The Oceans Connect Us

Plankton & Genetic Activity

University of Hawaii at Manoa,
Kewalo Marine Laboratory
6/28/2013

The Oceans Connect Us

Overview

The shared passion to stimulate interest on how we, as a global society, are connected by the oceans is what brings the University of Hawai'i Kewalo Marine Laboratory (UH KML) and Polynesian Voyaging Society (PVS) together. This booklet is designed to thread the fieldwork conducted by the students involved with the worldwide voyage with its application.

Students will collect and examine plankton, microscopic organisms that live in the water column. These organisms play a critical role in the ocean food web, and can serve as indicators of changes in the ocean ecosystem. The collected plankton will be preserved during the voyage and used for genetic testing (by UH KML staff). Seawater samples will also be observed during the voyage to monitor levels of dissolved oxygen and pH concentrations.

Suggestions for Curriculum Placement:

The content in this booklet covers Earth Science standards from 4th Grade to Junior College levels. The stories are easy to read and the corresponding extension questions grow in complexity, easy to difficult. Answers and explanation to questions are provided which allow the Teacher the flexibility to adjust the student-learning competency per grade level.

Materials:

Field Samples:	DNA extraction example:
Plankton Binder (data sheets)	Strawberry & plastic bag
Plankton tool box (50 vials w preservative)	Plastic bag
Hanna Water Quality Sensor	Coffee filter & container
Pen/pencil	Salt, soap, & chilled alcohol

Background Information:

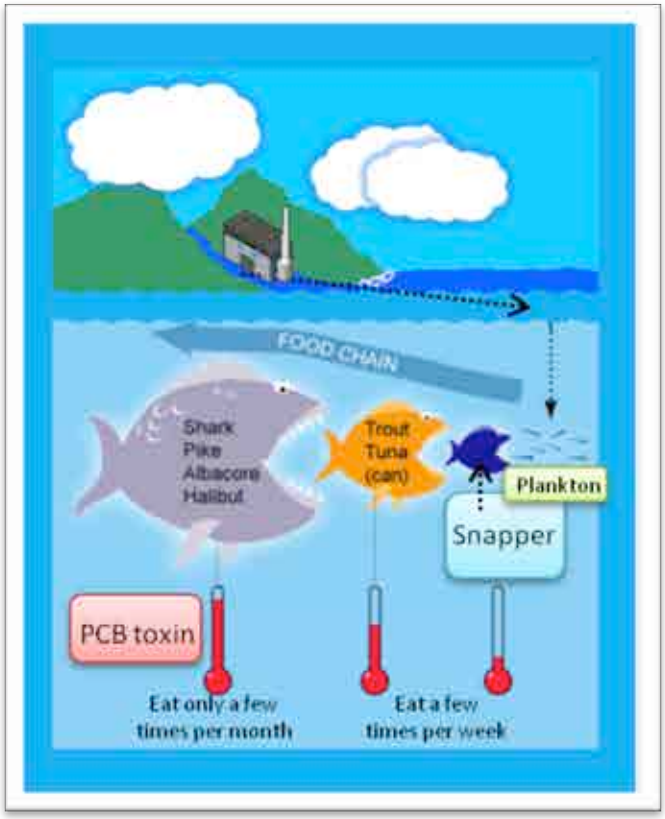
Prior to this activity, students will learn about plankton basics by the organization, *KahiKai.* However, a plankton review is provided on page 10. Answers to questions, extensions of scientific concepts, and vocabulary definitions can be accessed online via
http://hokulea.org/worldwide-voyage-curriculum-activities-2/

The four-part plankton activity design was inspired by Dave Gulko's "The Sea Sleuth: Edventures of a Marine Detective". Students take-on a marine detective role and solve marine related crimes. These modules challenge students to draw connections among plankton and the physiological factors that influence their global morphology and distribution. Additionally, students will consider various anthropogenic impacts such as pollution and climate change on plankton from a conservation perspective. By the end of this module, students should be able to explain how the oceans connect us and offer adaptive strategies for future sustainable conservation practices.

