Exercise 36

EXERCISE 36

Phototrophs: Algae and Cyanobacteria

Objectives

After completing this exercise, you should be able to:

1. List criteria used to classify algae.
2. List general requirements for the growth of phototrophic organisms.
3. Compare and contrast algae with fungi and bacteria.

Background

Most freshwater phototrophs belong to the groups listed in Table 36.1. Of primary interest to microbiologists are the **cyanobacteria.** Cyanobacteria have prokaryotic cells and belong to the Domain Bacteria.

Algae is the common name for photosynthetic eukaryotic organisms that lack true roots, stems, and leaves. Algae may be found in the ocean and in freshwater and on moist tree bark and soil. (See Color Plate IV.5.) Algae may be unicellular, colonial, filamentous, or multicellular. They exhibit a wide range of shapes: from the giant brown algae or kelp and delicate marine red algae to spherical green-algal colonies. Algae are identified according to pigments, storage products, the chemical composition of their cell walls, and flagella.

While the growth of phototrophs is essential in providing oxygen and food for other organisms, some filamentous algae, such as *Spirogyra*, are a nuisance to humans because they clog filters in water systems (see Color Plate IV.6). And others, such as *Alexandrium*, produce toxins that are harmful to vertebrates. Phototrophs can be used to determine the quality of water. Polluted waters containing excessive nutrients from sewage or other sources have more cyanobacteria and fewer diatoms than clean waters do. Additionally, the *number* of algal cells indicates water quality. More than 1000 algal cells per milliliter indicates that excessive nutrients are present.

Table 36.1

Some Characteristics of Major Groups of Phototrophs Found in Freshwater

	Bacteria	Algae		
Characteristics	Cyanobacteria	Euglenoids	Diatoms	Green Algae
Color	Blue-green	Green	Yellow-brown	Green
Cell wall	Bacteria-like	Lacking	Readily visible with regular markings	Visible
Cell type	Prokaryote	Eukaryote	Eukaryote	Eukaryote
Flagella	Absent	Present	Absent	Present in some
Cell arrangement	Unicellular or filamentous	Unicellular	Unicellular or colonial	Unicellular, colonial, or filamentous
Nutrition	Autotrophic	Facultatively heterotrophic	Autotrophic	Autotrophic
Produce O_2	Yes	Yes	Yes	Yes

Materials

Pond water samples:

A. Incubated in the light for 4 weeks.
B. Incubated in the dark for 4 weeks.
C. With nitrates and phosphates added; incubated in the light for 4 weeks.
D. With copper sulfate added; incubated in the light for 4 weeks.

Techniques Required

Compound light microscopy, Exercise 1

Hanging-drop procedure, Exercise 2

Procedure

1. Prepare a hanging-drop slide from a sample of pond water A. Take your drop from the bottom of the container. Why? _____
2. Examine the slide using the low and high-dry objectives. Identify the algae present in the pond water. Refer to Color Plate XIII for identification. Draw those algae that you cannot identify. Record the relative amounts of each type of alga from 4+ (most abundant) to + (one representative seen).
3. Repeat the observation and data collection for the remaining pond water samples.

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Phototrophs: Algae and Cyanobacteria

LABORATORY REPORT

NAME _____

DATE _____

LAB SECTION _____

Purpose

_____

_____

_____

Data

Name of Alga or Cyanobacterium	Relative Abundance in Pond Water			
	Incubated in Light	Incubated in Dark	Incubated with NO_3^- and PO_4^{3-}	Incubated with $CuSO_4$
Drawings of other algae seen				
Total number of species				
Total number of organisms				

Which sample is the control? _____

Conclusions

Compare the number and various groups of algae observed in each environment with the control.

Dark (sample B) vs. light (sample A)

In which sample did you expect more algae? _____

Why? _____

_____

_____

Did your findings agree with expected results? If not, briefly explain why. _____

_____

_____

Nitrate and phosphate (sample C) vs. no nitrate and phosphate (sample A)

In which sample did you expect more algae? _____

Why? _____

_____

_____

Did your findings agree with expected results? If not, briefly explain why. _____

_____

_____

Copper (sample D) vs. no copper (sample A)

In which sample did you expect more algae? _____

Why? _____

_____

_____

Did your findings agree with expected results? If not, briefly explain why. _____

_____

_____

Questions

1. Why can algae and cyanobacteria be considered indicators of productivity as well as of pollution?

2. How can algae be responsible for the production of more oxygen than land plants?

3. Why aren't algae included in the Kingdom Plantae?

4. Describe one way in which algae and fungi differ.

   How are they similar?

Critical Thinking

1. Outbreaks of cyanobacterial intoxication associated with lakes and ponds are reported annually. What would cause an increased number of cases in summer months? Why aren't cyanobacterial intoxications associated with swimming pools?

2. Cyanobacteria were once called "blue-green algae." What characteristics would lead to the name "blue-green algae"? What caused biologists to reclassify them as cyanobacteria?