# Fluorometry Project

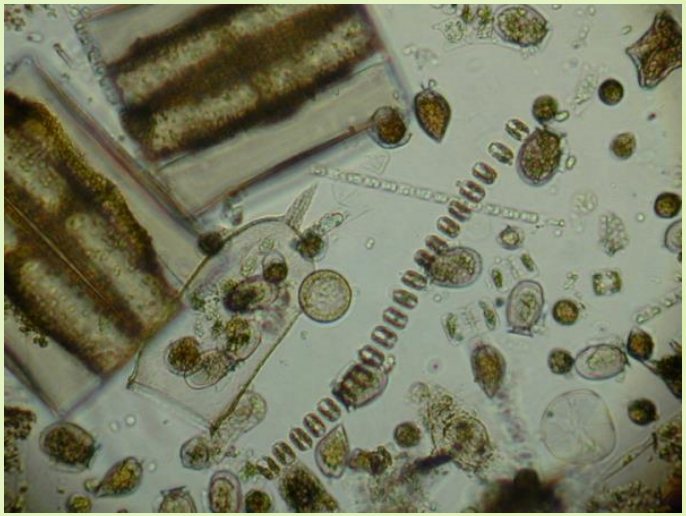
Ocean Institute + Scripps Institution of Oceanography

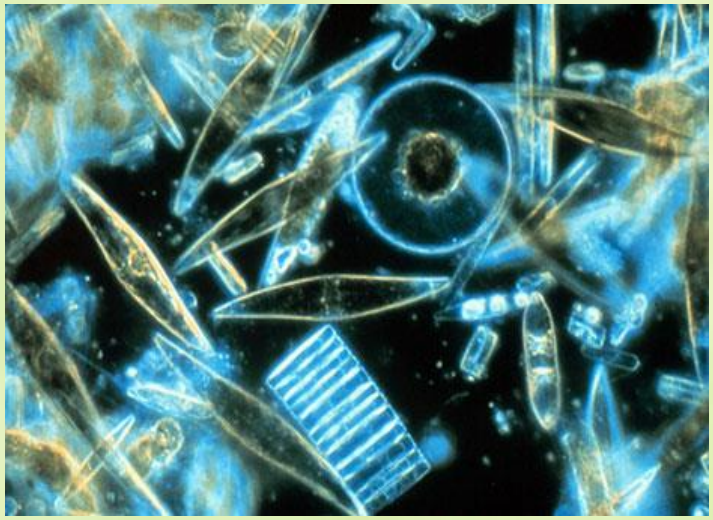
**Chlorophyll Temperature Time Series**

*The California Current Long Term Ecological Research (CCE LTER)*

# Phytoplankton

- Phytoplankton are microscopic plant-like aquatic organisms
- *phyto* (plant); *plankton* (made to wander or drift)
- Life span of individual phytoplankton: a few days



