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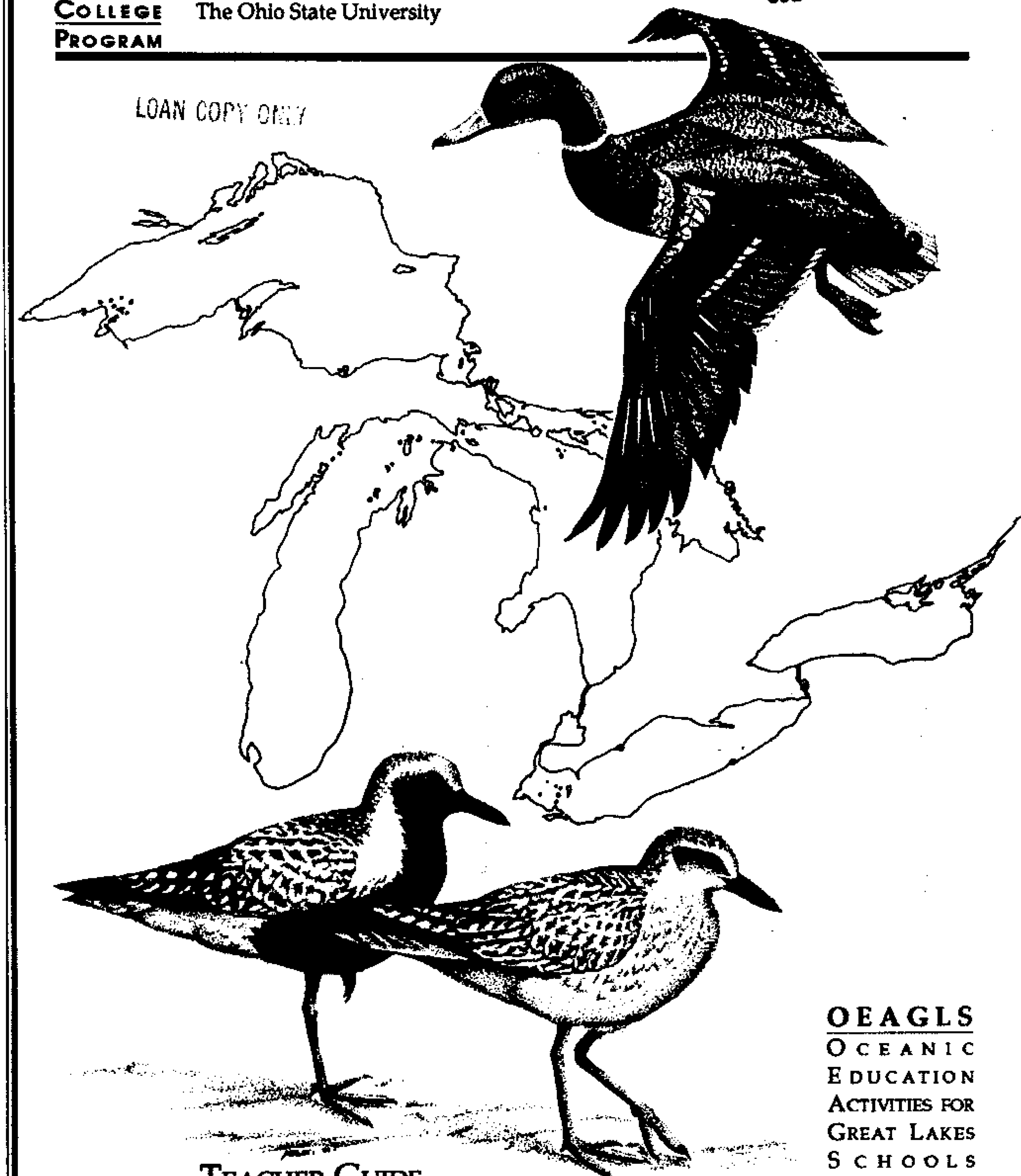
OHIO SEA GRANT COLLEGE PROGRAM

Eating like a bird

Chris Brothers & Rosanne W. Fortner

The Ohio State University



TEACHER GUIDE

OEAGLS
OCEANIC EDUCATION ACTIVITIES FOR GREAT LAKES SCHOOLS

Ohio Sea Grant College Program

OEAGLS EP-030T
Teacher Guide
Completed December 1991

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Activity A was adapted from "Bird Beak Buffet, " *Exploring the Coastal Environment and Its Resources,* San Francisco Bay Chapter Oceanic Society, 1988.

