

Subjects/Target Grades  
Science and Social Studies  
Grades 7-12

Duration/ Location

50-60 minute class period  
followed by a week of  
experiment monitoring and  
another 1 or 2 50-60 minute  
class periods  
Classroom setting

Materials

*Per student / small group*

- Investigate! student resource page
- Algal bloom experiment: pond water, plastic bottles, house plant fertilizer
- Duckweed experiment: duckweed, clear egg carton, forceps, graduated cylinder, house plant fertilizer
- Phosphorus and nitrate monitoring kits

## Lesson Four Explore: Managing Excess

**Nutrients-** pages 9 & 10 from lesson 4

### Activity Overview

Students explore the effect of nutrients on plant growth through an inquiry based experiment.

### Lesson Procedure

- 1) Challenge students to design and conduct an investigation to determine the effect of nutrients on algal growth or the growth of aquatic plants such as duckweed or water milfoil. This could be an open ended inquiry activity that is performed in groups.
- 2) Some basic questions for students to consider as they design their investigations are:
  - What question would we like to answer?
  - What is the dependent variable?
  - What is the independent variable?
  - What aquatic organism will we use?
  - What will be the source of nutrients?
  - What is the design of our investigation?
  - How will we monitor the results?
- 3) Have students brainstorm additional questions that need to be answered before beginning the investigation. Examples are: Where will we get the algae or duckweed? What materials are needed? How long will the investigation be run? How will we present the results? Also, students should do some research to become familiar with the topic of nutrients and algae or aquatic plants in general. The student resource page, *Investigate!* is available to guide students in creating their investigations.
- 4) If available, use test kits at collection time to determine levels of nitrate and phosphorus in the water from which the algae or duckweed have been harvested. These kits also could be used to test for nutrients from other water bodies or to monitor changes throughout the investigation. Have the groups create a scientific poster about their investigation.

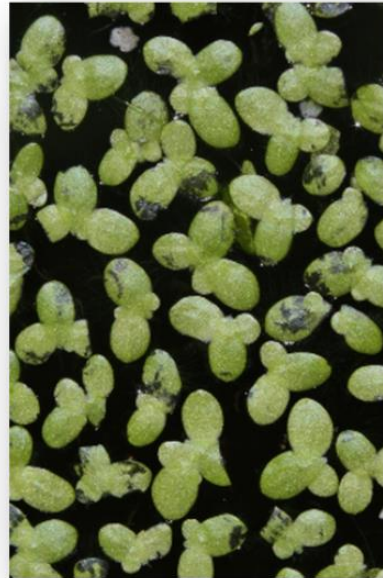
### Vocabulary Terms

**Duckweed-** a common, native plant found in Michigan lakes and wetlands, which is the smallest known flowering aquatic plant. It is not algae. Duckweed can rapidly reproduce, making it ideal for student investigations.

## Duckweed



J. Vail



<http://michiganflora.net/species.aspx?id=174>



J. Vail

# Investigate!



Question: What are the effects of nutrients on algal growth or the growth of aquatic plants such as duckweed or water milfoil?

1. When designing your investigation, consider the following:

- What question would we like to answer?
- What is the dependent variable?
- What is the independent variable?
- What aquatic organism will we use?
- What will be the source of nutrients?
- What is the design of our investigation?
- How will we monitor the results?
- Where will we get the algae or duckweed?
- What materials are needed?
- How long will the investigation be run?
- How will we present the results?

Before beginning your investigation, conduct research to become familiar with the topic of nutrients and the algae or aquatic plant you will be using in your investigation.

2. Conduct your investigation!

3. Create a scientific poster about your investigation. Be sure to include the following:

- Title of the investigation
- Introduction
- Materials and Methods
- Results
- Discussion
- Summary/Conclusion
- References

## Nutrients and Aquatic Plants Investigation Sample

*The following is an excerpt of an outline for an investigation designed by a high school student to observe the effect of fertilizer on the growth of aquatic plants (duckweed).*

Duckweed is a small green floating plant found in still or slow moving waters. Duckweed can rapidly reproduce in optimal conditions, quickly covering a body of water. So what conditions are optimal for duckweed?

