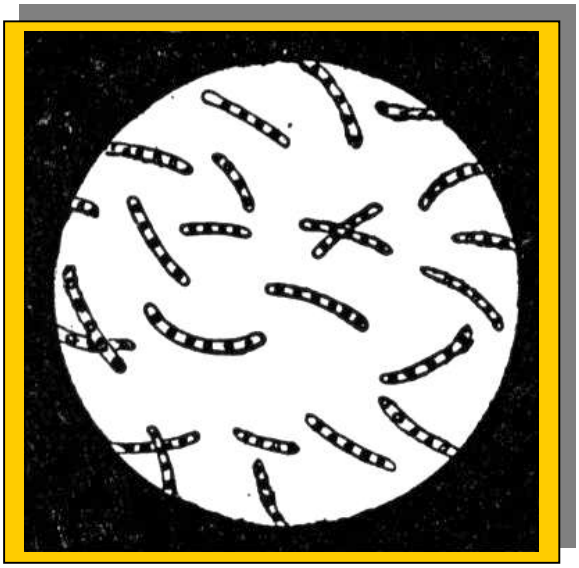
Dynamic Design: The Cleanroom

From Macroscopic to Microscopic

STUDENT TEXT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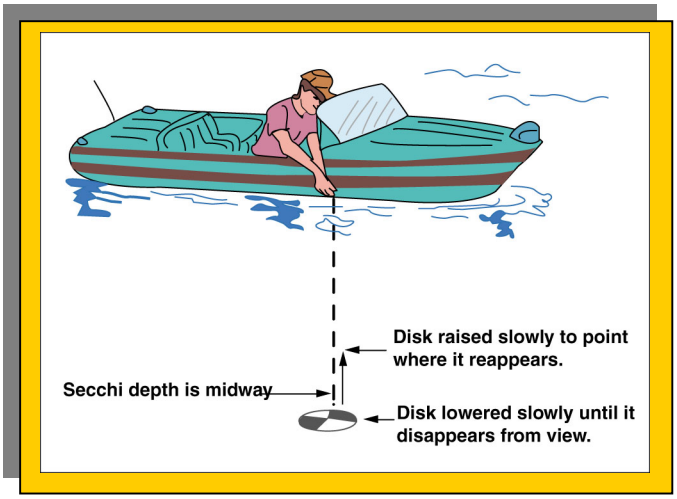
What do you think of when you hear the prefix, “micro”? What is a microscope used for? What do you think microbes are? “Micro” comes from the Greek word “mikros” meaning small. In the everyday world the word microscopic is used to refer to objects that are too small for the unaided eye to see. People often think of bacteria or viruses when considering the microscopic world. The prefix “macro” comes from the Greek word, “mackros” that means long. Macroscopic objects are those that can easily be seen by humans. The suffix “cosm” comes from the Greek word Kosmos meaning universe. Putting together these two pieces of information we would define a microcosm as a universe in miniature. Macrocosm would refer to the large universe or entity. When measuring water clarity at the macroscopic level, we would consider the leaves, dirt, and grass. At the microscopic level, clarity measurements would involve particles that are too small to be seen by the human eye. In the former we can look at the clarity of a lake. In the latter we can look at detecting substances in what appears to be “clean” water.