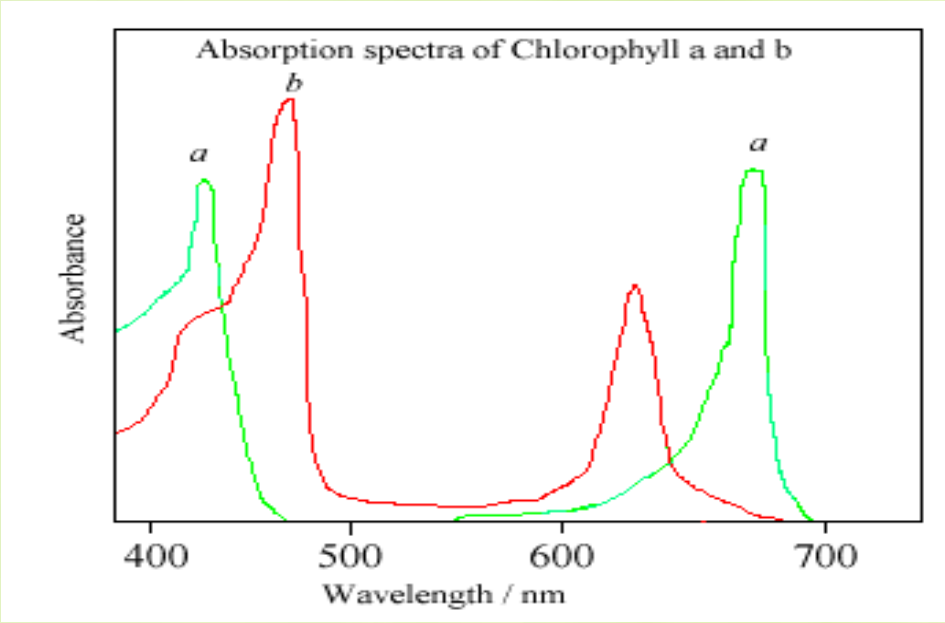


# Like plants on land, phytoplankton contain chlorophyll

- Chlorophyll: the molecule that traps light and is found in the chloroplasts of green plants. It is what makes green plants green.

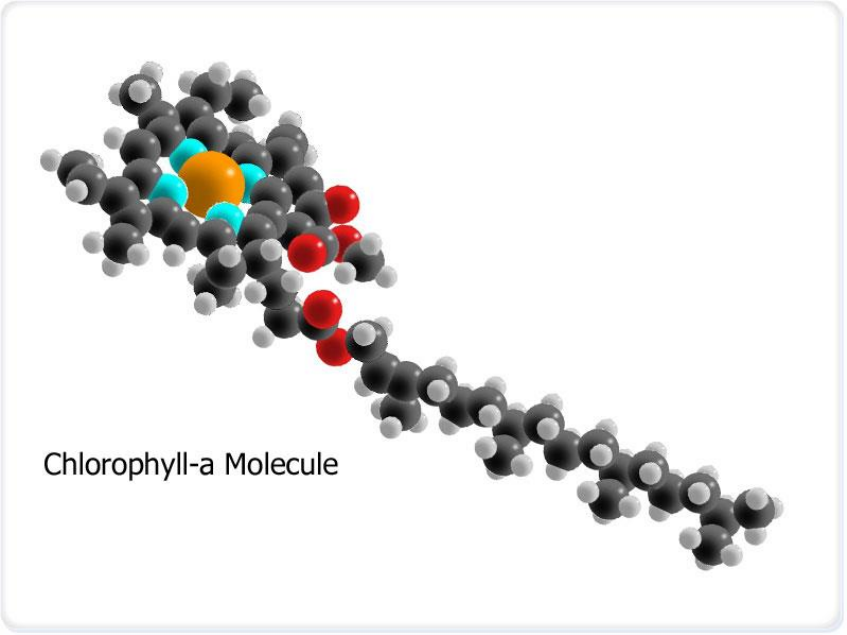
- There are actually 2 main types of chlorophyll, named *a* and *b*. They differ only slightly but are both very effective at allowing the plant to absorb the energy from sunlight.

• Chlorophyll *a* and *b* complement each other in absorbing sunlight. Plants can obtain all their energy requirements from the blue and red parts of the spectrum, however, there is still a large spectral region, between 500-600nm, where very little light is absorbed. This light is in the green region of the spectrum, and since it is reflected, this is the reason plants appear green.



# Chlorophyll *-a*

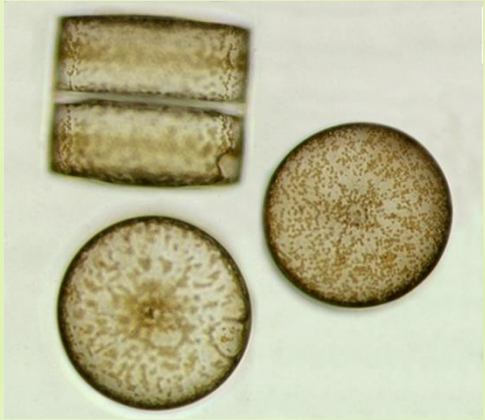
- Chlorophyll *a* absorbs blue light and fluoresces (emits) red light.



