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Algae Identification

FIELD GUIDE

Agriculture and Agri-Food Canada
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Algae Identification **Field Guide**

AN ILLUSTRATIVE FIELD GUIDE ON IDENTIFYING COMMON ALGAE FOUND IN THE CANADIAN PRAIRIES

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Foreword

The algae identification field guide and accompanying lab reference manual were created for agricultural field personnel interested in algae, such as agricultural extension staff, watershed groups and individuals who work with agricultural surface water supplies. Algae listed in this guide and manual are not organized according to their evolutionary relationship (i.e. taxonomically) as with most traditional classification keys, but are presented based on common situations or issues that are significant to our target audience. Algae are also classified into four main groups (Palmer 1962): Blue-Greens, Greens, Diatoms and Flagellates. Information on these algal groups are found in the Algae Identification Lab Guide.

The objective of the guide and manual is to provide a starting point in identifying the most common or easily identifiable algal genera typically found in lakes, dugouts, wetlands and other freshwater lentic systems that are significant to our target audience. This starting point for algae identification is outlined as a two-step approach:

A. In the field, where depending on the situation, using the three senses of sight, smell and touch will help give the user a primary assessment of which algal group or genera the algae might belong to; and

B. In the lab, where the identification of algae is validated using a compound microscope. Since there exists many diverse species within each genus of algae and many looking very similar macroscopically, verification of algae must be done using a microscope.

Provided is a two part document on algae identification: the Algae Identification Field Guide (Part A) and Algae Identification Lab Reference Manual (Part B). As well, the field guide is available as a program tool compatible with ESRI's GIS program ArcPAD, and is found attached to this guide as a CD-ROM. This program tool improves the efficiency of algae identification and data collection than can otherwise be done with paper-based field guides and data collection forms, as well as provides a way in which each sample can be plotted spatially for future reference.

Table of Contents

Introduction

What are algae?

They are organisms with a mixed evolutionary history that have four main commonalities:

1. They are very simple organisms with no vascular tissue. The only exception are brown algae where they have a higher degree of organ differentiation.
2. They have naked reproductive structures, i.e. there is no protective layer of cells around reproductive structures.
3. They are photoautotrophic, i.e. they produce their own food materials through photo synthesis by using sunlight, water and CO_2. There are some exceptions, such as some species of *Euglena*, where they ingest other organisms for food because they do not have any chloroplasts.
4. Similar to plants, they contain chlorophyll. However, not all algae are classified as plants.

Where are they found?

Algae commonly grow in any habitat where water or moisture is found. Habitats include fresh and salt water bodies, hot springs, ice, air, and in or on other organisms and substrate. In the Canadian Prairies, they are more common in summer than winter.

They are also found in communities, living with many other different species of algae, plankton and zooplankton. These communities can tell you a lot about the health of the ecosystem. For example, a community of *Euglena, Scenedesmus* and *Selenastrum* likely indicates a eutrophic water body.

Why study algae?

Algae are important indicators of ecosystem health and integrity because they form the base of most aquatic food chains. Virtually all aquatic animals are dependent on this primary producer. Algae are also an excellent indicator of water quality, as their abundance and community composition most often reflects (and has the capacity to affect) the chemical properties of water such as pH and nutrient levels.

Their ability to grow in large quantities can lead to dramatic changes in the appearance, taste and odour of water, and can negatively affect organisms in higher trophic levels (e.g. fish kills). Algae also can interfere with general water use and distribution, impairing water pumps, filters, pipes, animal troughs and misters, boilers and cooling equipment. For prairie water sources, algae can pose unique challenges for a variety of water uses because of the common and prolific growth cycles of algae during the open water season.

Knowledge about algae can provide valuable insights into water quality, indicating concerns such as pollution to waterways, reduction in water flow, or a health and safety risk, as some algal species are highly toxic to humans and livestock. Of significant concern for water users is Cyanobacteria (sometimes referred to as “blue-green algae”). Cyanobacteria is actually a bacteria that may produce lethal neurotoxins (brain toxin) or hepatotoxins (liver toxin), which can cause serious illness or death in humans and animals if the toxins are ingested.

It is important to note that while algae tend to be the most notable problem or issue in an aquatic ecosystem, other planktonic biota or organisms, including zooplankton and macro-organisms (both plants and animals), can also affect the physical, chemical and biotic properties of a water body. These factors should be taken into account when studying the aquatic ecosystem as a whole.

The starting point

1

Step One.

Which type of situation are you dealing with?

A. A surface water bloom
Go to page 12

B. Algae interfering with coagulation
Go to page 26

C. Attached algae and algae mats found near shore
Go to page 28

D. Potentially threatening freshwater algae
Go to page 30

2

Step Two.

Once you have matched your alga to a close description, there is a page number beside the algal name. This page number is makes reference to the *Algae Identification Lab Guide* where you can find more information about the alga and its characteristics under the microscope. For example, "*Cladophora*, pg 28" indicates that your alga may be from the genus *Cladophora* and "pg 28" refers you to page 28 of the *Algae Identification Lab Guide* where you can find more information about this genus.

If you can not successfully match your alga to any of the algae descriptions, it is likely that your alga may not be listed in this guide.

3

Step Three.

To validate your algae identification, collect a sample that can be brought back to the lab and examined under a compound microscope.

Legend

- **BG** — Blue Green (cyanobacteria)
- **GR** — Green Algae
- **DM** — Diatoms
- **FL** — Flagellates

Surface Bloom-forming Algae

Algae found in abundance near the surface of the water where light is present.

