Diatoms

Diatoms are commonly brownish to a yellowing/golden brown in color microscopic, single-celled, or colonial plant-like organisms, whose cell walls are composed of silicon dioxide (silica) in normal water quality. They are common to oceans, rivers, lakes, streams, estuaries, puddles, on wet rocks, in various soils. There are more than 200 genera of this organism. They consist of chlorophyll A, chlorophyll C, and carotenoid fucoxanthin that occurs in plastids. They produce food by photosynthesis, and are great suppliers of oxygen.

Diatoms undergo asexual reproduction as they reproduce by cell division. They becomes smaller with each round of replication. Very small species may follow a sexual mode of reproduction, which allows the growth of a relatively large zygote. Different species of this organism prefer different temperatures.

Cyanobacteria (AKA Cyano)

Cyano is an algae-bacteria symbiont where algae uses photosynthesis to produce energy for itself and the bacteria are known as bacteria (prokaryotes).

The symbiont typically develops when water quality is low which includes high levels of Nitrogen and

Phosphorous.

One criteria to distinguish cyanobacteria from true algae is that prokaryotes lack a whole bunch of organelles present in algae, plants and animals (eukaryotes). For example: they

don't have a Golgi apparatus!

Cyanobacteria:

- Are known to float up and down in the water column, meaning it seeks the best habitat
- Are known to produce a toxin as it dies and release the toxin

Lyngbya - hubpages.com

- Is predominately a fresh water species
- Can appear in shades of red, pink, green and blue.
- The symbiont can appear to be a red powder forming on top of a substrate or structures Once established it will appear as a slimy structure commonly forming filaments.
- Even though Cyanobacteria, technically isn't an algae, however, it still requires the basic requirements of an algae in terms of nutrients and light.

platinumlakemanagement.com

CyanoHABs can negatively impact.... increased turbidity that shades macrophytes or causes physical smothering, production of foul-tasting and -smelling compounds, extensive deoxygenation that can cause anoxic zones and fish kills, and the release of potent cyanotoxins linked to a variety of human health and environmental consequences (Paerl 1988; Puddick et al. 2014). There are upwards of 15 genera of cyanobacteria capable of producing cyanotoxins (Table 1). ....toxins, by standard laboratory methods outside of bloom conditions (Nienaber and Steinitz-Kannan 2018).

https://erdc-library.erdc.dren.mil/jspui/bitstream/11681/41680/1/ERDC-EL SR-21-3.pdf

Benthic (bottom dwelling) Lyngbyo Cyanobacteria

Algae in Water Supplies: An Illustrated Manual on the Identification, Significance, and Control of Algae in Water

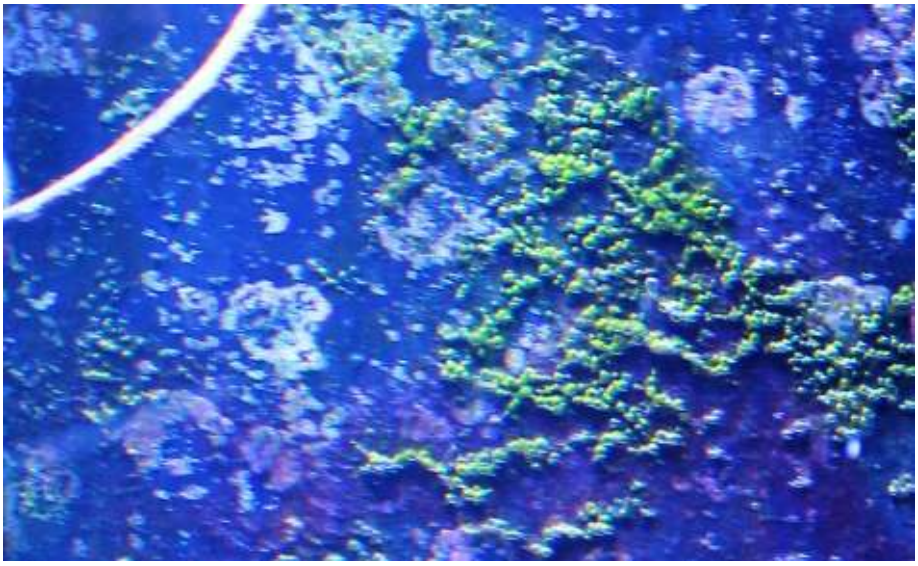
Where to get: Supplies - https://digital.library.unt.edu/explore/partners/UNTGD/
Title: Public Health Service Publication Number 657
By: U.S. Dept. of Health, Education, and Welfare, Public Health Service, Bureau of State Services, Division of Water Pollution Control, **Place of Publication:** Cincinnati, Ohio
Created 1959, Updated May 11 2018