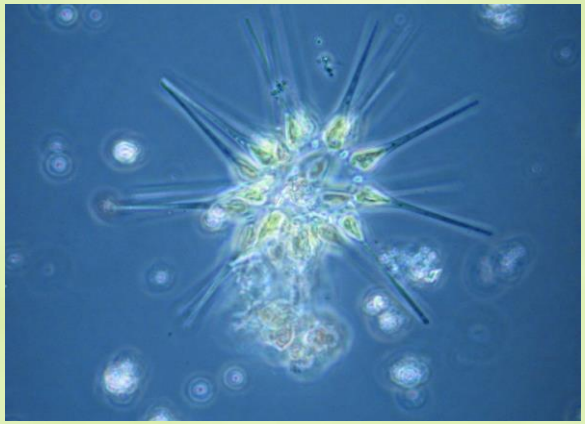
# Phytoplankton

- Can be bacteria, protists, or single-celled plants
- e.g. cyanobacteria, diatoms, dinoflagellates, green algae, and coccolithophores

Protoperidinium

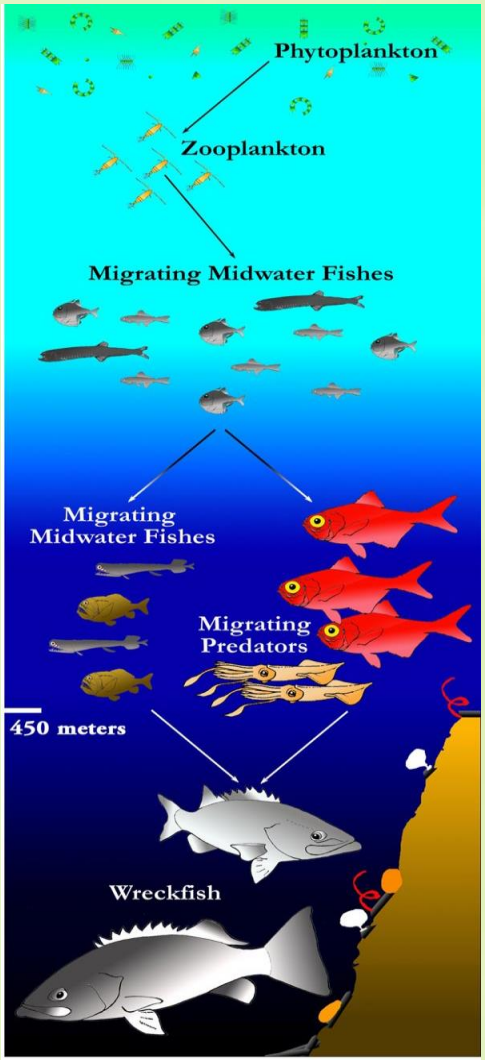


Coscinodiscus



Asterionella

# Role of Phytoplankton in the Environment




- Primary producers in aquatic food webs.
- Phytoplankton are responsible for approximately half of all primary production but only 1% of total plant biomass.