- Part 1: Food Web & Bioaccumulation
- Part 2: DNA Testing & Application **hands-on demo*
- Part 3: Water Quality Testing, DNA Analysis, and Ocean Currents
- Part 4: Ocean Connections

Plankton Activity

Part 1:
Food Web & Bioaccumulation



Danny Glover from the "Fish are Better in Bread" Restaurant called you today to tell you of another case where a guest got sick from eating the snapper sandwich. The guest was sent to the hospital for neurological symptoms (impaired vision and hearing). Immediately you are concerned because the number of these cases has increased in a very short time. Later that day, you read in the newspaper about a spear fisher woman being awarded for catching the largest snapper. The snapper was caught just offshore from the A.H.H Natural Gas facility. Being the savvy marine biologist you know heavy metals such as **PCBs** are likely to leach into the water from the facility's poorly maintained **outflow pipes**.

QUESTIONS:

1) Is there a direct correlation to the A.H.H Natural Gas facility and sick guest?

2) Identify the resources would you need to test your hypothesis and explain why you selected those resources.

3) How would plankton play a direct role in this case? Hint, apply your knowledge of the **food chain/web**.

See page 8 for answers to questions & explanation for this module.

Part 2:

DNA testing and application

Sandy Soup, your lab technician, collects several liters of water near the A.H.H. Gas Facility and tests the samples for heavy metal concentrations. She discovers the amount of PCBs found is the highest she has seen in her career and she is concerned how the PCBs may be **transposed**, **transformed**, and **transported** by the plankton.

Sandy needs your help to extract the **DNA** and send it to her professor, Dr. C.O. Pepod, who can run the proper analysis. By examining the DNA, Dr. Pepod will be able to determine the plankton species type and test for chemicals that disrupt the **endocrine system** such as PCBs.

START

Place strawberry in ziplock bag & mash to a pulp

Place pulp in a coffee filter and squeeze it thru with your hands. Pulp-juice will collect at the bottom of the coffee pot

Add 3 parts soap to 1 part salt to a cup & stir

Combine mixtures

Add 3 parts of alcohol, chilled is best

After about 5 minutes DNA extracts from the Strawberry, floats to the top

FINISH

Part 3:

Water quality testing, DNA analysis, and currents

Dr. Pepod tells you that one lazy afternoon he was talking story with the local fishermen, Smellie Bait, who couldn't stop chatting about the return of the blue-belly trevallies. This is the 4th time in his 45 years of fishing that he has seen so many of them. Not only are they good eating, they sell for 3 times the amount of normal fish caught. Dr. Pepod is concerned because he knows the blue-belly trevallies typically are found over 500 miles offshore from his home island of Palau. As you return to your laboratory, you bump into your friend Wei Finder, fisherman and traditional navigator. He tells you a story regarding the transportation of the early Yapanese currency, the **Rai**. It is believed over 20 men would be needed to lift one of these heavy calcite-stone coins! He further explains during this time, the Yapanese would travel on their traditional canoes once a decade to Palau to trade currencies, following a river of cooler water. You thank Mr. Wei for his helpful story and return to meet Dr. Pepod at his boat to lend him your Hanna water quality sensor.

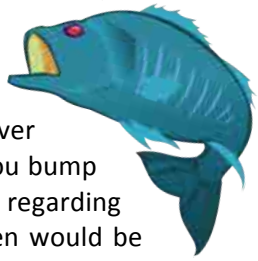
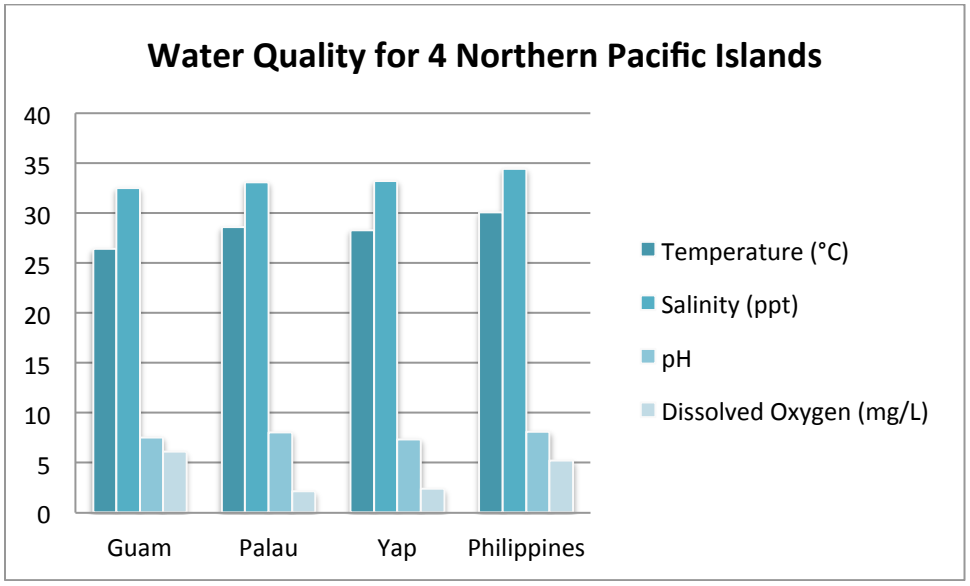


Table 1: Comparison of water quality data collected for 4 Northern Pacific Islands.

	Guam	Palau	Yap	Philippines
Temperature (°C)	26.4	28.6	28.3	30.1
Salinity (ppt)	32.5	33.1	33.2	34.4
pH	7.55	8.01	7.36	8.1
Dissolved Oxygen (mg/L)	6.08	2.12	2.38	5.2

Chart 1: Comparison of water quality data collected using a Hanna Sensor.



Questions:

1) Is this the first time the blue-belly trevally have been close to the shores of Palau?
2) Locate Palau and Yap on a map. From the story, what clue connects these two islands? How is this helpful to solving the case?
3) What water quality parameters does the Hanna sensor measure?
4) If you were Dr. Pepod, what would you want to test in order to understand why the blue-belly trevallies are so close to the shores of Palau?
5) Using Table 1 & Chart 1, identify the water quality parameters for the island that most matches those of Palau.
6) What other test could Dr. Pepod use to determine where the water is from?
7) If the waters in Yap were high in toxins like PCBs, should Dr. Pepod be concerned for **predatory fish** species near Palau?

See page 9 for answers to questions and explanation to module.

Part 4:
Ocean Connections

Presently, scientists understand only a fraction of the different types of plankton species and their global distribution. This information is critical to understand the local and global scale impacts on marine organisms and assess the overall health of the oceans. Sewage outflow is an example of a local impact, where as temperature increases in the world's oceans represents a global impact. The latter represents one of the consequences of a changing global climate. When seawater temperature rises, other constituents, like pH, also changes, making the oceans more acidic. Consequently, calcium carbonate organisms such as those containing shells, some species of plankton, and even corals, will dissolve much like Alka-Seltzer dissolves in water. Marine organisms will either adapt (changing their morphology) or die.

Students participating on the worldwide voyage have a very important role in helping scientist understand the impacts of these local and global changes. On their voyage, the students will collect simultaneous water quality and plankton. The plankton will be place in a preservative and shipped to scientists at the University of Hawai'i Kewalo Marine Laboratory. Scientists will analyze the plankton by examining the plankton genetics through DNA. This information will be paired with its corresponding water quality parameters. Combined, this data will provide a baseline for future investigations on our changing oceans.

> *"The importance of our ocean for the stability of the global environment, for meeting a significant proportion of the world's protein requirements, for the production of certain marine resources in waters that are relatively clear of pollution, for the global reserves of mineral resources among others, has been increasingly recognized, and puts paid to the notion that Oceania is the hole in the doughnut. ...Our role in the protection and development of our ocean is no mean task; it is no less than a major contribution to the well-being of humanity. Because it could give us a sense of doing something very worthwhile and noble, we should seize the moment with dispatch."*
>
> *- Adapted from "Our Sea of Islands" by Epeli Hau'ofa*