To ensure the best possible algal match or matches, read all questions under each category before selecting a genus or page number.

Is the algae:

1. Filamentous*?

A. Does it have a septic odour and net-like appearance?
Hydrodictyon Pg 14

B. When squeezed, does it look like cotton?
Cladophora Pg 14

C. Does it feel silky or slippery?
Spirogyra Pg 15

D. Is it abundant near shore and leaves behind dried masses of algal paper?
Oedogonium Pg 15

E. Also see “Attached algae and algal mats” Pg 28

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2. Planktonic*?

A. Is it like pea-soup? And/or has a pigpen odour?
Anabaena, Microcystis, Aphanizomenon Pg 16-17

B. Is it spherical or globular?
Gloeotrichia, Volvox, Nostoc Pg 18

C. Does it have a grassy odour?
Green algae, Ankistrodesmus Pg 19

D. Is the bloom throughout the water column? And deep green or green-black?
Oscillatoria, Pediastrum, Ankistrodesmus Pg 19-20

E. Does it look like grass clippings?
Aphanizomenon Pg 20

F. Does it look like bright green foam?
Euglena Pg 20

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3. Jelly ball or aquatic plant-like?

A. Are they small, disc-like, bright green and have small roots on their undersides?
Duckweed Pg 21

B. Are they large, jelly-like balls?
Nostoc Pg 21

C. Is it plant-like, has whorled branches and smells of garlic or skunk?
Chara Pg 22

4. Too small to see individuals or colonies? And the water is cloudy or coloured?

A. Does it smell like geraniums or ripe cucumber? Musty or fishy?
Asterionella, Synura, Dinobryon, Synedra Pg 23

B. Also see Question #2, as the algae might be at different stage of development

C. No smell, but the water is coloured reddish brown? Pg 25

D. Common bloomers Pg 24
Bright green foam - *Euglena*
Fishy smell and green water - *Chlamydomonas*
"Clean water" and clogged filter - *Cyclotella*

E. Other possibilities (no distinguishable field cues)
Scenedesmus, Closterium, Spirulina Pg 25

Planktonic or Filamentous Finger Test

Wearing gloves, scoop a handful of whatever is blooming in the water with fingers spread slightly apart. Let the water drain and examine what remains. If long, stringy masses are left dangling from the fingers, it is a filamentous form. If mostly everything drains through the fingers and only a few bits stick to the glove, then it is a planktonic form.

FILAMENTOUS

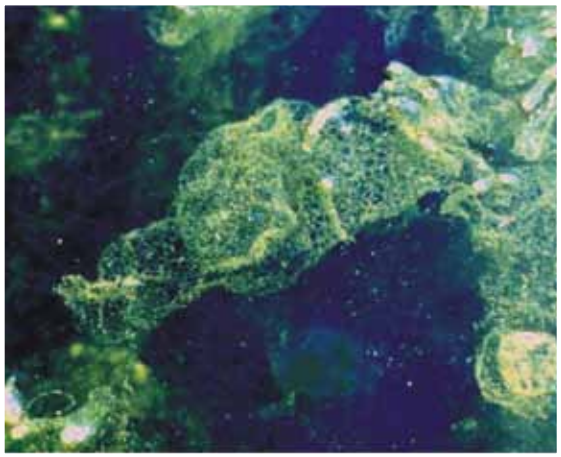
PLANKTONIC

Filamentous Blooms

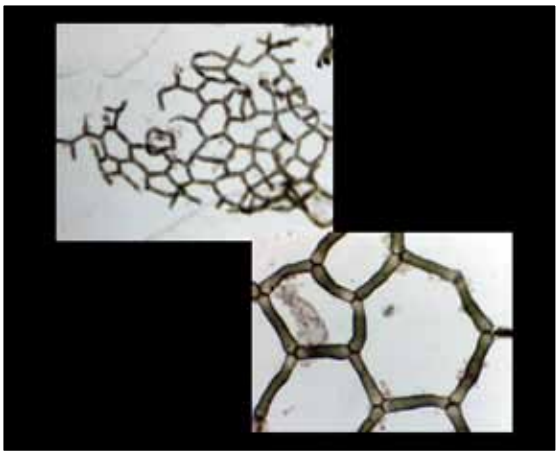
Stringy algal mats

Does it have a septic odour and net-like appearance?

▸ HYDRODICTYON pg 25 GR



In situ: D.M. John, York et al. (2002)



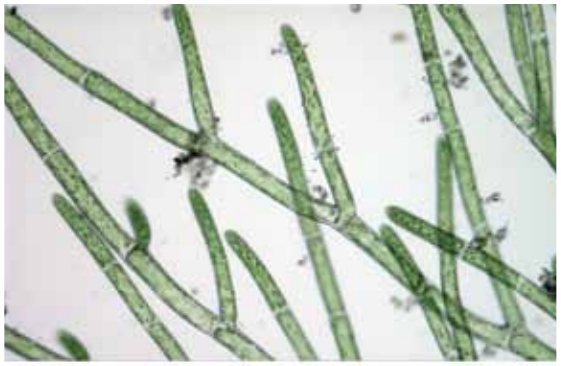
Microscale: M. Vis, Ohio University (2002)

The common name is “water net”. It can be found growing in hard water lakes and ponds. This genus is very susceptible to copper treatment.

When squeezed, does it look like cotton?
Colour also varies from green, yellow-brown to orange.

