Activity #2

Marine Food Webs

● ● ● Class Period One *Constructing Marine Food Webs*

Materials & Setup

For each group of four to six students

- Marine Food Chains and Webs Cards (master, pp. 23-28)
- Student Page "Living and Eating On the Web" (pp. 29-30)
- Three large pieces of paper (at least the size of a flip chart page)
- Colored marking pens, at least three colors per group
- Scotch tape

For each student

- Student Page "Poison Pathways" (pp. 31-33)
- Student Page "Poison Pathways: Questions on the Reading" (pp. 34-35)

Instructions

1) Divide students into groups of four to six.

2) Give each group a set of cards, paper, and marking pens.

3) Have students follow the instructions on the Student Page "Living and Eating on the Web" to create one or more marine food chains (15 minutes).

4) Have each group present its food chain to the whole class, allowing each group two minutes to present.

5) Have students follow the instructions on the student activity sheet to create a marine food web, using all of the cards in the set. NOTE: Groups may want to tape the two remaining sheets of paper together for their food web, since it will be larger than the food chain (20 minutes).

6) Have each group present its food web to the class, allowing each group two minutes to present. If there is time at the end of the class, discuss questions and observations from the activity.

7) Keep the food webs intact for the next class period.

8) As homework, assign the Student Page "Poison Pathways."

● ● ● Class Period Two *Poison Pathways*

Materials & Setup

For each group of four to six students

- Food webs from the previous class period
- One colored marker (of a different color than they used to create their food webs, if possible)

Instructions

1) Divide the class into the same groups as in the previous class. Have each group add to its food web to show how ciguatoxin is transferred between organisms and bioaccumulates in the food chain until it reaches humans. Groups should show how people could get ciguatera poisoning from eating herbivorous fishes as well as from carnivorous fishes. They will need to use information from the Marine Food Chains and Webs Cards as well as the Student Page "Poison Pathways" and will need to draw additional species onto their food webs to illustrate the transfer of ciguatoxin.

2) When groups have finished their work, have each present its results to the class.

3) Discuss student responses to and questions about the homework assignment.

4) As a wrap-up to the "Poison Pathways" activity, share with students the following information from J. L. Shirai, L. K. Shirai, and Y. Hokama, *Seafood Poisoning: Ciguatera*, Yosh Hokama Family Trust, Gardena, California, 1991. This passage provides some insight into the third homework question, which asked students to hypothesize about how *ʻūʻū* or soldierfish might be implicated in cases of ciguatera poisoning:

> Examination of the clinical symptoms in patients with pufferfish, shellfish (red tide due to dinoflagellates) and polyether type toxin (ciguatoxin, okadaic acid, brevetoxin and other polyether) poisonings shows that the symptoms overlap and the causative toxins can't be distinguished. In other words, there is no unique feature that separates the clinical effect. The temperature reversal was supposedly unique for ciguatoxin. This is no longer the case as…okadaic adid, palytoxin, brevetoxin and other ciguatoxin-like compounds including organophosphates and botulism toxin can produce this clinical effect (p. 9).

Journal Ideas

- Draw a food web that includes some of your favorite foods and illustrates their relationship with other organisms when they (or their constituent ingredients) were alive.
- If you got ciguatera poisoning or another kind of seafood poisoning, would you change anything about your fishing or eating habits? If so, what? If not, why not?

Assessment Tools

- Group food chains and webs and in-class presentations (Evaluate based on reasoning, consistency with information given on the cards, and clarity of presentation.)
- Student Page "Poison Pathways: Questions on the Reading" (teacher version, pp. 21-22)
- Group ciguatoxin bioaccumulation illustrations and in-class presentations
- Journal entries

Teacher Version

Poison Pathways: Questions from the Reading

1) Draw a food chain showing how a person could get ciguatera poisoning from eating one of the herbivorous fishes.

