What are Nutrients?

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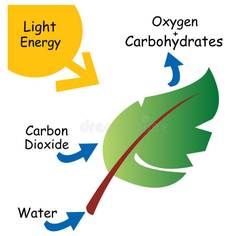
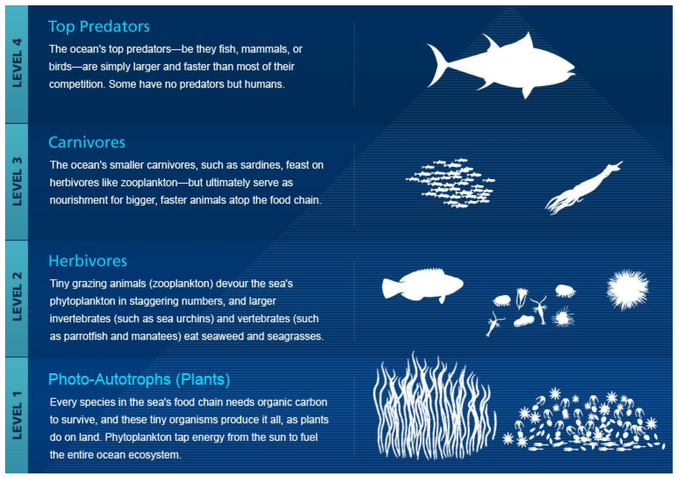
EUTROPHICATION

Eutrophication (you-trof-eh-cation) is just a really big word for too many nutrients. In the marine environment, when we talk about too many nutrients, we are talking about nitrogen (N) and phosphorus (P). Just like the fertilizers that grow plants on land, nitrogen and phosphorus stimulate plant and algal growth in the marine environment. One of the biggest consequences of too many nutrients = too much phytoplankton.

PRIMARY PRODUCERS



Primary producers are plants and algae that perform photosynthesis to create food, energy and oxygen. Primary producers are incredibly important because they form the base of the food chain and create the oxygen we breathe in the atmosphere. Primary producers are the only group that create their own food; all other organisms on Earth must eat to obtain energy for growth and reproduction. There are two types of primary producers in the ocean: seagrasses, which are true plants, and algae. Algae are divided into two groups: micro-algae and macro-algae.



Ocean Food Chain. Credit NOAA

- **Phytoplankton (Micro-algae)**

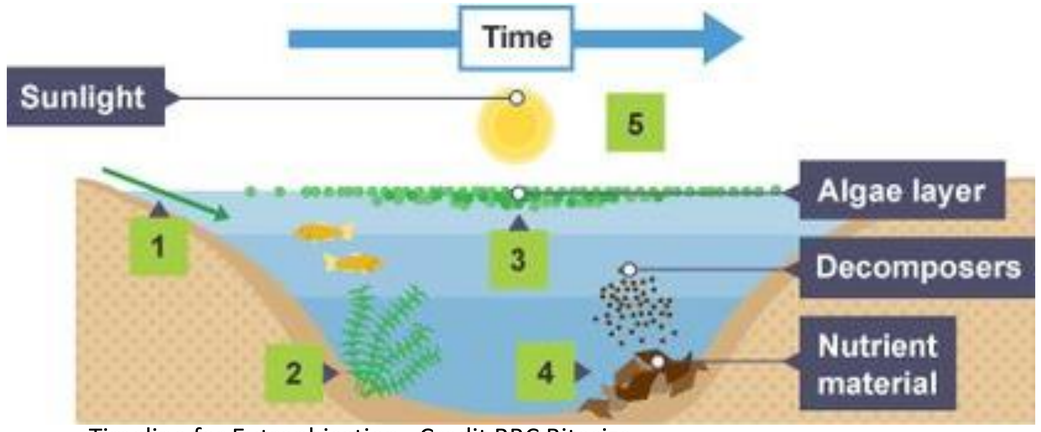
Phytoplankton are microscopic, single-celled organisms that float in the top layers of the Earth's oceans and produce 40% of the Earth's oxygen supply.

- **Seaweed (Macro-algae)**

Seaweed is the common name for large, visible algae. Sargassum, halimeda, mermaid's cups, shaving brushes and hair algae are common seaweeds in the Florida Keys.

- **Seagrasses (True Plants)**

Did you know the Florida Keys are surrounded by one of the largest seagrass beds in the world? The three most common are turtle grass, manatee grass and shoal grass.