▸ CLADOPHORA pg 29 GR

In situ: W. Bourland, micro*scope (2006)



Microscale: W. Bourland, micro*scope (2006)

It is commonly found attached to rocks or substrates but can be detached by wave action. It is most often associated with streams, rivers and waterfalls. Septic odour can be present when abundant from the decomposition of the mat.

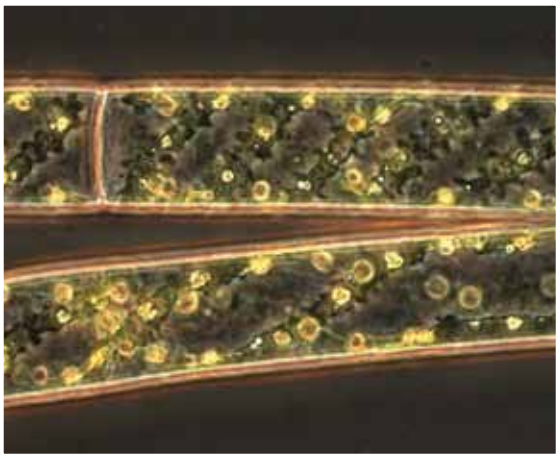
Filamentous Blooms

Stringy algal mats

Is it very silky or slippery?

▸ SPIROGYRA pg 30 GR

In situ: J. Jamieson, York et al. (2002)



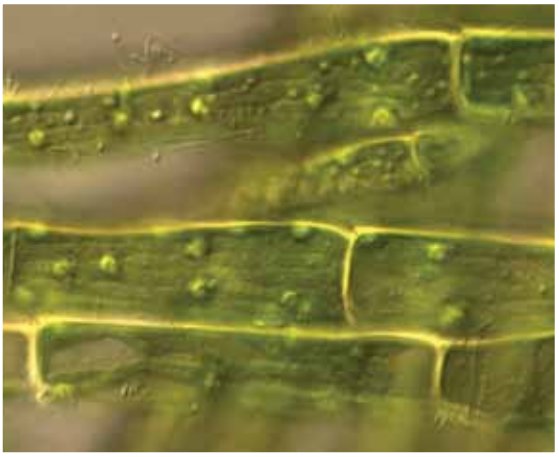
Microscale: Australian Biological Resources Study, micro*scope (2006)

It is most likely a 'frog-spit' algae from the Order Zygnematales because of its silky/slippery qualities. A common genus from this Order is *Spirogyra*, also known as water silk or pond scum.

Is it abundant near the shore and leaves behind dried masses of 'algal paper'?

▸ OEDOGONIUM pg 28 GR

In situ: D. Patterson, micro*scope (2006)



Microscale: D. Patterson, micro*scope (2006)

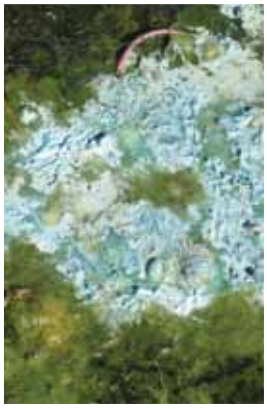
When scooped up, it adheres to your hand rather than slipping through your fingers like *Spirogyra* (above). This genus is very susceptible to copper treatment.

Planktonic Blooms

Dispersed in water and unattached to solid objects

Is it like pea-soup? And/or has a pigpen odour? *Anabaena* and *Microcystis* require a microscope to view colonies, but are often distinguished by their pea-soup conditions. *Aphanizomenon* can often be identified macroscopically.

ANABAENA pg 15 BG



In situ: S. Murrell

Microscale (M. Graham and S. Murrell)

This blue-green is capable of producing anatoxin, microcystin, or both. Blooms of some species of *Anabaena* can cause death in pets, livestock and wildlife. It is prevalent in phosphorus-rich water.

APHANIZOMENON pg 18 BG

In situ: N. Serediak

In situ: E. Zoski

Microscale: W. Bourland, micro*scope (2006)

The most easily recognized blue-green. Colonies form a distinctive shape that resembles tiny grass or green fingernail clippings. They are roughly 0.5 to 1.0cm long.

Some species are capable of producing a neurotoxin called saxitoxin, similar to the paralytic shellfish poisin that occur in marine environments. In North American freshwater environments, *Aphanizomenon* appears to be primarily non-toxic, although it can cause skin irritation to recreational water users.

Planktonic Blooms

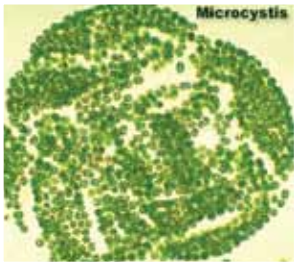
Dispersed in water and unattached to solid objects

Is it like pea-soup? And/or has a pigpen odour? Continued....

▸ MICROCYSTIS pg 10 BG

In situ (R. Zurawell)

Microscale: D. Krogmann and M. Schneegurt, Cyanosite (2006)



In situ: P.V. York, York et al. (2002)

Blooms appear to be very similar to *Anabaena* blooms. *Microcystis* is found throughout the water column because they have gas vesicles that allow the colonies to regulate buoyancy.

Some species are capable of producing *microcystin*, a hepatotoxin (liver toxin) lethal to pets, livestock and humans. They may cause skin irritation for recreational water users.

Planktonic Blooms

Dispersed in water and unattached to solid objects

Is it spherical or globular?
And has a soft mucilage that is yellow-brown to light green, and slimy to touch?