Activity B was adapted from "Food Chain Tag," *Supplemental Curriculum Activities for use with Holling Clancy Holling's Paddle to the Sea,* The Ohio State University Research Foundation, 1988.

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EATING LIKE A BIRD (EP-030T)
Teacher Guide*

OHIO SEA GRANT COLLEGE PROGRAM

Chris Brothers & Rosanne W. Fortner
The Ohio State University

Overview:
In Activity A, students use everyday objects to simulate species of shorebirds with beaks of different shapes and sizes. They gather different food items with different beak types then compare feeding success and survival to these adaptations. In Activity B, students play a tag game simulating organisms in a food chain and observe the concentration of toxics through the food chain.

Prerequisite Student Background:
Students should be able to construct bar graphs. They should be somewhat familiar with the concepts of adaptations and food chains. You may want to review or introduce these concepts before beginning the activities.

Objectives:
When students have completed these activities, they should be able to:

1. describe how shorebirds' beaks are adapted for the types of foods they eat,
2. identify how such adaptations determine feeding success and affect survival, and
3. explain how the concentration of toxic chemicals changes through the food chain and how it affects birds.

Materials:
Activity A: (For a class of thirty)—30 paper cup "stomachs"; "food items": 150-200 marbles, 300 round toothpicks, 150-200 metal washers or pennies; "beak types": 10 spoons, 10 clothespins, 20 popsicle sticks or tongue depressors; newsprint paper for a large graph. **Activity B:** (for a class of 20-30 students)—At least 200 small squares of paper; one paper lunch bag for each student; and short pieces of yarn in three colors.

Audiovisual Aids:
The Ohio Sea Grant Education Program has a set of labeled slides of ducks and geese in the Lake Erie region available for loan. The borrower pays return first-class postage only. Other slides can be purchased from biological supply house catalogs.

Suggested Approach:
Both activities together will take approximately 45 minutes to complete, depending on how many rounds you choose to play. Students may need extra time to complete their graphs and question sheets.

***Note:** Information to teachers is enclosed in boxes in this guide.

Ohio Sea Grant College Program

EATING LIKE A BIRD (EP-030T)
Teacher Guide

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Introduction:

Over three hundred different kinds of birds have been seen in the Great Lakes region. Canada geese, bitterns, coots, rails, terns, and many species of ducks nest in the marshes. The islands are important nesting sites for egrets, herons, gulls, and cormorants. Bald eagles nest in trees along the shoreline. Many more bird species are found in the forests and fields around the lakes. This great variety of birds is found in the Great Lakes region because the area includes so many kinds of habitats, the places in which birds live. Different habitats provide the nesting sites and feeding places that the birds need to live. Each species of bird is adapted for living in a certain kind of habitat and for feeding on certain kinds of foods.

Some of the birds in the Great Lakes region are common birds while others are rare or endangered. The bald eagle became endangered when DDT, a pesticide used to kill insects, caused the birds to lay very thin-shelled eggs. These eggs were easily crushed by the parent bird when it tried to incubate them. Other chemicals found in the Great Lakes affect other species of birds. Cormorant chicks are sometimes born with misshaped beaks that keep them from eating. Although the Great Lakes region supports many nesting and feeding birds, chemicals found in the area may threaten the lives and health of these birds.

Objectives:

When students have completed these activities, they should be able to:

1. describe how shorebirds' beaks are adapted for the types of foods they eat,
2. identify how such adaptations determine feeding success and affect survival, and
3. explain how the concentration of toxic chemicals changes through the food chain and how it affects birds.

Terns and some other Great Lakes birds have beaks deformed by toxic pollutants. Could this bird eat a fish?

Activity A: How are shorebirds adapted for feeding?

Marshes and mudflats in the Great Lakes support many shorebirds. All seem to feed in the same area, yet the different species of birds rarely compete for food. Where shorebirds feed together, their sizes, shapes, food tastes, and behavior help them gather the food items for which they are best adapted. In a marsh or mudflat, many different kinds of birds can feed together because there are many different kinds of food items available. Each type of bird is best suited for eating a certain type of food.