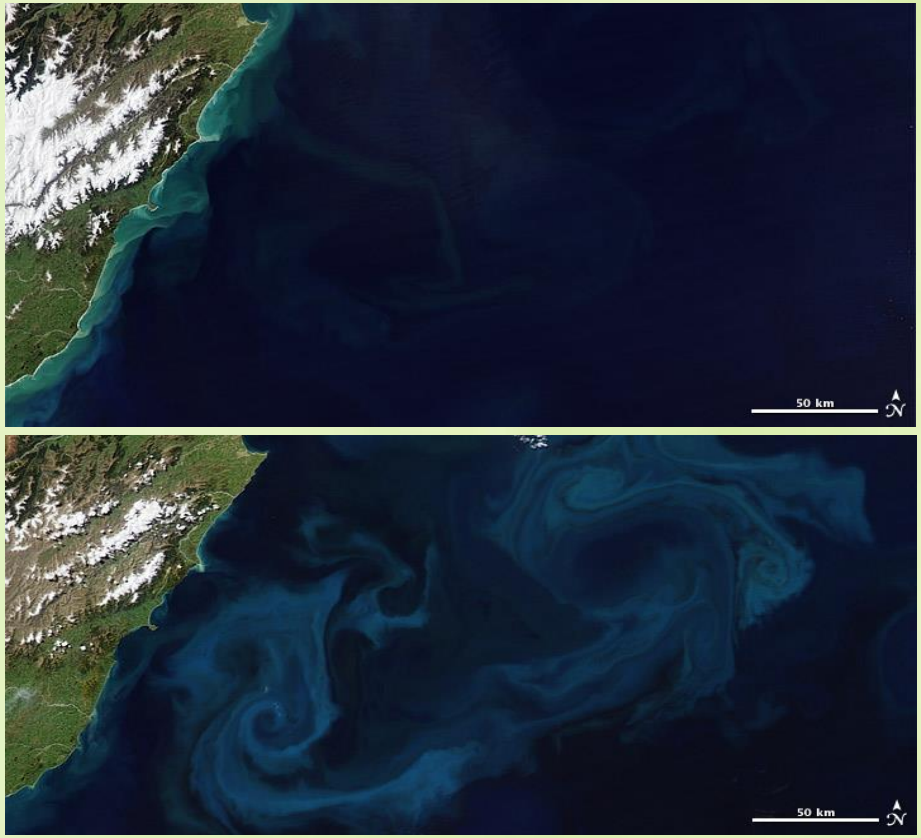
# Phytoplankton

- "Bloom"= when growth conditions are right and allow for explosive increase in phytoplankton population.


Red tide off the coast of California caused by *Noctiluca scintillans*

- Growth rate depends on water temperature, salinity, water depth, wind, and predators, $CO_2$, sunlight, and nutrients (nitrate, phosphate, silicate, and calcium).

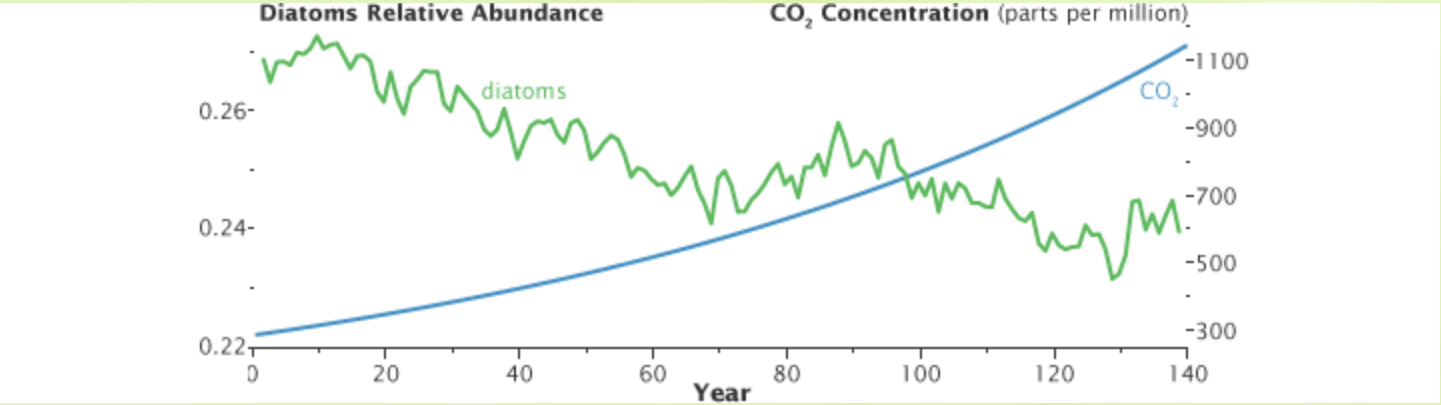
# Phytoplankton bloom as seen by satellite




- This pair of satellite images shows a bloom that formed east of New Zealand between October 11 and October 25, 2009. (NASA images by Robert Simmon and Jesse Allen, based on MODIS data.)