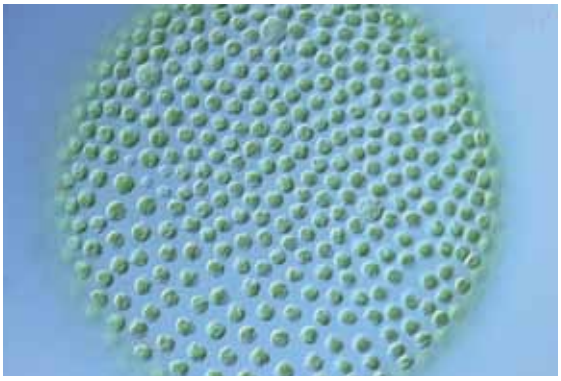
▸ GLOEOTRICHIA pg 17 BG

Microscale : P York, York et al (2002).

Heavy blooms may cause serious skin irritations to recreational water users. When mature, colonies are visible to the naked eye and look like tiny fish eyes, tapioca beads or pom poms.

In situ photo not available.

▸ VOLVOX pg 20 GR



Microscale: D. Patterson and M. Farmer micro*scope (2006)

Blooms are infrequent but will occur over short periods during warm months, especially in waters contaminated with nitrogenous wastes or organically enriched water.

Spherical colonies at their largest are visible to the naked eye and can reach about 1mm in diameter. They are usually yellowish-brown to light green.

In situ photo not available.

▸ NOSTOC pg 16 BG

In situ (N. Serediak)

Nostoc is the most readily identified blue green in the field and sometimes called “freshwater grapes”. The colonies are in a jelly-like ball, which are usually surrounded by thick mucilage. Some species are capable of producing cyanotoxins.

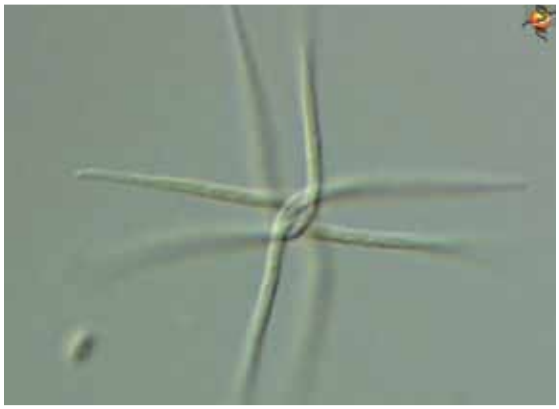
It can be macroscopic in size and grow up to a few centimeters in diameter. Colour of the mucilage ranges from yellow-clear to blue-olive green.

Planktonic Blooms

Dispersed in water and unattached to solid objects

Does it have a grassy odour? (Like freshly cut grass)

▸ ANKISTRODESMUS pg 22 GR



Microscale: M Bahr and D Patterson, micro*scope (2006)

Grassy odour is the most common odour produced by green algae (not during decomposition). The smell is apparent only when present in large numbers. Common green algae are *Chlorella* (Lab Guide pg 23 and *Ankistrodesmus*.

Presence of *Ankistrodesmus* is a good indicator of clean water, since they tend to disappear from the algal community in very polluted systems.

In situ photo not available.

Is the bloom throughout the water column? And deep green or green-black?

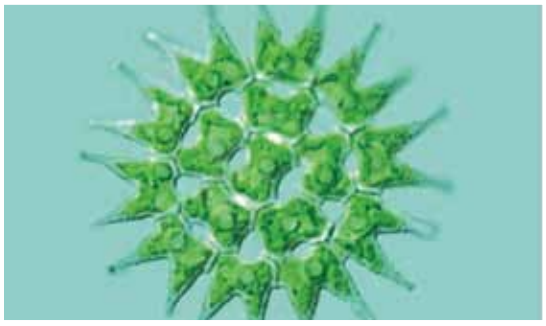
▸ OSCILLATORIA pg 13 BG

In situ: D. Krogmann and M. Schneegurt, Cyanosite (2006)

B Anderson and D Patterson, micro*scope (2006)

It is a blue-green that can produce *microcystin* (hepatotoxin) and anatoxin-a (neurotoxin)

▸ PEDIASTRUM pg 26 GR



Microscale: D. Patterson and M. Farmer, micro*scope (2006)

Blooms are throughout the water column and thus do not result in surface scums. It is common in moderately nutrient-enriched water bodies. Also see *Ankistrodesmus* (above).

In situ photo not available.

Planktonic Blooms

Dispersed in water and unattached to solid objects

Does it look like grass clippings?

▸ APHANIZOMENON pg 18 BG

In situ: N Serediak

In situ, E Zoski

Microscale: W. Bourland, micro*scope (2006)

The most easily recognized blue-green. Colonies form a distinctive shape that resembles tiny grass or green fingernail clippings. They are roughly 0.5 to 1.0cm long.

Some species are capable of producing a neurotoxin called saxitoxin, similar to the paralytic shellfish poisin that occur in marine environments. In North American freshwater environments, *Aphanizomenon* appears to be primarily non-toxic, although it can cause skin irritation to recreational water users.

Does it look like bright green foam or a thin film of scum?

