chemical and biological factors are addressed, showing a basic understanding of the connection to the problem	Not all factors are addressed, or mistakes are made in the discussion of the physical, chemical and biological factors	Few factors are addressed, or several mistakes are made in the discussion of the physical, chemical and biological factors	No background information is given
<b>HYPOTHESIS/ EXPECTATIONS</b>	Tells what is expected to happen and why, clear tie to background information	Tells what is expected to happen and why	Tells what is expected to happen	Superficial statement regarding expectations	No hypothesis and/or expectations given
<b>MATERIALS/ METHODS</b>	Provides a complete, well organized list of all materials used in the investigation	Provides a complete list of all materials used in the investigation	Provides an incomplete list of all materials used in the investigation	Provides a superficial list of materials used in the investigation	No material list given
	All the steps in the procedure are listed and written in present tense	All the steps in the procedure are listed	Most steps in the procedure are listed	Some steps in the procedure are listed	No methods are given
<b>DATA/ CALCULATIONS</b>	Complete data set, presented in a neat, easy to read manner includes descriptions, diagrams, charts and/or drawings where appropriate	Complete data set, includes descriptions, diagrams, charts and/or drawings where appropriate	Partially complete data set, includes descriptions, diagrams, charts and/or drawings where appropriate	Incomplete data set, includes descriptions, diagrams, charts and/or drawings where appropriate	No data given
<b>CONCLUSION</b>	Demonstrates synthesis of data, identifies trends, incorporates and discusses meaning of data, shows a thorough understanding of original problem	Demonstrates synthesis of data, identifies trends, incorporates data, shows an understanding of original problem	Identifies trends, shows a basic understanding of original problem	Discusses superficial overviews of results and meaning	Does not discuss meaning of results
	States weather hypothesis/ expectations are supported or refuted, incorporating data as evidence, shows thorough understanding	States weather hypothesis/ expectations are supported or refuted, incorporating data as evidence	States weather hypothesis/ expectations are supported or refuted	States weather hypothesis/ expectations are supported or refuted, incorporating data as evidence, shows misunderstanding	Does not reference hypothesis/ expectations
	Areas for further study are identified and explained showing a thorough understanding of the concepts	Areas for further study are identified and explained	Areas for further study are identified	Superficial areas for further study are given	No areas for further study are given
	Describes ways in which error might have been introduced and/or caused your results to be less likely to fit the expected results, explains the direction in which data could have been skewed due to error	Describes ways in which error might have been introduced and/or caused your results to be less likely to fit the expected results	Discusses mistakes made during the lab, not error	Describes superficial ways in which the errors or mistakes could have occurred	Sources of error are not discussed
<b>WORKS CITED</b>	Sources are cited in MLA format and are well referenced throughout the report	Sources are cited in MLA format and are referenced throughout the report	Sources are cited in MLA format	Sources are cited	Sources are not cited
<b>OVERALL</b>	Integrates relevant science vocabulary throughout the report in a meaningful way	Integrates relevant science vocabulary throughout the report	Includes relevant science vocabulary in the report	Superficial inclusion of relevant science vocabulary in the report	Little to no inclusion of relevant science vocabulary in the report
	The report engaged the reader through visuals, organization and overall professionalism	The report contained visuals, organization and overall professionalism	The report contained some visuals, organization and overall professionalism	The report contained few visuals, organization and overall professionalism	No enhancement of the report through visuals, organization and professionalism
	Student was present for and engaged in classroom experiences necessary for the report	Student was present for classroom experiences necessary for the report	Student did not participate in portions of the experiences necessary for the report	Student did not participate in the majority of the experiences necessary for the report	Student did not participate in the experiences necessary for the report
<b>Final Score:</b>	100-90	89-80	79-70	69-60	59-0