Small birds, like sanderlings and dunlin, pluck tiny insects from the surface or first inch of mud. Plovers and dowitchers pick up worms and mollusks a little deeper in the mud or sand. Willets and godwits with longer bills pull out small clams, worms, and other animals that burrow still deeper in the mud.

Materials:

(For a class of thirty)—30 paper cup "stomachs"; "food items": 150-200 marbles, 300 toothpicks, 150-200 metal washers or pennies; "beak types": 10 spoons, 10 clothespins, 20 popsicle sticks or tongue depressors; newsprint paper for a large graph.

Procedure:

A. In this activity, you will play the part of a hungry shorebird. You have a special kind of "beak" for getting "food" to go in your paper cup "stomach." Other birds will be feeding in the same area and may be trying to get the same kind of food. Discuss how each beak might be used to pick up food.

> Have students sit in a circle on a carpeted floor or rough pavement in an area large enough to avoid bumping and crowding by the hungry birds. Each student should have a paper cup stomach in which to collect food and either a spoon, clothespin, or set of two popsicle sticks to use as a beak. There should be an equal number of each type of beak in the group. If there is not, you will need to divide the total number of the food type by the number of birds having that type of beak. Another possibility is to have one or two students assist with data collection. In step E, when all three food items are available at the same time, there should be about the same number of each food available.

B. Your teacher will distribute one of the food types (pennies, marbles, or toothpicks) on the floor. When the teacher gives the signal, start picking up food from the floor "mudflat." You must use only your beak to pick up the food and put it in your stomach.

> Allow about 20 to 30 seconds for the birds to eat.

C. At the end of round one, count the number of food items in your stomach. On your answer sheet, add and record for each type of beak the number of food items eaten by the students having that kind of beak.

D. Feed two more times using each of the other two food items. Again, add and record on your answer sheet the total number of that food item eaten by students with different types of beaks.

E. Try testing all three food items at the same time. Record on your worksheet the total of each type of food eaten by each type of beak.

F. Draw a bar graph of the results of your experiments. Discuss the results of your feeding experiments with your class. Answer the questions on your worksheet.

> See sample, figure TG-1. The bar graph can be done with the whole class, at the blackboard or on a piece of newsprint, or each student can draw his or her own graph on graph paper. This game can also be modified and played on desk or table tops with smaller groups of students.

1. Which beak type gathered the most marbles? Which gathered the most pennies? Which gathered the most toothpicks? Which types of beaks seem to be best adapted for which types of food?

> The beak best adapted for each type of food is the one that is able to pick up the most of that food. For example, spoons may be good for picking up marbles but not toothpicks; clothespins may be good for picking up toothpicks and pennies; popsicle sticks can pick up toothpicks and pennies but perhaps not as well as clothespins.

2. What could a bird do if the only food item available in a mudflat was marbles, but its beak was not well adapted for eating marbles?

The bird might move to another mudflat or marsh where more of the food it is well adapted for eating is available. The bird may switch to other food sources that its beak will allow it to eat. The bird may starve if it cannot find another food source.

3. What might happen to the birds in the marsh if a chemical spill "killed" all of the marbles but did not affect the toothpicks or pennies?

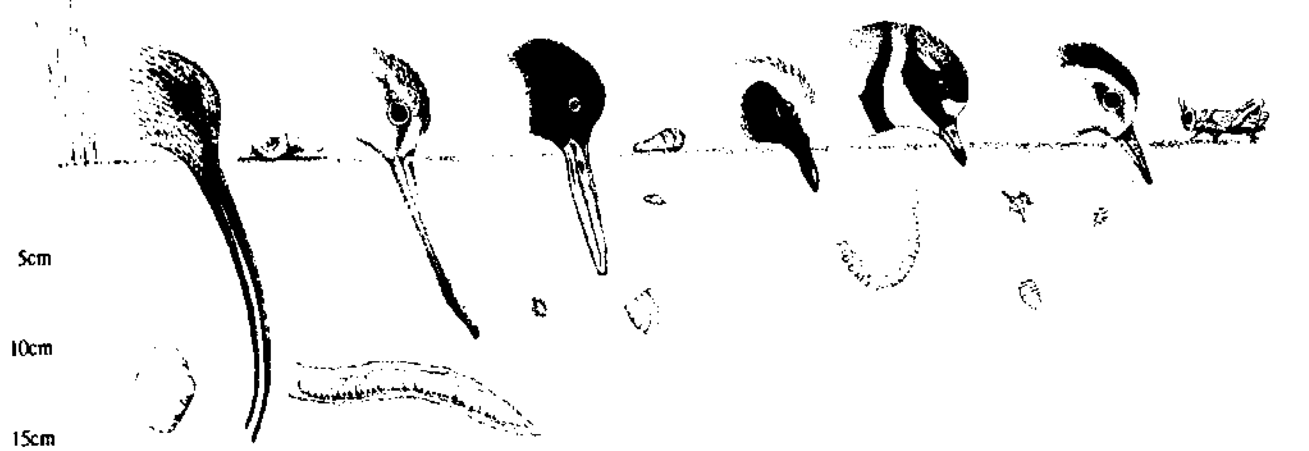
The spoonbills might be greatly affected since they rely heavily on marbles for food. They might starve or they might try to eat more pennies. If they ate more pennies, they would be competing more with clothespinbills and popsicle stick birds for food. Answers will vary depending on the actual data your students collect.

4. In the last experiment, did each beak type obtain some food when all three food items were available at one time? Was it easier to get more food with only one type available or with all the food items together? How did success at finding food in the last round differ from the rounds with only one kind of food?

If all three kinds of birds were competing for the same food type, even those birds best adapted for gathering that food may have found it hard to get much food because some of it was being eaten by the other kinds of birds. If more than one type of food is available, each bird can eat the food it is best adapted to catching. Thus it will likely be easier to find food and each bird type will have greater feeding success when all three food types are available. In general, the more kinds of food available, the greater the number of bird species that can live in the mudflat or marsh.

5. How are your simulated spoon, clothespin, and popsicle stick beaks like those of real birds? Look at photographs or drawings of birds in field guides, books, magazines, or on posters to find out.

Each species has a beak especially adapted for the type of food and how the food is gathered.



Long-billed Curlew	Marbled Godwit	American Oystercatcher	Black-bellied plover	Semipalmated Plover	Least Sandpiper
(*Numenius americanus*)	(*Limosa fedoa*)	(*Haematopus palliatus*)	(*Pluvialis squatards*)	(*Charadrius semipalmatus*)	(*Calidris minutilla*)
Body length 50-60cm (20-24in)	**Body length** 42-50cm (16.5-20in)	**Body length** 42.5-50cm (17-20in)	**Body length** 27.5-37cm (11-15in)	**Body length** 15-18cm (6-8in)	**Body length** 12.5-15cm (5-6in)
Food molluscs, worms, and insects.	**Food** grasshoppers, insects and their larvae, molluscs, snails, and crustaceans.	**Food** bivalves, snails, and worms.	**Food** grasshoppers, seeds, and berries.	**Food** worms, insects, crustaceans, and seaweed.	**Food** small crustaceans, worms, insects, and larvae.

Each species has a beak specially adapted for the type of food and how the food is gathered.