▸ EUGLENA pg 36 FL

In situ (R. Zurawell)

In situ (S. Reedyk)

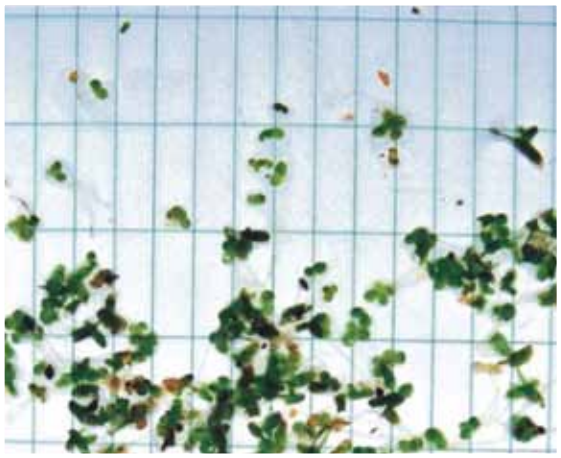
Microscale: D. Patterson and M. Farmer, micro*scope (2006)

Euglena is mostly found in freshwater habitats that are polluted by organic matter. E*uglena* blooms can also be red and exhibit a foam-like appearance in full bloom.

Other

Are they small, disc-like, bright green and have small roots on their undersides?
It is most likely not algae.

▸ DUCKWEED pg 39

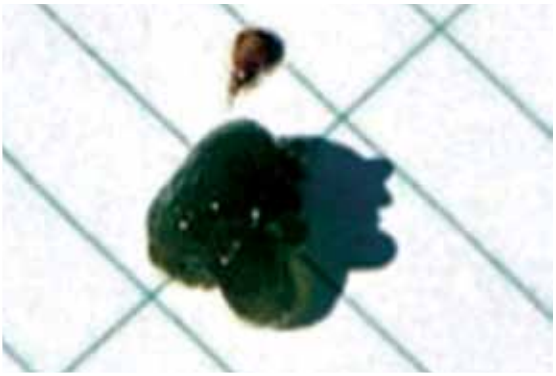


In situ (N. Serediak)

Duckweed is often referred to as algae, but it is an aquatic plant. Individuals are typically 2-5cm long and by looking at the undersides, you can see short hair-like roots.

Are they large, jelly-like balls?

▸ NOSTOC pg 16 BG



Nostoc is the most readily identified blue green in the field and sometimes called “freshwater grapes”. The colonies are in a jelly-like ball, which are usually surrounded by thick mucilage. Some species are capable of producing cyanotoxins.

It can be macroscopic in size and grow up to a few centimeters in diameter. Colour of the mucilage ranges from yellow-clear to blue-olive green.

In situ (N. Serediak)

Also see:

Volvox and ***Gloeotrichia***
go to page 18

Other

Is it plant-like, has whorled branches and smells of garlic or skunk?

▸ CHARA pg 32 GR

In situ: N.F. Stewart, York et al. (2002)

Chara is also known as “stonewort”. It has a plant-like appearance and can grow several decimeters tall. It is easily recognized by their musky or garlicky odour.

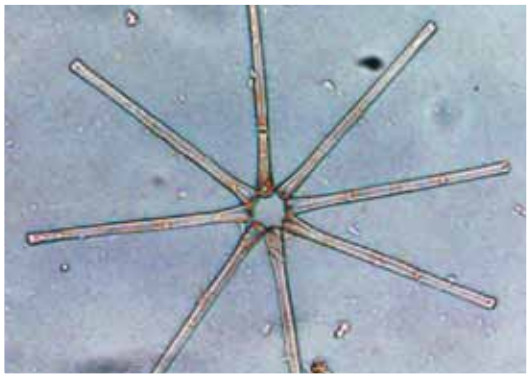
Chara is abundant in hard, basic water (ph>7), where calcium is abundant.

Too small for the naked eye

Water appears cloudy or coloured. Also see Planktonic Blooms on pages 16-20.

Does it smell like Geraniums? Musty? Ripe cucumber? Or fishy?

ASTERIONELLA pg 33 DM



Microscale: M.Vis, Ohio University (2002)

Abundant in hard water lakes and known to clog filters. Geranium odour is present in low to moderate numbers; but changes to fishy in high numbers.

In situ photo not available.

SYNURA pg 37 FL

Microscale: W. Bourland, micro*scope (2006)

Common in hard water lakes. Exhibits a ripe cucumber/musk melon smell in low to moderate numbers; but fishy in high abundance.

In situ photo not available.

DINOBRYON pg 38 FL

Microscale: W. Bourland, micro*scope (2006)

Commonly bloom in summer in basic eutrophic bodies and exhibits a fishy odour. Also known to clog filters.

In situ photo not available.

SYNEDRA pg 39 DM

Microscale: M.Vis, Ohio University (2002)

In moderate to high abundance, Synedra has an earthy to musty odour. Well-known to clog filters because of its rigid walls.

In situ photo not available.

Too small for the naked eye

Water appears cloudy or coloured. Also see Planktonic Blooms on pages 16-20.

Easily identified algae using a microscope. Common bloomers.

▸ EUGLENA pg 36 FL

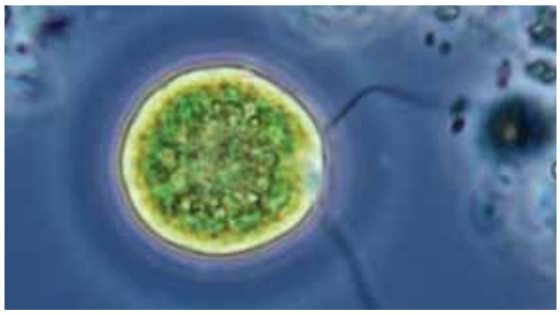
In situ (R. Zurawell)

In situ (S. Reedyk)

Microscale: D. Patterson and M. Farmer, micro*scope (2006

Euglena is mostly found in freshwater habitats that are polluted by organic matter. *Euglena* blooms can also be red and exhibit a foam-like appearance in full bloom.