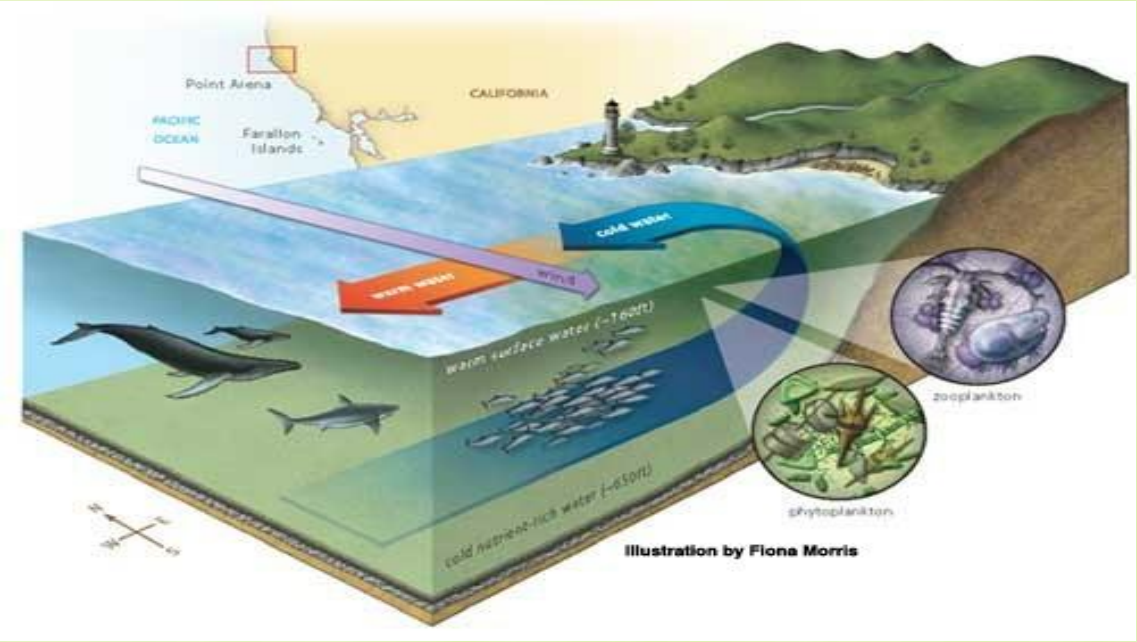
# Role of Phytoplankton in the Environment

- Responsible for the largest $CO_2$ sink.
- Small changes in growth of phytoplankton may affect atmospheric $CO_2$ concentration, which can influence global surface temperatures by adding heat-trapping $CO_2$ gases to the atmosphere..



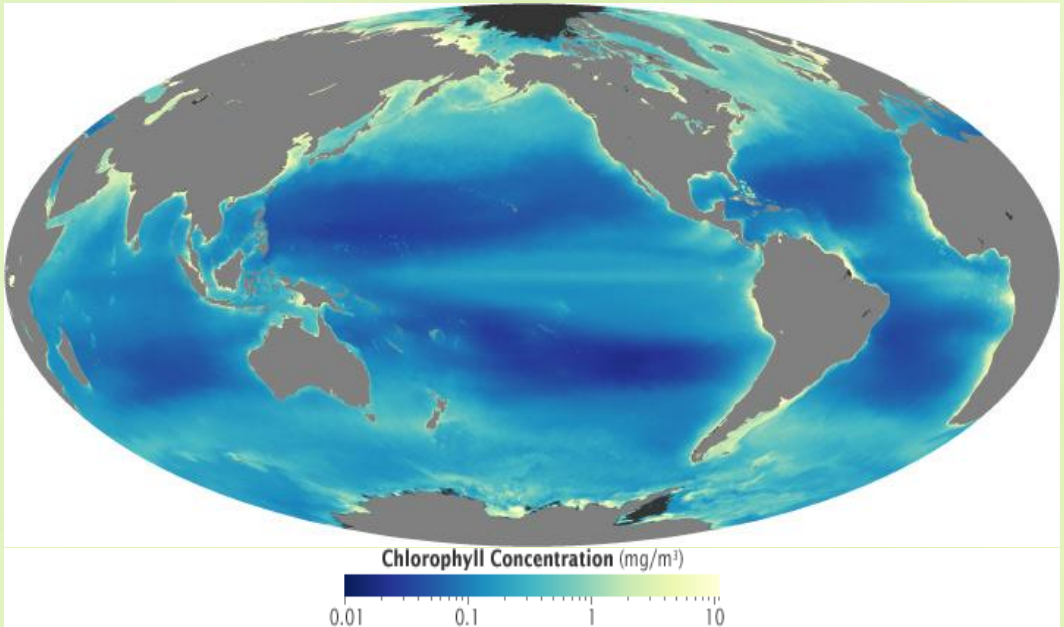
# Studying Phytoplankton (Patterns and Cycles)

- Factors affecting concentration of phytoplankton:
  - Wind (Coriolis effect) -- driving currents that push warmer, nutrient-poor surface water away from the coastline and allows for mixing of deep water that are nutrient-rich come to the surface (***upwelling***).