Question: How will different amount of nutrients affect the growth of duckweed?

Hypothesis: Lower amounts of nutrients will yield a lower amount of growth whereas higher amounts of nutrients will yield a greater amount of growth.

Materials: clear plastic egg cartons, permanent marker, liquid plant food\* (dilute according to manufacturer instructions), distilled water, graduated cylinder, small spoon, live duckweed

\*Originally performed with Miracle-Gro – Liquid Houseplant Food 8-7-6

Methods:



1. Design a preliminary investigation to look at the effects of fertilizer on the growth of duckweed.
2. Collect duckweed.
3. Label each pocket in the egg carton “1-12” with a permanent marker.
4. Fill each pocket with 15 mL of distilled water.
5. Add liquid plant food into each pocket as corresponding to the Data Table.
6. Remove duckweed from the culture by dipping spoon into the water.
7. Place 5 individual duckweed plants into each pocket.
8. Close or cover egg carton to prevent evaporation.
9. Photograph each pocket at the start and the conclusion of the investigation.
10. Observe for one week or more counting the number of plants.
11. Compare photographs and record findings including the appearance of plants.
12. Revise the experimental design based on the results of the preliminary investigation.
13. Re-run the investigation making sure to use replicates.



Results:

## 1. Preliminary investigation:

| Pocket #  | Amount of liquid plant food added | Duckweed after one week | Duckweed change |
|-----------|-----------------------------------|-------------------------|-----------------|
| Pocket 1  | 0 drops                           | 7 Plants                | +2 Plants       |
| Pocket 2  | 0 drop                            | 6 Plants                | +1 Plants       |
| Pocket 3  | 0 drops                           | 11 Plants               | +6 Plants       |
| Pocket 4  | 1 drops                           | 9 Plants                | +4 Plants       |
| Pocket 5  | 1 drops                           | 9 Plants                | +4 Plants       |
| Pocket 6  | 1 drops                           | 10 Plants               | +5 Plants       |
| Pocket 7  | 2 drops                           | 10 Plants               | +5 Plants       |
| Pocket 8  | 2 drops                           | 8 Plants                | +3 Plants       |
| Pocket 9  | 2 drops                           | 10 Plants               | +5 Plants       |
| Pocket 10 | 3 drops                           | 12 Plants               | +7 Plants       |
| Pocket 11 | 3 drops                           | 11 Plants               | +5 Plants       |
| Pocket 12 | 3 drops                           | 7 Plants                | +2 Plants       |



Pocket #1 Before



Pocket #1 After



Pocket #9 Before



Pocket #9 After

Plants with greater amounts of fertilizer tended to turn brown and appeared unhealthy.

## 2. Actual investigation:

| <b>Pocket #</b> | <b>Amount of liquid plant food added</b> | <b>Initial number of duckweed (Date: )</b> | <b>Final number of duckweed (Date: )</b> | <b>Duckweed change</b> |
|-----------------|--|--|--|------------------------|
| Pocket 1        | 0 drops                                  |  |  |                        |
| Pocket 2        | 0 drop                                   |  |  |                        |
| Pocket 3        | 0 drops                                  |  |  |                        |
| Pocket 4        | 1 drops                                  |  |  |                        |
| Pocket 5        | 1 drops                                  |  |  |                        |
| Pocket 6        | 1 drops                                  |  |  |                        |
| Pocket 7        | 2 drops                                  |  |  |                        |
| Pocket 8        | 2 drops                                  |  |  |                        |
| Pocket 9        | 2 drops                                  |  |  |                        |
| Pocket 10       | 3 drops                                  |  |  |                        |
| Pocket 11       | 3 drops                                  |  |  |                        |
| Pocket 12       | 3 drops                                  |  |  |                        |

Discussion:

Conclusion: