

Nutrient Cycle - Tutorial Script

Nutrients are dissolved ions that are the building blocks of cell material. Heterotrophs get their nutrients through the food they eat. Autotrophs make their own food, so they must receive their nutrients, such as iron, calcium, nitrogen, and phosphorus, directly from the surrounding water usually through diffusion. That means that autotrophs are confined to areas of the ocean where nutrient concentrations are high. So where do these nutrients come from? How are they moved around? And what are their sinks?

Nutrient sources to the ocean include decomposition, rock weathering along the coast, and rock weathering and fertilizer from land brought to the ocean via rivers and rain runoff. Also, nitrogen gas, as we know, is readily available in the oceans. But it's not a form that organisms can use. They can uptake only nitrates and nitrites, an ionic form of nitrogen combined with oxygen. Some species of bacteria can convert nitrogen gas into a form usable by autotrophs. This is called nitrogen fixation (These same bacteria are at work in the roots of clovers and lupine and alfalfa and other plants that farmers rotate into their planting schedules to naturally add nitrogen back into the soil after previous crops have used it all up.) Thus, bacterial fixation of nitrogen gas is a source of available nutrients to the autotrophic organisms in the oceans and an important part of the nitrogen cycle.

Nutrient sinks from the ocean include nodule and sediment deposition on the bottom of the seafloor and marine organism growth and feeding.

Because of these sources and sinks, we would expect nutrients to be high near rivers and agriculturally rich or highly populated coastlines. We would also expect high nutrients on the bottom of the seafloor where most decomposition happens. We would expect nutrients to be low in the surface waters where there is a well-developed pycnocline, because they would be used up by autotrophic growth and then transported and trapped on the seafloor when these organisms die and sink. The only way to restock the surface waters with nutrients in these areas is for upwelling or mixing to bring those waters back to the surface.

Nutrients are considered one of the major **limiting factors** for biological productivity. Without nutrients, autotrophic populations cannot be sustained. Without autotrophs, heterotrophs have no food source. Thus nutrient-poor surface waters will be devoid of life – marine deserts. These marine deserts will be noticeable because of their clear waters and deep photic zone. These waters are the crystal-clear blue waters typically found in tropical islands. Why there? Well-developed pycnoclines and no rivers.

Pause now.

If you like to fish in the waters off California or watch whales feeding, you can use real-time satellite imagery and data, such as these from NASA, that show the location and extent of offshore upwelling. When sunlight is aplenty, and nutrients are high, life will abound.

[end credits]

Nutrient Cycle, Produced by Katryn Wiese, City College of San Francisco

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