Chlorophyll

What is chlorophyll?

Chlorophyll gives plants their green colour and is produced by microscopic plants called algae in lakes and rivers. The amount of chlorophyll in water is usually highest in summer and lowest in winter because of course it is not easy for plants to grow in winter. There are many human activities that affect chlorophyll in water, such as sewage inputs and destruction of lake and river shorelines.

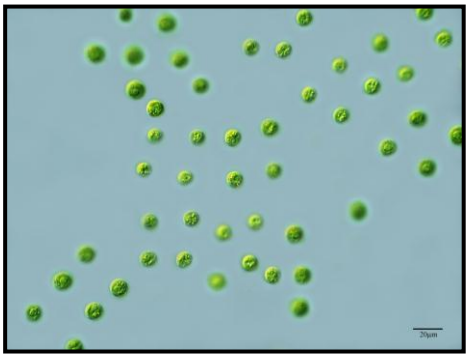

Photo credit: Proyecto agua/water project

Why does chlorophyll matter?

Chlorophyll in lakes and rivers comes mostly from floating algae. More chlorophyll indicates more algae, and algae are very important because they form the base of the food chain. Without algae, there would be no bugs or fish! Algae are very small and grow very quickly. If conditions are suitable in the water, algae can grow and cause a "bloom" which can cover lakes with green scum or make the water look greener than normal. Algae blooms may be dangerous for fish because when algae die, bacteria decompose them and use up oxygen in the water. When oxygen levels decrease, fish can suffocate and die. This happens quite often in the south, where human activities have caused algae to grow much more quickly than normal. What this means is that we need a "happy medium" level of algae – enough to feed the food chain – but not so much that bacteria go crazy decomposing and use up all the oxygen.

Algae blooms happen more often in polluted lakes and rivers where humans have added nutrients. For example, human sewage contains nutrients needed by algae to grow. Sewage lagoons may have algae blooms on them during the summer because there are lots of nutrients in the water and because the water can be warmer compared to other lakes. Industrial and residential development and fertilizers may also add nutrients to lakes and rivers and result in algae blooms. Algae blooms are not good for fish, so it is very important to monitor chlorophyll levels at regular intervals.

Two Canadian Shield lakes are pictured to the right. The dark green coloured lake in the front is experiencing a large algal bloom because scientists added nutrients (phosphorus) to it during an experiment in the 1970s. The lake in the background is untouched and in its natural state.

Photo credit: Karen Scott

How do we measure chlorophyll?

Chlorophyll is measured by a specialized sensor than shines light into the water and measures light reflected by chlorophyll. The amount of light reflected back to the sensor is related to the amount of chlorophyll in the water. Some waterbodies have naturally high levels of chlorophyll whereas others have naturally low levels of chlorophyll. In general, lakes and rivers in the Arctic tend to have naturally low chlorophyll, but this is not always true. Chlorophyll also changes throughout the year, so it is important to monitor it in many different seasons.

Chlorophyll and productivity

When we talk about lakes and rivers, we often talk about how 'productive' they are. Productivity refers to how many living things are in the system. Because it is impossible to count every living thing in a waterbody, we often use two parameters to estimate productivity. One of these parameters is chlorophyll (which as we have discussed is an indicator of the amount of algae), and the other is phosphorus. To measure phosphorus, we have to take a water sample and send it to a lab. Even with just the chlorophyll measurement, though, we can get a rough idea of how productive our lakes and rivers are. Low productivity lakes are called 'oligotrophic.' Most Arctic lakes and rivers are oligotrophic because it is cold and because there are not many nutrients for algal growth. Less algae means less animals in general. Medium productivity lakes are called 'mesotrophic.' There are several mesotrophic lakes and rivers in the Arctic. High productivity lakes are called 'eutrophic.' Eutrophic lakes are common in Alberta, where the soil is very deep (there are more nutrients in soil than in rocks). Extremely high productivity lakes are called 'hypereutrophic.' Human activities, such as dumping sewage, can cause an oligotrophic lake to turn into a mesotrophic lake, or a mesotrophic lake to turn into a eutrophic lake, etc… We tend to see algal blooms and associated fish die-offs in lakes that are eutrophic and hypereutrophic. Below is a table that indicates (roughly) how chlorophyll is translated into productivity.

Productivity/Trophic Status	What does the water look like?	Maximum chlorophyll concentration (µg/L)
Oligotrophic	Clear	Less than 8
Oligo-mesotrophic	Usually clear	Occasionally over 8
Mesotrophic	Sometimes green	8 to 25
Eutrophic	Green most of summer	26 to 75
Hyper-eutrophic	Frequent dense algal blooms	Over 75

Table adapted from: Atlas of Alberta Lakes, http://sunsite.ualberta.ca/Projects/Alberta-Lakes

References/For More Information

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