▸ CHLAMYDOMONAS pg 19

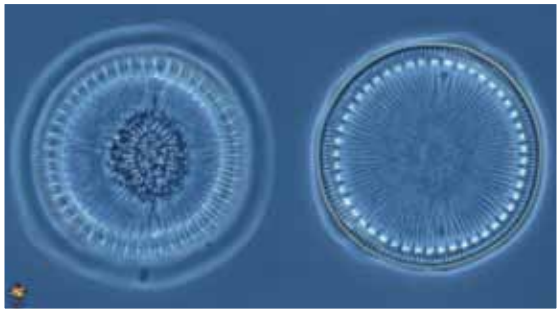


Microscale: D. Patterson and A. Laderman, micro*scope (2006)

Chlamydomonas is found in a variety of habitats, even snow in the high alpine! It exhibits a fishy smell in high numbers, and often colours the water green.

In situ photo not available.

▸ CYCLOTELLA pg 35



Microscale: M. Bahr and D. Patterson, micro*scope (2006)

Cyclotella is a common bloomer of the diatoms. It is a well known filter clogger and often found in ‘clean’ water..

In situ photo not available.

Too small for the naked eye

Water appears cloudy or coloured. Also see Planktonic Blooms on pages 16-20.

Easily identified algae using a microscope.
Algae commonly found in the plankton community.

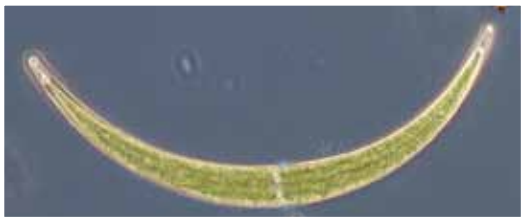
▸ SCENEDESMUS pg 24 GR

Blooms can colour the water a lovely shade of green. It is common in freshwater aquaria and is a typical member of the open water plankton community.

In situ photo not available.

Microscale: L.A. Zettler and D. Patterson, micro*scope (2006)

▸ CLOSTERIUM pg 31 GR



Closterium is common in acid waters, while only a few species are found in nutrient rich hard waters. It is generally found mixed with other species of green algae.

In situ photo not available.

Microscale: D. Patterson and A. Laderman, micro*scope (2006)

▸ SPIRULINA pg 14 BG

Microscale: D. Patterson, L.A. Zettler and V. Edgecomb, micro*scope (2006)

Spirulina does not produce intense blooms or toxins. It is commonly marketed by health food producers as a general curative. In situ photo not available.

No smell? But the water is reddish-brown?

It could likely be that the water is high in dissolved organic carbon- dissolved compounds from organic material. Leached tannins and lignins from decomposing plant matter can create tea-coloured water.

Another possibility is that the water may be high in iron, or polluted with other chemical compounds.

In situ: M. Huynh

Algae interfering
with coagulation

▸ EUGLENA pg 36 FL

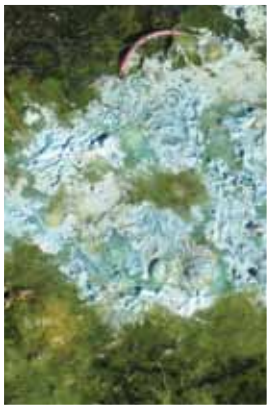
In situ (R. Zurawell)

In situ (S. Reedyk)

Microscale:
D. Patterson
and M. Farmer,
micro*scope (2006

Euglena is mostly found in freshwater habitats that are polluted by organic matter. *Euglena* blooms can also be red and exhibit a foam-like appearance in full bloom.

▸ ANABAENA pg 15 BG



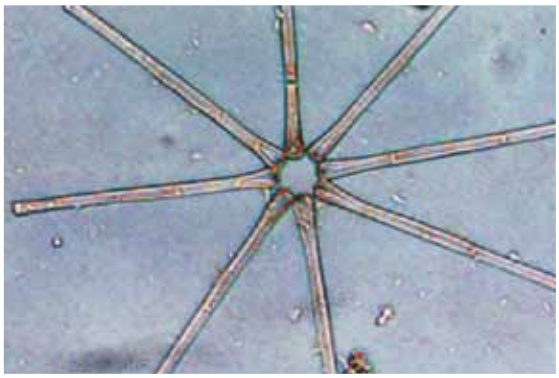
In situ: S. Murrell

Microscale (M. Graham and S. Murrell)

This blue-green is capable of producing anatoxin, microcystin, or both. Blooms of some species of *Anabaena* can cause death in pets, livestock and wildlife. It is prevalent in phosphorus-rich water.

Algae interfering
with coagulation

▸ ASTERIONELLA pg 33 DM



Microscale: M.Vis, Ohio University (2002)

Abundant in hard water lakes and known to clog filters. Geranium odour is present in low to moderate numbers; but changes to fishy in high numbers.

In situ photo not available.

▸ SYNEDRA pg 34 DM

Microscale: M.Vis, Ohio University (2002)

In moderate to high abundance, *Synedra* has an earthy to musty odour. Well-known to clog filters because of its rigid walls.

In situ photo not available.