Quick Reference Guide
Different algae species overgrowing corals:
Lyngbya majuscula on Echinopora lamellosa (a)
Caulerpa peltata on live Acropora formosa (b)
Codium fragile overgrowing on Acropora hyacinthus (c)
Caulerpa serrulata growing on Porites lutea (d)
Caulerpa taxifolia on Montipora digitata (e)
Caulerpa sertularioides on growth on Porites solida (f)
C. racemosa on M. digitata (g)
P. solida (h)
Halimeda opuntia on P. lutea (i)
Red filamentous cyanobacterium Moorea sp. on A. formosa (j)
Turbinaria species on Porites sp. (k)
Portieria hornemannii on Acropora coral (l)
Asparagopsis taxiformis (m)
Lobophora variegate overgrowing live and dead A. Formosa (n)
Padina boergesenii bloom on dead Acropora reef (o)

Attribution:
ResearchGate - https://www.researchgate.net/figure/Different-species-of-algae-overgrowing-on-corals-Lyngbya-majuscula-on-Echinopora_fig5_333793732

Dinoflangellates

Is among the hardest marine nuisance algae to correctly identify as a group of unicellular protists (creature not identifie as an animal, plant, or fungus).



Can be identified using a light microscope and are commonly recognized by their golden-brown cell content (plastids), with indented waist, distinctive swimming pattern, and relatively large nucleus.

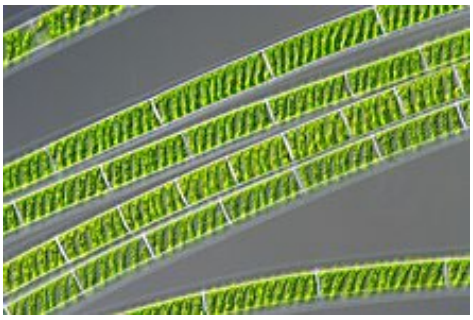
Best known to the public as the source of red tide
Range in color from dark brown, to light green, to colorless
General appearance - like stringy "snot" and may have a bubble like surface

Best way to manage Flowing water or high turnover rates can reduce this toxic algae.
To control toxins, use activated carbon to adsorb the toxins, not algae.
Grows on any surface as a greenish material…. pictured is Dinoflangellates.

Hair Algae

Hair Algae is one of the more common problem algae. It is easy to recognize because it starts to look like a few short and fine little light green to dark green hairs. It has a habit of fast growth. As it spreads, the algal filaments form a thick carpet and grow long until it looks like tuffs of grass. It commonly grows on rocks and other exposed surfaces. To discourage or eliminate Hair Algae, reduce the phosphate and nitrate micronutrients and other sources of human pollution.

Spyrogyra https://en.wikipedia.org/wiki/Spirogyra



(common names include **water silk**, **mermaid's tresses**, and **blanket weed**) is a filamentous charophytegreen alga of the order Zygnematales, named for the helicalor spiral arrangement of the chloroplasts that is characteristic of the genus.

It is commonly found in freshwater habitats. There are more than 400 species of *Spirogyra* in the world. *Spirogyra* measures approximately 10 to 100µm in width and may grow to several centimeters in length. It's often seen as green slimy patches on the ground near ponds and other water bodies stagnant water with high level of nutrients. The filamentous masses come to the surface and become visible as slimy green mats.

Bryopsis cf. pennata Re'union algae

Early Bryopsis outbreaks looks like hair algae. Comparing the two, hair algae has individual strands of thin, filamentous hair like growth, which is where it gets it's name, like hair.

Bryopsis has the hair-like filament in early stages of growth, but eventually develops a fern-like structure or shape as it grows.

It starts to look like a fern as it grows then hair algae. As with hair algae, you won't touch this stuff once if grows very long. Bryopises will typically be found growing on

rocks and will be shades of green in color.

Valonia (*Valonia aegagropila*)**, (AKA Bubble Algae)**

There are several types of bubble algae, where each forms a slightly different shaped bubble.
Although the size and shade of green of the bubble may vary, there is no mistaking of bubble algae for any other type of algae.

It starts as one green bubble sitting as a standalone bubble ranging in size from a marble to a small ball about the size of a pea. It's growth pattern starts as bubble sack numbers increase daily. Inside each bubble are thousands of spores. This algae expands as bubble break open, releasing thousands of spores. **Valonia** is usually seen on hard or stable surfaces like rocks.

Caulerpa, Caulerpaceae Bryopsidales, Kelp, Sea Lettuce

Caulerpa is a genus of seaweeds in the family Caulerpaceae in the order Bryopsidales.
It is estimated to be responsible for approximately 25-30% of $CaCO_3$ in Neogene fossil reefs.
It's an edible seaweed from the green, brown, and red groups of algae and can generally be used "in fresh salads." "It is a protein and iodine rich marine plant found in both cold and warm seas.
https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/caulerpa

This is a greenish algae with runners and stems that have an almost leaf like looking structure on top of the stems. They are unusual because they consist of only one cell with many nuclei, making them among the biggest single cells.

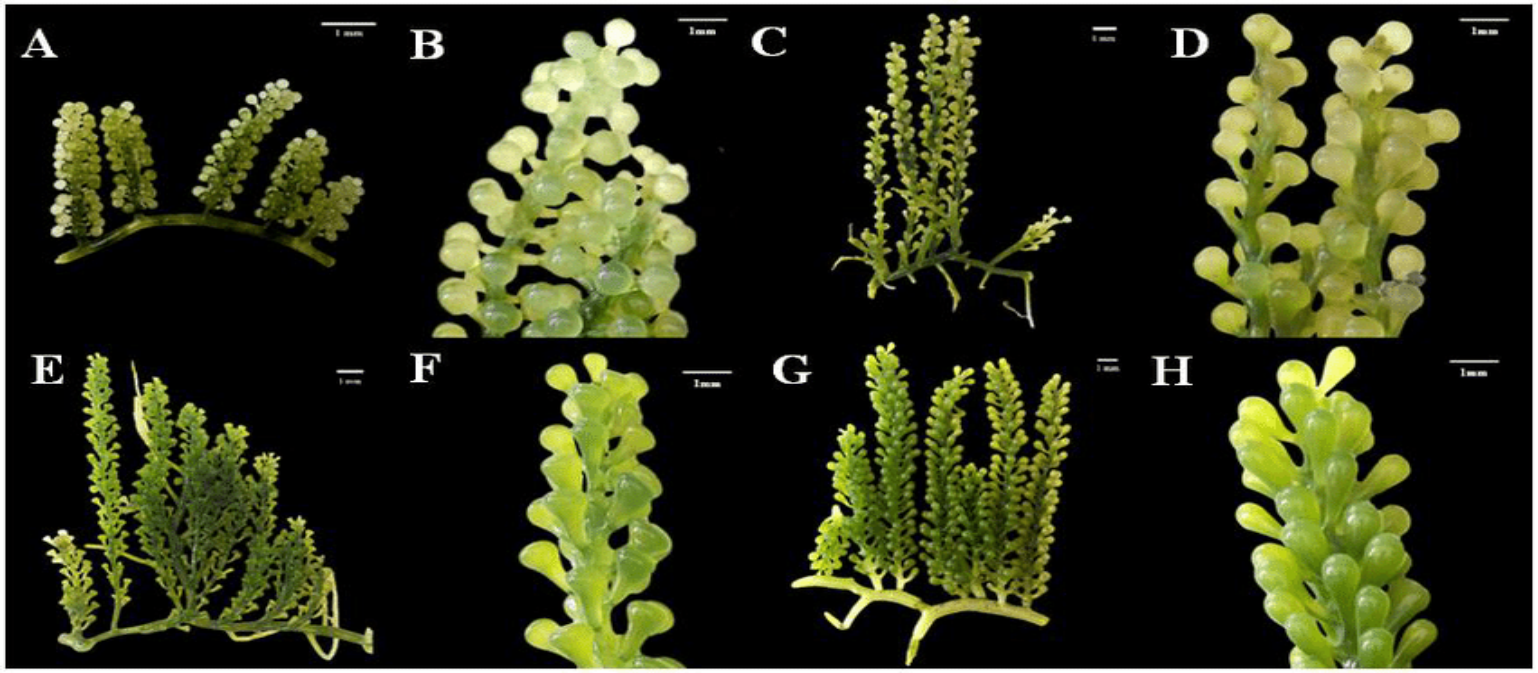
Sometimes this leaf like structures can look more like ferns rather than leaves making it easy to confuse with Bryopsis.

Caulerpa is a fast growing algae that can reproduce sexually or asexually by runners. You can also find red Caulerpa but that is not as common as the normal green variety. It's usual growth habitat is on hard surfaces, i.e. rocks

Grape Caulerpa

This a prolific green macroalgae species that grows from a "runner" and is a lot like the already mentioned Caulerpa with the exception of the grape shaped like structures instead of leaf like structures.

Identified sea grape species and varieties: (A-B) Caulerpa lentillifera and detailed part of assimilator, (C-D) Caulerpa racemosa and detailed part of assimilator, (E-F) Caulerpa racemosa var. turbinata and detailed part of assimilator, and (G-H) Caulerpa racemosa var. laetevirens and detailed part of assimilator. Scale bar = 1mm



Caulerpa, species C. taxifolia

https://en.wikipedia.org/wiki/Caulerpa_taxifolia

a species of green seaweed, or alga of the genus Caulerpa, native to tropical waters of the Pacific Ocean, Indian Ocean, and Caribbean Sea. The species name taxifolia arises from the resemblance of its leaf-like fronds[3] to those of the yew (Taxus).

It is one of two species of algae listed in 100 of the World's Worst Invasive Alien. Species compiled by the IUCN Invasive Species Specialist Group.

C. taxifolia is light green with stolons (stems or runner on the water body sea floor, from which sparsely-branched upright fronds of approximately 20–60 cm in height arise.[6] Algae in the genus Caulerpa synthesize a mixture of toxins.

Coraline algae **Geniculate or (articulated) & Nongeniculate or (nonarticulated) corallines**

Are highly desirable and *not nuisance algae*, but, are macroalgae algae that thrives and grows generally in good water conditions only and on almost any surface. Encrusting coralline algae form carbonate shells, makes them somewhat similar to coral, comes in a wide range of hues, including green, red, purple, pink and white.

Geniculate or (articulated) include branching, tree-like organisms which are flexible by having noncalcified sections.

Nongeniculate or (nonarticulated) corallines – are your typical encrusting and plating reef tank variety. Generally very slow growing and will grow on live rock, coral skeletons, shells, glass, plastics, and other algae. Matured coralline crusts may produce knobby protuberances, which provide microhabitats for many invertebrates. Other, non-articulated, corallines produce's chemicals that promote the settlement of the larvae of certain invertebrates. It is a little known fact that sea urchins, chitons, and limpets would not exist if it were not for the protection by coralline algae formations. https://arcreef.com/live-rock/coralline-algae/

Macro algae Examples:

Macro algae can be very beautiful and are often used as decoration.

Maiden's Hair genus Chlorodesmis

Ulva Lettuce Algae from the genus Ulva.

Chaetomorpha (Spaghetti algae, Green Hair algae or simply Chaeto)

Red kelp genera Haliptilon and/or Botryocladia.

Nuisance algae

Suggested methods to reduce or eliminate algae:

- Filtration:
- Nutrient filtration rids water of sustainable compounds
- Algae filtration adsorbs the whole physical algae and prevents mobility
- Marine algae in healthy ratios of habitat to algae count feed on water nutrients.
- Nearly all algae produce oxygen as a by-product from photosynthesis while also removing carbon dioxide from the

water. Some algae will bind heavy metals and various toxins.
- Dead alga releases everything it absorbed while living