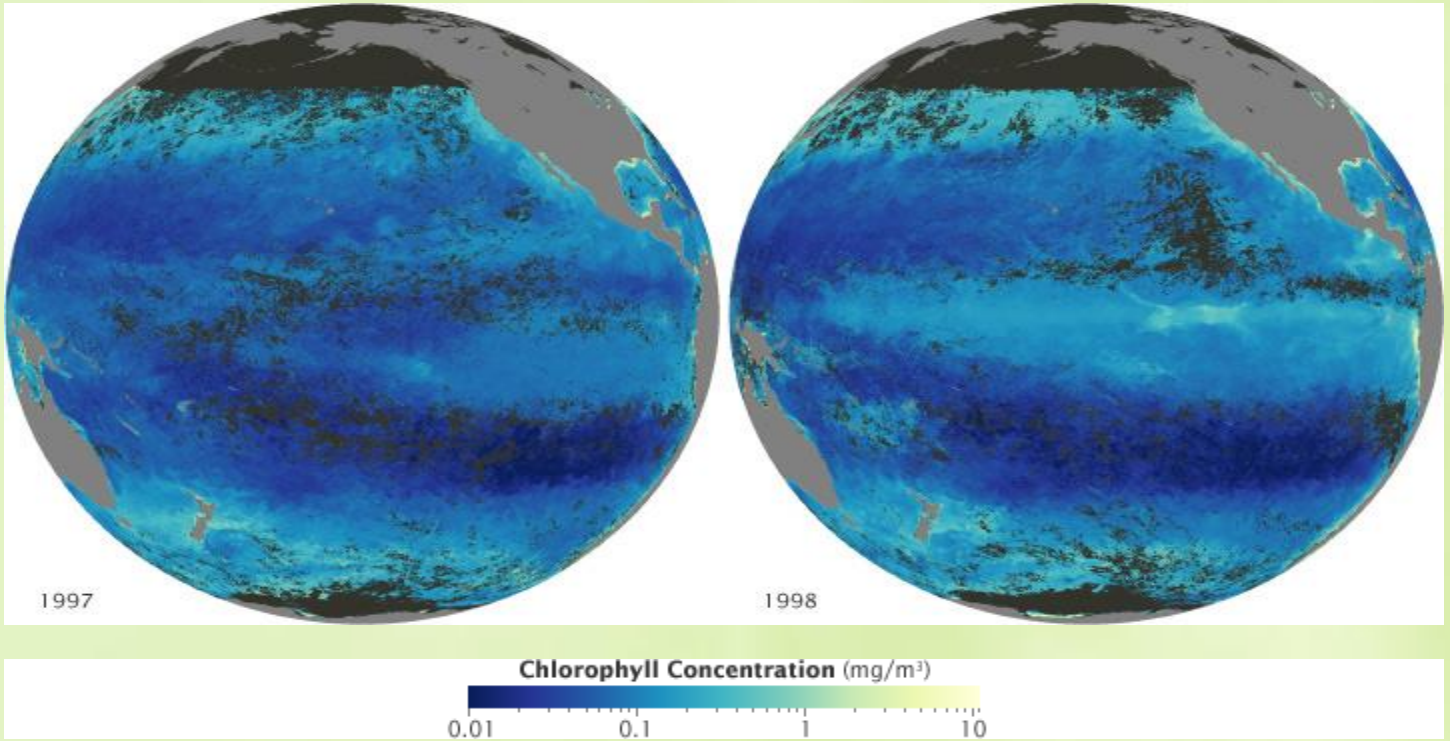
# Studying Phytoplankton
## (Patterns and Cycles)