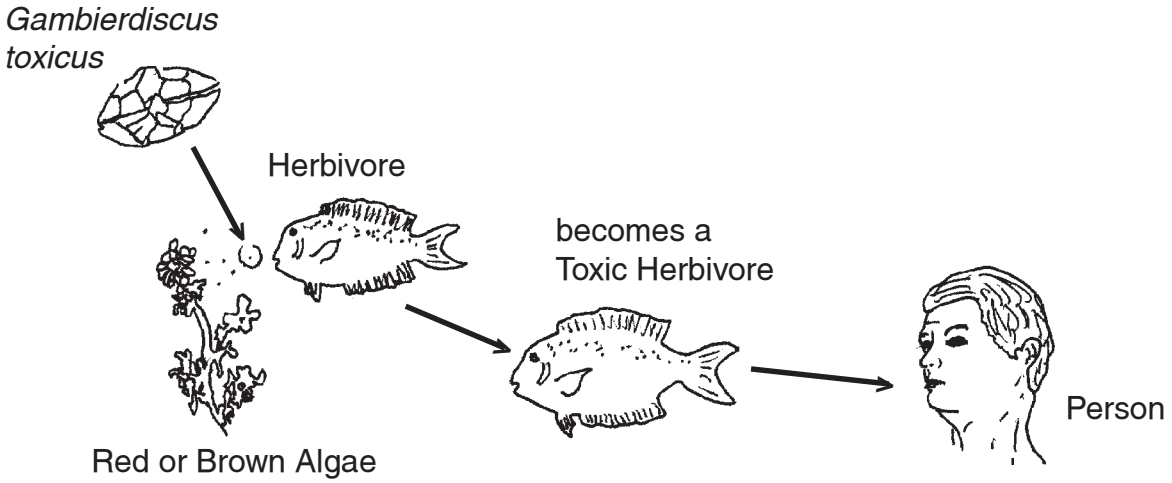


Image after J. L. Shirai, L. K. Shirai, and Y. Hokama, Seafood Poisoning: Ciguatera*, Yosh Hokama Family Trust, Gardena, California, 1991*

2) Draw a food chain showing how a person could get ciguatera poisoning from eating one of the carnivorous fishes.

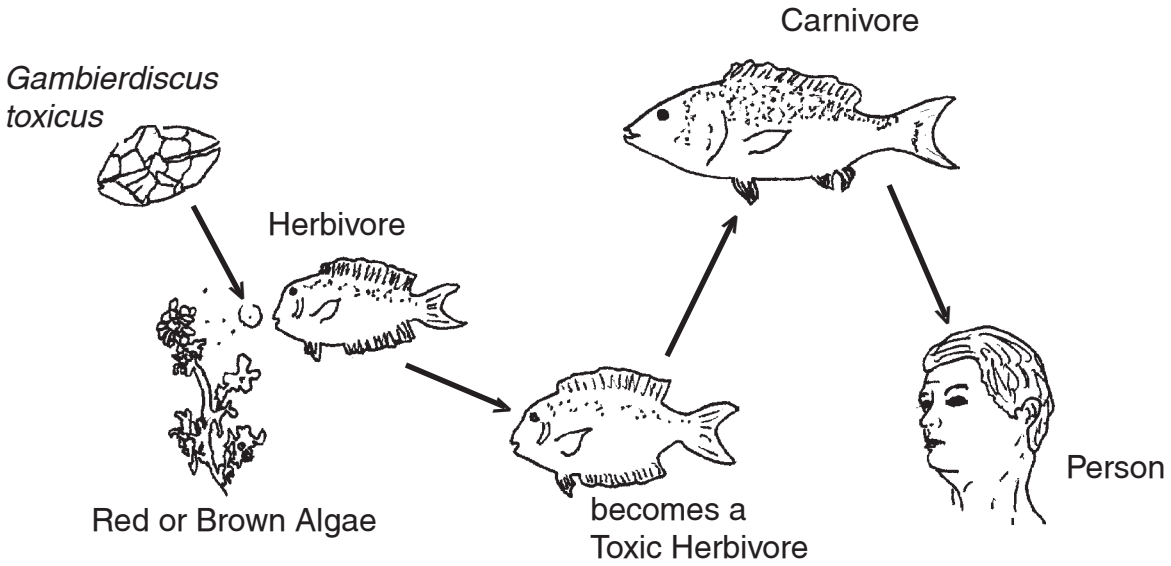


Image after J. L. Shirai, L. K. Shirai, and Y. Hokama, Seafood Poisoning: Ciguatera*, Yosh Hokama Family Trust, Gardena, California, 1991*

3) *ʻŪʻū* or soldierfish do not fit into the two categories of fish that become ciguatoxic: herbivores that graze on "toxic" algae, and carnivores that feed on toxic herbivores. *ʻŪʻū* feed on plankton in midwater—away from the algae growth. Come up with one possible explanation for the fact that *ʻūʻū* have been implicated in at least one case of ciguatera poisoning in Hawaiʻi and describe it below in as much detail as you can. (You do not need to do additional research to formulate your explanation, but make sure you clearly explain your idea and your reasoning.)

Possible answers include:

- It was a case of mistaken reporting by the person who got ciguatera.
- As *ʻūʻū* feed on plankton, they may ingest *Gambierdiscus toxicus* dinoflagellates that dislodged from the algae, perhaps by wave action, and are floating freely in the water.
- There may be other toxins that are chemically similar to the ciguatoxin and cause the same symptoms but come from other sources, for example, within the plankton.
- There may be other types of dinoflagellates that produce ciguatoxin, and these may be found in the plankton that *ʻūʻū* feed on.

Marine Food Chains and Webs Cards

Cut on solid lines

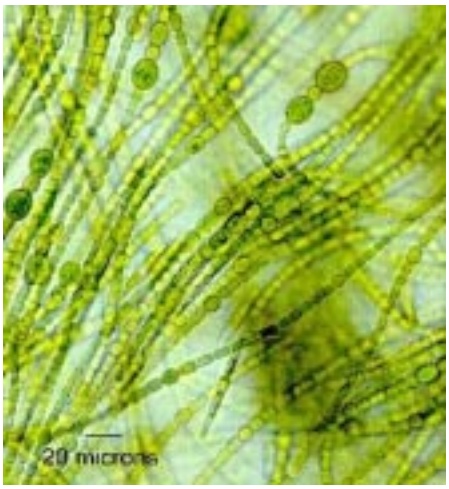


Photo: Roger Burks (University of California, Riverside), Mark Schneegurt (Wichita State University), Cyanosite (www-cyanosite.bio.purdue.edu/index.html)

Blue-green algae (Cyanobacteria)

These are primitive plant-like organisms which receive energy from the sun for photosynthesis. Some live on the surface of *limu* and are eaten along with the algae.

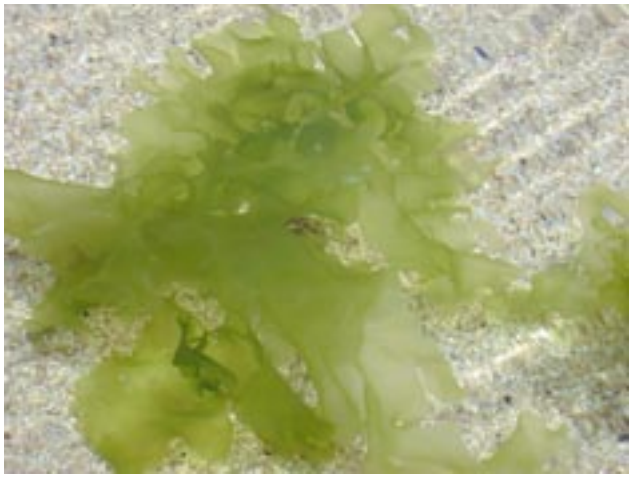


Photo: Kim Martz and Forest Starr

Limu (various species of seaweed)

Grows on rocks
Receives energy from the sun for photosynthesis

Photos: Karl Embleton, Sir Alister Hardy Foundation for Ocean Sciences

Phytoplankton

These are microscopic plants floating in the water which receive energy from the sun.

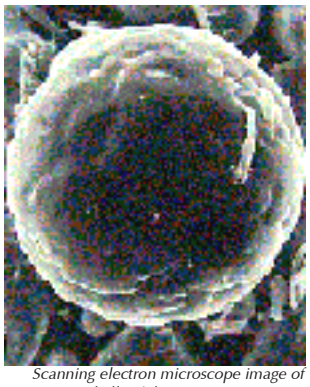
Photo: Karl Embleton, Sir Alister Hardy Foundation for Ocean Sciences

Zooplankton

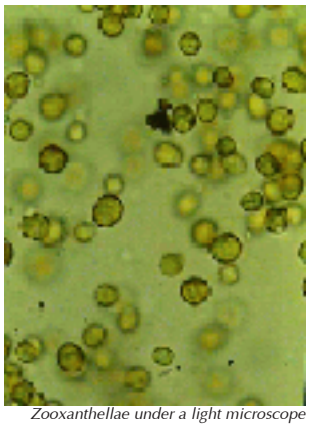
Most are tiny animals floating in the water, but some are larger, like jellyfish. The smallest ones feed on phytoplankton; larger ones eat smaller zooplankton.