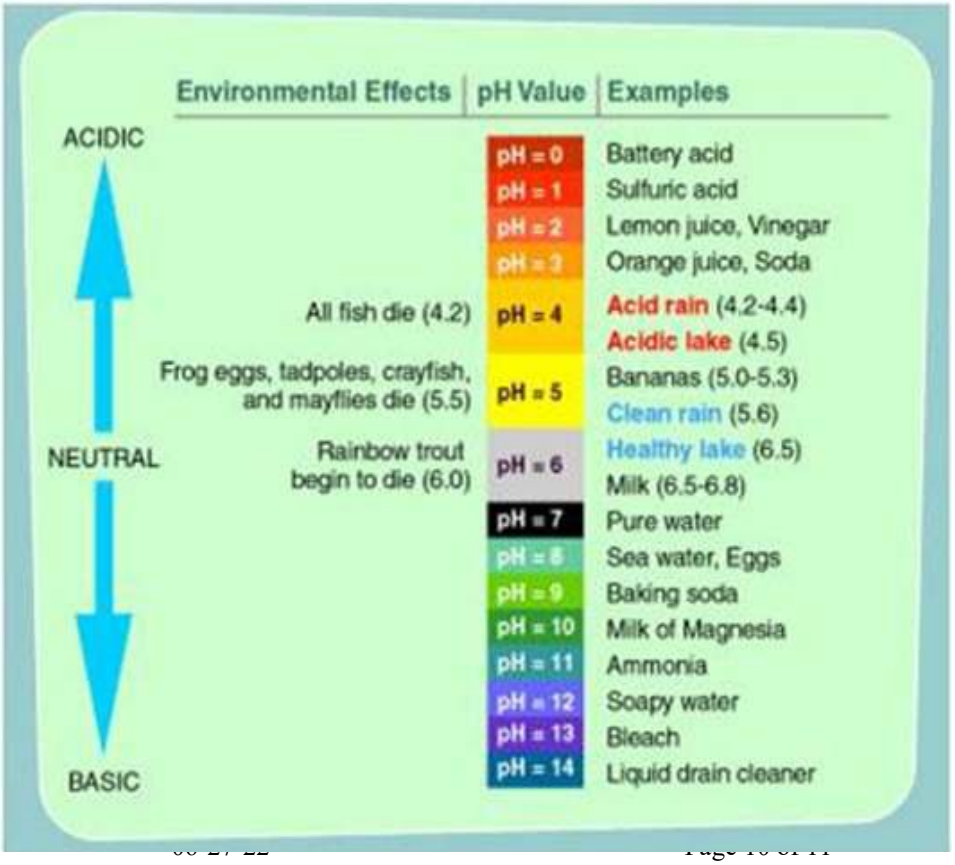
Reference: Reef Flux (Fluconazole) is a medication that was originally patented in the ’80s and marketed to fight fungal and yeast infections in humans, and is still used as a prescription anti-fungal treatment today.

A report of one product that not only effects algae, but, kills it is a product called Fluconazole. The commercial name is Reef Flux and is generally used in controlled confinement such as aquariums.

Instructions say NOT to use Reef Flux if your trying to kill Caulerpa or bryopsis algae. Killing the algae will create nutrient spikes due to released nutrients and other materials adsorbed during it's lifetime.

References:
https://www.reefaquarium.com/category/chemistry/
https://www.gettyimages.com/photos/spirogyra
https://commons.wikimedia.org/wiki/File:Bryopsis_cf._pennata_R%C3%A9union.jpg
http://www.plantcellbiology.com/2012/08/why-are-blue-green-algae-called-cyanobacteria/
https://en.wikipedia.org/wiki/Caulerpa_prolifera

pH values of common materials: Acidic to Basic



Micro & Macro Nutrients

https://soilsfacstaff.cals.wisc.edu/facstaff/barak/soilscience326/macronut.htm

Macronutrients: **N**, **K**, **Ca**, **Mg**, **P**, and **S**,

Micronutrients: **Cl**, **Fe**, **B**, **Mn**, **Zn**, **Cu**, **Mo**, **Ni**

Typical concentrations sufficient for plant growth. After E. Epstein. 1965. "Mineral metabolism" pp. 438-466. in: Plant Biochemistry (J.Bonner and J.E. Varner, eds.) Academic Press, London.

Element	Symbol	mg/kg	percent	Relative number of atoms
Nitrogen	N	15,000	1.5	1,000,000
Potassium	K	10,000	1.0	250,000
Calcium	Ca	5,000	0.5	125,000
Magnesium	Mg	2,000	0.2	80,000
Phosphorus	P	2,000	0.2	60,000
Sulfur	S	1,000	0.1	30,000
Chlorine	Cl	100	--	3,000
Iron	Fe	100	--	2,000
Boron	B	20	--	2,000
Manganese	Mn	50	--	1,000
Zinc	Zn	20	--	300
Copper	Cu	6	--	100
Molybdenum	Mo	0.1	--	1
Nickel	Ni	0.1	--	1