FYI:
Relative toxicity to *copper sulphate**

Susceptible
Anabaena, Microcyctis, Aphanizomenon, Oscillatoria, Closterium, Hydrodictyon, Spirogyra, Cladophora, Asterionella, Synedra, Dinobryon, Synura, Volvox, Euglena

Resistant
Nostoc, Chlorella, Chara, Stigeoclonium, Ankistrodesmus, Scenedesmus, Chlamydomonas

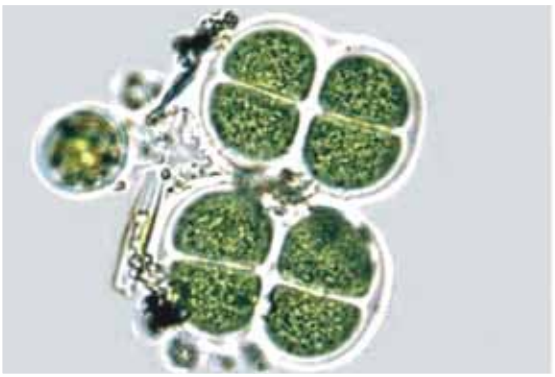
*See Recommended Reading Material "Algal treatment and removal" on page 37 at the back of this guide.

Attached algae

and algal mats commonly found near shore

Mucilaginous and slimy film or tube on the substrate?

▸ CHROOCOCCUS pg 11 BG

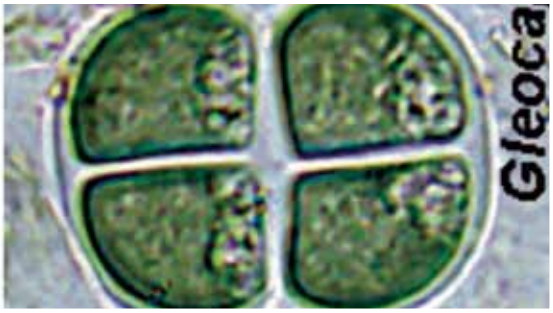


Microscale: B.A. Whitton, York et al. (2002)

Chroococcus is found attached to rocks or soil in or near water and has a colourless mucilaginous sheath.

In situ photo not available.

▸ GLOEOCAPSA pg 12 BG



Microscale: M. Vis, Ohio University (2002

A subaerial genus that forms red, brown or orange jelly globs on substrates in or near water.

In situ photo not available.

▸ TETRASPORA pg 21 GR

In situ- collapsed tube: P.V. York, York et al. (2002)

Colonies are in a soft, fragile, mucilaginous common tube or sac, which can be found attached to aquatic plants.

In situ photo not available.

Attached algae

and algal mats commonly found near shore

Floating mats or filamentous?

▸ STIGEOCLONIUM pg 27 GR

In situ: P.V. York, York et al. (2002)

Microscale: P.V. York, York et al. (2002)

It is a distinctly bright green alga often attached to rocks in fast-flowing water. It is also a filamentous mat that will not pass though open fingers of a cupped hand.

Also see:

Cladophora
go to page 14

Chara
go to page 22

Oedogonium
go to page 15

Spirogyra
go to page 15

BG

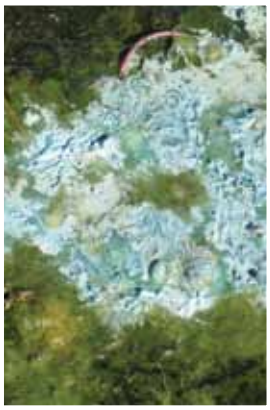
Common blue-greens not listed in this manual that also form dense mats include: *Phormidium*, *Lyngbya*, *Tolypothrix* and *Stigonema*.

Potentially threatening freshwater algae

Listed below are common blue-greens known to cause low to serious risk to human health.
Only certain species of the genera below are toxic. Microscopic work or lab testing is required.

Is it like pea soup? And/or has a pigpen odour? A pigpen odour is usually associated with *Anabaena, Microcystis* and *Aphanizomenon*.

ANABAENA pg 15 BG

In situ: S. Murrell

Microscale (M. Grahamand S. Murrell)

This blue-green is capable of producing *anatoxin*, *microcystin*, or both. Blooms of some species of *Anabaena* can cause death in pets, livestock and wildlife. It is prevalent in phosphorus-rich water.

APHANIZOMENON pg 18 BG



In situ: N. Serediak

In situ: E. Zoski.

Microscale: W. Bourland, micro*scope (2006)

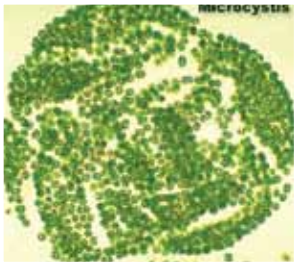
The most easily recognized blue-green. Colonies form a distinctive shape that resembles tiny grass or green fingernail clippings. They are roughly 0.5 to 1.0cm long.

Some species are capable of producing a neurotoxin called saxitoxin, similar to the paralytic shellfish poisin that occur in marine environments. In North American freshwater environments, *Aphanizomenon* appears to be primarily non-toxic, although it can cause skin irritation to recreational water users.

▸ MICROCYSTIS pg 10 BG

In situ (R. Zurawell)

In situ: P.V. York, York et al. (2002)



Microscale: D. Krogmann and M. Schneegurt, Cyanosite (2006)

Blooms appear to be very similar to *Anabaena* blooms. *Microcystis* is found throughout the water column because they have gas vesicles that allow the colonies to regulate buoyancy.