Marine Food Chain and Web Cards

Cut on solid lines



Scanning electron microscope image of zooxanthellae (Photos: Scott R. Santos, SUNY at Buffalo)



Zooxanthellae under a light microscope

Zooxanthellae

Single-celled algae cells living in coral tissue that photosynthesize and provide the coral with 90% of its food

Photo: Jan Barosh in John P. Hoover, Hawaii's Fishes, *Mutual Publishing*

Spiny porcupinefish - *Kōkala* (*Diodon holocanthus*)

Feeds on snails and crabs

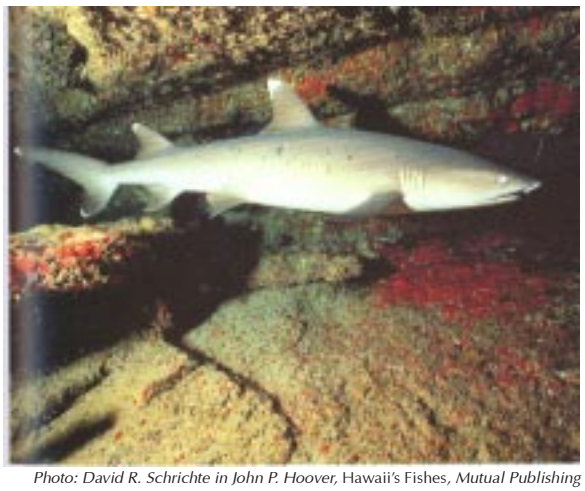


Photo: David R. Schrichte in John P. Hoover, Hawaii's Fishes, *Mutual Publishing*

Whitetip reef shark - *Manō lālā kea* (*Triaenodon obesus*)

Feeds at night on reef fish, octopus, lobster and crabs

Photo: Maui Ocean Center

Tiger shark - *Niuhi* (*Galeocerdo cuvier*)

Feeds on octopuses, crabs, sharks, rays, porpoises, seabirds, turtles, lobsters, slow-swimming fishes

Marine Food Chain/Web Cards

Cut on solid lines

Photo: John P. Hoover, Hawaii's Fishes, *Mutual Publishing*

Bigeye scad - *Akule* (*Selar crumenophthalmus*)

Feeds on zooplankton

Photo: John P. Hoover, Hawaii's Fishes, *Mutual Publishing*

Hawaiian dascyllus - *ʻĀloʻiloʻi* (*Dascyllus albisella*)

Feeds on zooplankton

Photo: Scott Johnson in John P. Hoover, Hawai'i's Sea Creatures, *Mutual Publishing*

Penniform cone snail - *Pūpū pōniuniu* (*Conus pennaceus*)

Feeds on other snails

Photo: John P. Hoover, Hawaii's Fishes, *Mutual Publishing*

Fourspot butterflyfish - *Lau hau* (*Chaetodon quadrimaculatus*)

Feeds on coral polyps

Marine Food Chain/Web Cards

Cut on solid lines

Photo: Philip Thomas

Yellowmargin moray eel - *Pūhi paka* (*Gymnothorax flavimarginatus*)
Feeds on reef fish and octopus

Photo: John P. Hoover, Hawaii's Fishes, *Mutual Publishing*

Eyestripe surgeonfish - *Palani* (*Acanthurus dussumieri*)
Feeds on algae

Photo: David R. Schrichte in John P. Hoover, Hawai'i's Sea Creatures, *Mutual Publishing*

Day octopus - *He'e mauli* (*Octopus cyanea*)
Feeds on crabs and snails

Photo: Kim Martz and Forest Starr

Green sea turtle - *Honu* (*Chelonia mydas*)
Feeds on algae

Marine Food Chain/Web Cards

Cut on solid lines

Photo: John P. Hoover, Hawaii's Fishes, *Mutual Publishing*

Manta ray - *Hāhālua*
(*Manta* spp.)
Feeds on zooplankton

Photo: Philip Thomas

Cauliflower coral - *ʻĀkoʻakoʻa* or *Puna kea*
(*Pocillopora meandrina*)
Take energy primarily from zooxanthellae (which produce energy directly from the sun) in their tissues and also feed on zooplankton

Photo: John P. Hoover, Hawaii's Fishes, *Mutual Publishing*

Bluefin trevally - *ʻOmilu*
(*Caranx melampygus*)
Feeds on fishes

Photo: John P. Hoover, Hawaii's Fishes, *Mutual Publishing*

Spectacled parrotfish - *Uhu uliuli*
(*Scarus perspicillatus*)
Feeds on algae found on the surface of dead coral and on the zooxanthellae in live coral

Marine Food Chain/Web Cards

Cut on solid lines

Photo: John P. Hoover, Hawai'i's Sea Creatures, *Mutual Publishing*

Cowries - *Leho* (*Cypraea spp.*)

(Tiger Cowrey, *Cypraea tigris*, shown)
Most eat algae.