

The Oceans Connect Us

Answers, Explanations, &
Definitions for the Plankton &
Genetic Activity

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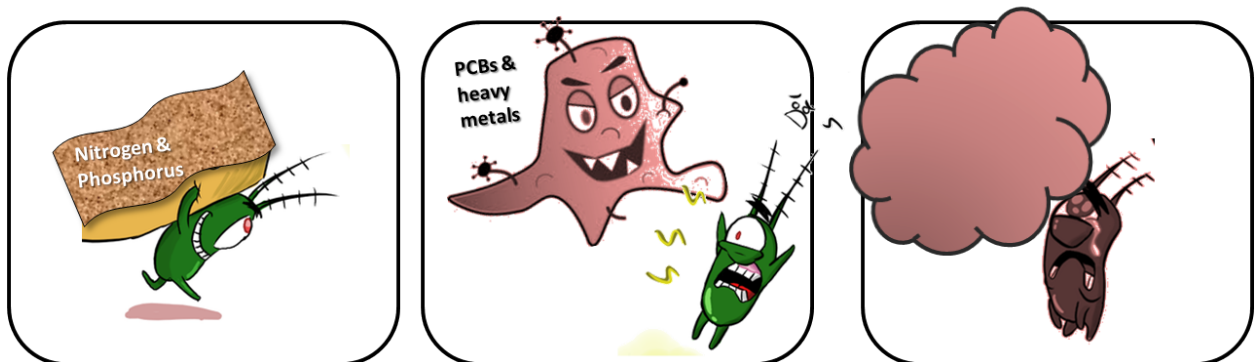


Answers to Questions:

Part 1: Food Web & Bioaccumulation

- 1) Yes (students should notice a connection exists, however, answering the following questions will make this connection more apparent)
- 2) Examine other organisms in a water sample, like plankton - easy to collect and test (the following resources may seem adequate, however the reason why not is provided)
 - Water quality-> no hand-held device can provide a direct test exists at this time
 - Examine fish tissues-> you would have to find the snapper that was used in the fish sandwiches, think it's gone!
 - Examine human blood sample -> can detect recent exposures to large amounts of PCBs which identifies the toxin type, but does not identify the pollutant source
- 3) See explanation below:

Explanation: This case demonstrates the effects of **bioaccumulation**, the process by which organisms collect and store chemicals from their environment. Plankton are specifically adapted for extracting scarce chemicals from the seawater and storing them for food. Normally, the phytoplankton uptake nutrients such as nitrogen and phosphorus. However, in areas heavily polluted with PCBs, the plankton uptake it as well. And then, when ingested, the plankton becomes toxic to other living organisms.



In this story, other living organisms, such as small fish or crustaceans, eat the toxic plankton. Then, the bigger fish (snapper) eats the smaller fish or crustacean. This toxicant is stored in the fish tissues and becomes 10 times more toxic with each eating sequence!

Part 3: Water quality

- 1) No, Smellie Bait has witnessed this event 4 times.
- 2) a. The "river of cooler water" connects the two islands, Yap and Palau.
b. The ocean current occurs regularly since traditional navigators relied on it in the past to transport the Yapanese Rai. *Students should make the connection that the ocean current is capable of transporting other things like plankton and the fish that eat the plankton and the bigger fish that eat the fish that eat the plankton, etc. The larger predatory fish would be attracted to these schools and follow them towards Palau.*
- 3) Water temperature, salinity, pH, and dissolved oxygen. *Students should be familiar with the Hanna sensor since it is used on their worldwide voyage to measure water quality.*
- 4) Water quality and plankton samples. *This question is similar to question 2 from Part 1.*
- 5) Yap - *Matching similar water parameters is the key to understanding where the 'new' water is coming from. The student should understand that the water surrounding each island has distinct properties and those properties provided in Table 1 and Chart 1 provide an example to demonstrate this point. If the water moves from Yap to Palau, then the water properties in Palau should match relatively closely to Yap. This is an over-simplistic example, for water transportation and mixing is a bit more complicated and beyond the scope of this activity.*
- 6) Dr. Pepod could examine plankton DNA to match particular type of plankton species. *Like the explanation above with the water parameters, specific species or distribution of plankton could be unique to Yap. If a match exists with the 'new' water in Palau, then this information provides more evidence that the 'new' water came from Yap.*
- 7) Yes. The PCB toxin is likely to be bioaccumulated by predatory fish. And, the people of Palau who catch and eat these fish could get sick from the toxins. *For further understanding of bioaccumulation and food chains, see the Explanation from Part 1.*



Explanation: This case demonstrates ocean connectivity among water **constituents**, marine organisms, and people. When the temperature in the atmosphere changes, winds begin to blow. This force is one of several mechanisms that cause ocean water to move. Some water currents can move fast like water shooting out of a fire hose while others move much slower. Sometimes, on the outer edges of currents, if the water flow is disturbed, it can **shear** resulting in a small **eddy** to spin off these currents. These eddies trap the original water and its constituents until the spinning slows and, eventually, it mixes with the adjacent water.

The shapes of islands can affect water flow. In the above example, water circulation around the Palau **archipelago** is steered away from and around the archipelago. The eddies that form from this current are the most common means of marine organism dispersal. Identifying the extent of larval exchange among marine ecosystems is of primary importance for furthering our understanding of connectivity among marine populations.

Genetic variation is important because it allows organisms to become adaptable to changes in their environment. Circumstances always change, so the ability to react and adapt to those changes is vital for survival. But, sometimes this water eddy transport mechanism also carries harmful elements, such as toxicants. Scientists can apply genetic testing techniques to organisms, like plankton, to distinguish between different species type and the scientists observe their morphological differences. This relatively new technique will greatly enhance our understanding of species population and distribution in the global ocean, so we can better monitor the human impact on marine ecosystems worldwide.

Note, the blue-belly trevally does not exist in real life. The current from Yap to Palau does exist, however the 10 year occurrence of it was created to provide a simplistic demonstration of ocean current periodicity. Eddies can form from this current and the traditional canoes from Yap did use this current to travel to Palau for monetary exchanges. And yes, the coins were so heavy over 20 men were needed to lift one coin!

Vocabulary

- 1) **Archipelago** - a group or chain of islands
- 2) **Bioaccumulation** - the process by which contaminants such as mercury, arsenic, PCBs, etc. concentrate and magnify as it moves up the food chain - a threat to all species.
- 3) **Constituents** - (water) parts found in the water to make that water mass unique
- 4) Dissolved Oxygen -
- 5) **DNA** - genetic material found in all living organisms; specifically, a nucleic acid molecule in the form of a twisted double strand double helix that is the major component of chromosomes and carries genetic information. DNA, which is found in all living organisms except some viruses, reproduces itself and is the means by which hereditary characteristics pass from one generation to the next.
- 6) **Eddy** - the swirling of a fluid and the reverse current created when the fluid flows past an obstacle
- 7) **Endocrine disruptors** - a substance that interferes with the endocrine system, sometimes causing reproductive or developmental problems, e.g. by mimicking a natural hormone
- 8) **Food chain** - a hierarchy of different living things, each of which feeds on the one below
- 9) **Genetics** - the genetic makeup of an organism or group of organisms
- 10) **Morphology** - the form and structure of an organism or of a part of an organism
- 11) **Outflow pipe** - discharge; the flow, movement, or transfer of (pollutants) away from a place
- 12) **PCBs** (polychlorinated biphenyls)- belong to a broad family of man-made organic chemicals known as chlorinated hydrocarbons
- 13) Plankton - see page 12
- 14) **Predator** - In ecology, predation describes a biological interaction where a predator (an animal that is hunting) feeds on its prey (the animal that is attacked). Often results the eventual absorption of the prey's tissue through consumption.
- 15) **Rai** - Yapanese stone currency, usually dough-nut shaped and made of calcite
- 16) Toxicants - a type of poison human made or introduced into the environment by human activity
- 17) **Transposed** - to take something (genetic makeup) out of its original setting and relocate it in another. Story context - PCBs can transfer from nonliving to living particles. The diatom, *Ditylum*, one of the phytoplankton most sensitive to metal poisoning, secretes an outer mucous sheath, which can slough off along with any pollutants adhering to it.
- 18) **Transformed** - to convert one form of something to another. Story context - some plankton have the ability to alter, breakdown (transform) chemicals foreign to their systems.
- 19) **Transported** - to carry something from one place to another. Story context - the transfer of pollutants from dissolved to particulate (solid) material, such as generation of fecal pellets by zooplankton.

Plankton Summary

The term plankton comes from the Greek word “Planktos” meaning wanderer or drifter. Plankton are organisms that live in the water and cannot swim. Alternatively, to move, plankton drift with the ocean currents and tides. Plankton can be classified into two main groups: phytoplankton (plants) and zooplankton (animals). This naming convention is easy to remember because what do you expect to find at the zoo? Animals, right? Even though the word is pronounced, zoa-plankton, it is spelled z-o-o. Phytoplankton get their name from photosynthesis. What other living thing depends on converting light to energy? Plants, right? So phytoplankton are plants. Next time you swim in the ocean and get water in your mouth, you have swallowed thousands of these organisms!! More than likely that gulp of seawater will include a few copepods, a zooplankton that contains more protein than any other organism in the ocean per its volume!

Not all plankton remain plankton and some will grow into other familiar sea creatures such as shrimp, lobsters, fish and coral! These zooplankton are termed *meroplankton*. Those plankton that spend their entire lives as plankton, like the copepod, are termed *holoplankton*. Holo sounds a lot like “whole” so that may help you remember its definition because holoplankton spend their whole life as plankton.

Plankton are very important because they form the base of the marine food web. Phytoplankton are eaten by zooplankton which are then eaten by small fish. Small fish get eaten by medium fish, which are in turn eaten by large fish, such as tuna. Sharks and other predators are at the top of the food web eat the big fish. Without plankton, none of the larger fish or animals in the ocean could survive. The entire marine food web would collapse.

Take four deep breaths. Would you believe phytoplankton are responsible for 2 of those breaths? They provide 50% of the oxygen we breathe!

It is important to take care of our oceans and keep pono or balance in the marine ecosystem. A slight change in plankton (type, distribution, and/or quantity) will have large impacts on all the organisms depending on them to survive - including us!