Some species are capable of producing *microcystin*, a hepatotoxin (liver toxin) lethal to pets, livestock and humans. They may cause skin irritation for recreational water users.

Glossary of Terms

Algae - a group of organisms with mixed evolutionary history that share common characteristics. The most notable being that they have no vascular tissue (with some exceptions), have naked reproductive structures, are photoautotrophic, and contain chlorophyll (with some exceptions).

Chloroplast - pigmented structure (organelle) within the cell that conducts photosynthesis.

Coagulation - a chemical process that can reduce turbidity, dissolved organic compounds, and colour (AAFRD 2002).

Epiphytic/epiphyte - an organism attached to substrate or another organism.

Filamentous algae - long, multicellular threadlike filaments or masses of algae.

Hepatotoxin - a toxin that affects liver function, such as microcystin.

Lentic - standing water such as wetlands, dugouts, reservoirs and lakes. Antonym: lotic.

Neurotoxin - a toxin that affects brain function, such as anatoxin and saxitoxin.

Photoautotrophic - the ability to make food materials through photosynthesis by using sunlight, water and CO2. Synonym: photosynthetic.

Planktonic algae - single-celled organisms or aggregations of single-celled algae that live near the water surface.

Surface bloom-forming algae - algae found in abundance near the surface of the water where light is present.

Photo credits

Plantonic/Filamentous (page 7): N. Serediak.

Microcystis: (in situ) R. Zurawell; (microscopic photo) D. Krogmann and M. Schneegurt. 2006. Cyanosite. <http://www-cyanosite.bio.purdue.edu>; (Algae in container) P.V. York in York et al. (2002).

Anabaena: (in situ) S. Murrell; (microscopic photo) M. Graham and S. Murrell.

Aphanizomenon: (microscopic photo) W. Bourland. 2006. Micro*scope. <http://starcentral.mbl.edu/microscope/portal.php>; (In situ) N.Serediak.

Oscillatoria: (In situ) D. Krogmann and M. Schneegurt. 2006. Cyanosite. <http://www-cyanosite.bio.purdue.edu>; (microscopic photo) B. Anderson and D. Patterson. 2006. Micro*scope. <http://starcentral.mbl.edu/microscope/portal.php>.

Gloeotrichia: P. York in York et al. (2002).

Nostoc: N. Serediak.

Gloeocapsa: M. Vis. 2002. Ohio University. Algae homepage. <http://vis-pc.plantbio.ohiou.edu/algaeindex.htm>.

Chroococcus: B. Whitton in York et al. (2002).

Tetraspora: P.V. York in York et al. (2002).

Ankistrodesmus: M. Bahr and D. Patterson. 2006. Micro*scope. <http://starcentral.mbl.edu/microscope/portal.php>.

Volvox: D. Patterson and M. Farmer. 2006. Micro*scope. <http://starcentral.mbl.edu/microscope/portal.php>.

Closterium: D. Patterson and A. Laderman. 2006. Micro*scope. <http://starcentral.mbl.edu/microscope/portal.php>.

Spirogyra: (in situ) J. Jamieson in York et al. (2002); (microscopic photo) Australian Biological Resources Study. 2006. Micro*scope. <http://starcentral.mbl.edu/microscope/portal.php>.

Oedogonium: (in situ and microscopic photo) D. Patterson. 2006. Micro*scope. <http://starcentral.mbl.edu/microscope/portal.php>.

Hydrodictyon: (in situ) D.M. John in York et al. (2002); (microscopic photo) M. Vis. 2002. Ohio University. Algae homepage. <http://vis-pc.plantbio.ohiou.edu/algaeindex.htm>.

Stigeoclonium: P.V. York in York et al. (2002).

Cladophora: (in situ and microscopic photo) W. Bourland. 2006. Micro*scope. <http://starcentral.mbl.edu/microscope/portal.php>.

Chara: N.F. Stewart in York et al. (2002).

Chlamydomonas: D. Patterson and A. Laderman. 2006. Micro*scope. <http://starcentral.mbl.edu/microscope/portal.php>.

Synedra: M. Vis. 2002. Ohio University. Algae homepage. < http://vis-pc.plantbio.ohiou.edu/algaeindex.htm>.

Cyclotella: M. Bahr and D. Patterson. 2006. Micro*scope. <http://starcentral.mbl.edu/microscope/portal.php>.

Pediastrum: D. Patterson and M. Farmer. 2006. Micro*scope. <http://starcentral.mbl.edu/microscope/portal.php>.

Scenedesmus: L.A. Zettler and D. Patterson. 2006. Micro*scope. <http://starcentral.mbl.edu/microscope/portal.php>.

Dinobryon: W. Bourland. 2006. Micro*scope. <http://starcentral.mbl.edu/microscope/portal.php>.

Synura: W. Bourland. 2006. Micro*scope. <http://starcentral.mbl.edu/microscope/portal.php>.

Euglena: (in situ) R. Zurawell; (microscopic photo) D. Patterson and M. Farmer. 2006. Micro*scope.<http://starcentral.mbl.edu/microscope/portal.php>.

Duckweed: N. Serediak.

Asterionella: M. Vis. 2002. Ohio University. Algae Homepage. <http://starcentral.mbl.edu/microscope/portal.php>.

Spirulina: D. Patterson, L.A. Zettler and V. Edgecomb. 2006. Micro*scope. <http://starcentral.mbl.edu/microscope/portal.php>.

Colored water (page 19): M. Huynh

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