Limnology



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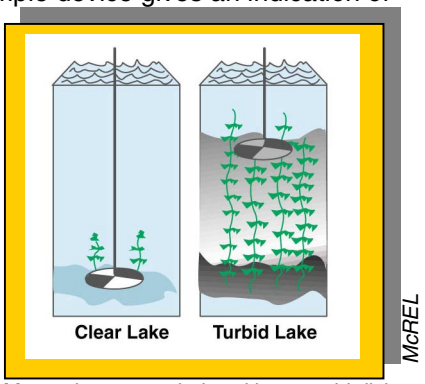
Limnology is the study of the transparency of water. The Secchi disk is used to measure the water clarity in a body of water. The Secchi disk works by indicating to a person how far light can penetrate into that body of water. Father Pietro Angelo Secchi, an Italian astrophysicist invented the Secchi disk. He was requested to measure transparency in the Mediterranean Sea by Commander Cialdi, head of the Papal Navy. Secchi was the scientific advisor to the Pope around 1865. “Secchi experimented with two types of disks, a 43-cm diameter disk of white clay and a 60-cm diameter disk of sailcloth painted white and stretched over an iron ring. Secchi lowered the disks until they became invisible; this depth was thereafter known as the secchi depth.” (Horne, 1994) “Various sizes of disks have been used since that time, but the most frequently used disk is an 8 inch diameter metal disk painted in alternate black and white quadrants.” (http://mlswa.org/secchi.htm, 2000) The Secchi disk is often used to measure the clarity of the water in lakes, ponds and rivers. The simple device gives an indication of how clear the water is. It is useful for comparing the water clarity of the same lake over time. It is less useful for comparing **turbidity** or cloudiness of different lakes.



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Measuring water clarity with a secchi disk.

The Secchi disk is normally used at the deepest part of the lake. Typically the person in a boat lowers it into a body of water by unwinding the cord to which it is attached until the observer loses sight of it. The disk is then raised until it reappears. The depth of the water where the disk vanishes and reappears is the Secchi disk reading. A more accurate measurement is obtained when this process is done several times and the mean is calculated. A Secchi disk measures water clarity. Water clarity may be affected by three different factors: algae, sediment and water color. A photometer is used for a more precise measurement of light in aquatic environments. Based on your experience and this simple description what

are some factors that would need to be kept constant for someone to get reliable readings using a Secchi disk? your teacher has instructions for constructing your own Secchi disk. Once you have your Secchi disk, you may start to monitor the conditions of a local lake. If you are interested you may join other volunteers from around the country in the Great American Secchi Dip In. For more information go to http://dipin.kent.edu/main.htm.

The Secchi disk and the liquid particle counter in the cleanroom are similar in that they both measure the clarity of water. The Secchi disk measures clarity on a macroscopic level and the liquid particle counter measures clarity on a microscopic level. The liquid particle counter can be set to measure eight sizes of particles from 0.5-300 microns. A revolving laser beam passes through the walls of a glass container. When it is directed through a central "sensitive zone" the liquid particle counter not only counts the particles in suspension, but also tabulates the size of the particles. If the particles are from 0.5 to 1.5 microns, the light from the liquid particle counter is scattered. If the particles are greater than ten microns, light is blocked. The analog signals generated by the light pulses are routed to a computer and digitized.

Whether something needs to be cleaned again depends on the type of item it is. Contamination control lead scientist Eileen Stansbery states that the rinse analysis results give a concentration of particles based on the surface area rinsed. Generally, items with any particles larger than 10 microns or have more than 100 particles of 1 micron size, need to be re-cleaned. “Each component must be assessed differently.” If you have not done so, visit the *Genesis Cleanroom Interactive Field Trip* to complete a simulation of the liquid particle counter when you have completed this text.

Other Applications of the Liquid Particle Counter

Liquid particle counters can be used for a variety of purposes. One study was done in the Mississippi River to examine the effect of commercial and recreational boats on the amount of sediment that is resuspended. In this study, a sample of the water was taken before any boats had disturbed the water. Then twenty-four samples were taken at regular intervals after a boat passed by. Fifty commercial and sixteen recreational boats were included in the study. The results of the study concluded that 78% of the commercial boats caused a significant increase in sediment and 50% of recreational boats caused a significant increase.

Determining the cleanliness of a sample is of vital importance during the assembly of the Genesis spacecraft. Using the liquid particle counter is one method of verifying that component parts are clean after the cleaning process and before assembly.

Water clarity is an important aspect of our daily lives. Think about the last time you went swimming in a body of water that was murky. How does that compare with swimming in a crystal clear pool of water? Drinking water is another example of when clean water is desired. Think about other examples when water clarity should be measured.

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