- Factors affecting concentration of phytoplankton:
  - Seasonal changes
    - High latitudes: concentrations peak during spring and summer due to increased light intensity and subsiding of winter storms
    - Subtropical oceans: concentration low in summer due to insufficient mixing of water column
    - Lower latitudes: linked to monsoon-related changes in winds



# Studying Phytoplankton
## (Patterns and Cycles)

- Factors affecting concentration of phytoplankton:
  - El Niño-Southern Oscillation (ENSO) climate pattern:
    - El Niño conditions reduce phytoplankton productivity by reducing or reversing upwelling
    - La Niña conditions increase phytoplankton by upwelling nutrient-rich deep water




El Niño conditions (reduced upwelling; reduced phytoplankton density)

La Niña conditions (increased upwelling; increased phytoplankton density)

# Studying Phytoplankton
## (Long-Term Research)

- To study concentrations of phytoplankton, satellite images have been used, but chlorophyll-*a* from water samples can be quantified through the use of a ***fluorometer.***

# Fluorometer

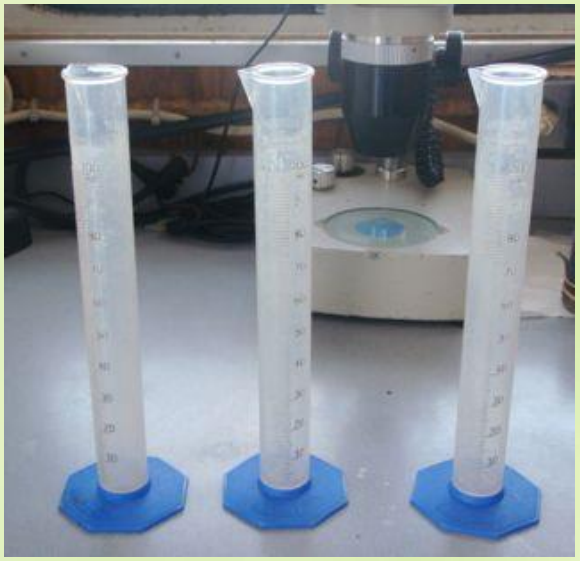
- A ***fluorometer*** is an instrument that detects chlorophyll- *a* by transmitting excitation beams of light in the blue range (440 nm) and by detecting the light fluoresced at 685 nm (red).

- The fluorescence is generally directly proportional to the concentration of the chlorophyll in the sample.

# Phytoplankton Sample Collection and Data Analysis at the Ocean Institute

# Materials -- Water Sampling

1.5 L Sample Bottle



100 ml Graduated Cylinders

Niskin water sampler

# Materials -- Filtration

Funnel

Filter

Pump

Vacuum Filtrate Bottle (1000 ml)

# Materials -- Filtration


GF/F Filter
(0.7 µm)

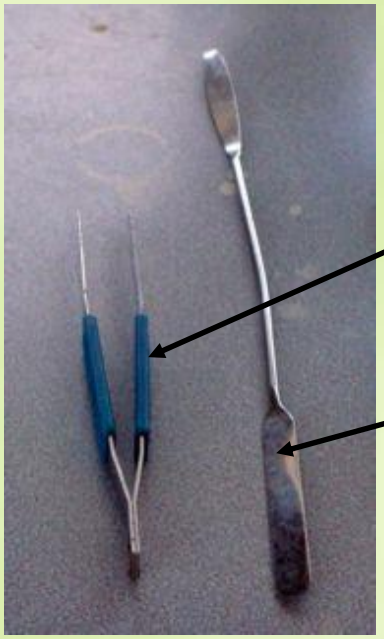
Test Tubes
with acetone


3 µm Filter

Distilled
Water

# Materials -- Chlorophyll Analysis


Fluorometer



Forceps
&
Spatula


1 N HCl


Kimwipes

# Materials -- Other Supplies

Thermometers

Hydrometer


Messenger: Trigger to close Niskin bottle

# Sample Collection at the Ocean Institute, Dana Point, CA

- The R/V Sea Explorer provides a perfect platform for students to gather data and conduct analyses. This is accomplished through the Human Impacts on Coastal Ecosystems (HICE) program.