Timeline for Eutrophication. Credit BBC Bitesize

Timeline for Eutrophication

1 Nutrient Loading: Nitrogen and phosphorus enter the waterbody from the surrounding watershed. Sources include urban runoff, agriculture, fertilizers, detergents, animal and human waste.

2 Primary producers proliferate: The N and P act like fertilizers, stimulating exponential phytoplankton, macro-algae and seagrass growth.

3 Algae Bloom: The abundance of phytoplankton creates an algae bloom. The phytoplankton may become so thick they block light for the seagrasses at the bottom. The water may appear very green or red-brown.

4 Decomposition: The phytoplankton decay, and the decomposition of the organic matter by microbes removes oxygen from the water. Very low oxygen levels lead to fish kills. Some phytoplankton blooms cause health effects in humans and death for dolphins and manatees.

What is Non-Point Source Pollution?

Non-point source pollution is the type of pollution that comes from diffuse sources. The more impervious surfaces, like parking lots and urban development, the more nonpoint source pollution enters waterways. This is because after a rain event, the rainwater literally runs-off into the nearest waterbody – rivers, lakes, estuaries and oceans. When rainfall travels over the ground, it picks up whatever pollutants the water encounters – sediment, fertilizers, pesticides, fossil fuels, animal waste and heavy metals, and carries them through the watershed via gravity to waterbodies. It is important to educate residents about nonpoint source pollution because we can all use best management practices to prevent nonpoint source pollution from entering waterways in the first place.

What is a Harmful Algal Bloom (HAB)?

A proliferation of algae is called an algal bloom. Algal blooms can deplete the water of oxygen and cause fish kills. Some phytoplankton species contain toxins that are harmful to humans, which are called Harmful Algal Blooms (HABs). The red tide causing species, *Karenia brevis*, causes respiratory problems in humans, fish kills and dolphin deaths. Drinking or inhaling contaminated water from toxic blooms, or eating contaminated shellfish can cause liver disease and long-term cognitive dysfunction.

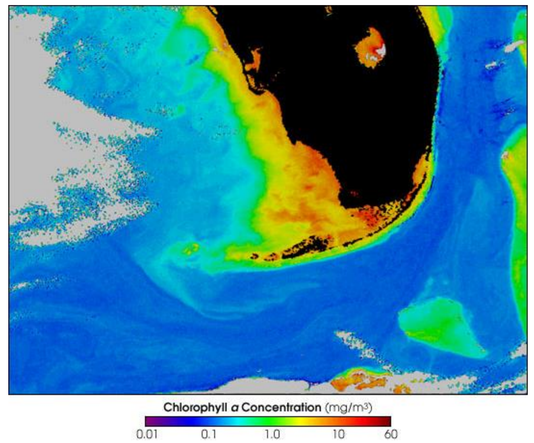
NITROGEN

Nitrogen is an organic element with the atomic symbol N, and it is present in all life forms. The majority of the air we breathe is nitrogen gas (N_2; 78%) followed by oxygen gas (O_2; 21%). Nitrogen gas in the atmosphere is inert, and must be converted into a usable form for living organisms to build amino acids for proteins and nucleic acids for DNA and RNA. Nitrogen is taken up by seagrasses, seaweed and phytoplankton in the form of nitrate (NO_3) and ammonium (NH_4) and incorporated into their tissues, which forms the base of the food chain.

PHOSPHORUS

Phosphorus is an organic element with the atomic symbol P, and it is required for aquatic plant growth. Phosphorus is a building block for energy. It is also a key element in fertilizer, because it makes plants grow.

When concentrations of nitrogen and phosphorus are high, it is like a buffet for phytoplankton, which causes them to multiply exponentially. The Gulf of Mexico Dead Zone is an example of a low oxygen area from too much nitrogen and phosphorus entering the Gulf of Mexico from the Mississippi River watershed.



Satellite imagery of chlorophyll A concentrations in the Florida Keys. Credit SEAWiFS

What is Chlorophyll A?

Chlorophyll A is the primary photoreceptor used for photosynthesis by aquatic plants and algae. Chlorophyll A gives plants and algae their green pigment and it is used as a proxy to estimate the amount of phytoplankton in the water column. There are scientific instruments and even satellites that measure the chlorophyll A pigment to estimate the abundance of phytoplankton in the environment.

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