Adapted from Dee Estuary Conservation Group © 1976

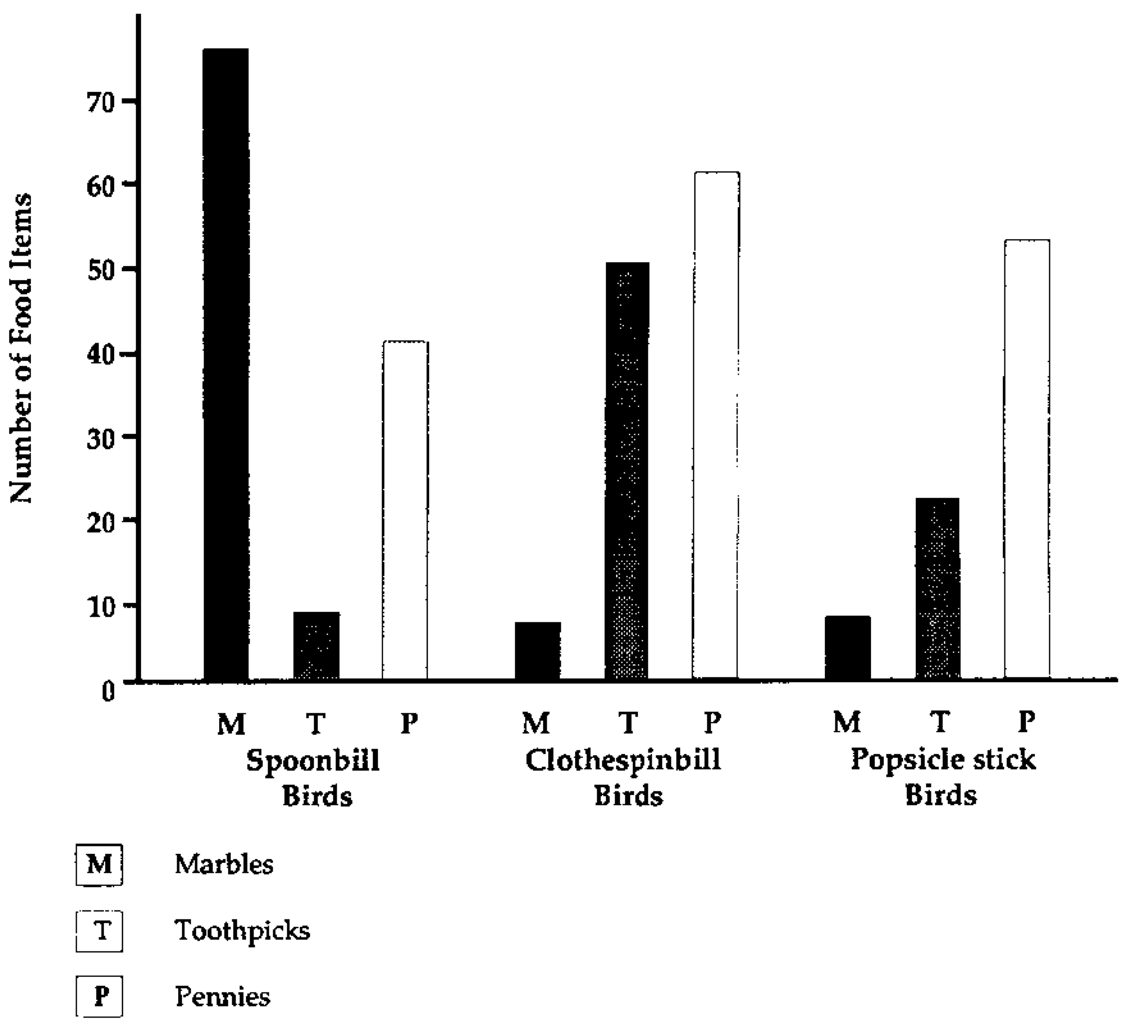


Figure TG-1. Sample graph of the ability of different types of birds to obtain various foods.

Activity B: How do toxins move through the food chain?

Many of the chemicals we use in our homes and on our farms are poisonous, or toxic. These chemicals include insecticides, weed killers, oil-based paints, nail polish remover, silver polish, motor oil, and many cleaning products. Our factories also produce many toxic chemicals as waste in manufacturing. What happens when these chemicals enter the environment? How do they affect the plants and animals in a food chain? How are birds in the Great Lakes affected by these toxins?

Materials:

(For a class of 20-30 students)—At least 200 small squares of paper; one paper lunch bag for each student; and short pieces of yarn in three colors.

> Before the game, mark about 1/3 of the paper squares with an X. Fold all the papers in half so that marked and unmarked ones appear identical. The marked papers represent contaminated algae. (See Procedure, item E.) Divide the students into two groups of equal size. From one of these two groups, separate out one third of the students to form a third group. You should have about 15 students in the largest group, 10 in the second group, and 5 in the smallest group.

Procedure:

A. In this game you will play the part of a *Daphnia* (water flea), sunfish, or cormorant. The *Daphnia* will feed on paper square algae, the sunfish on the *Daphnia*, and the cormorants on the sunfish. The organisms form a food chain in the food web shown. Since this is a tag game, you will be trying to get enough food into your lunch bag stomach to survive without being eaten yourself. *Daphnia* can only gather algae, the sunfish may only catch *Daphnia*, and the cormorants may only catch sunfish. Each organism in the game will be identified by a different color piece of yarn.

B. Decide where the boundaries of the game will be. Your teacher will scatter the paper algae over the ground within these boundaries. This algae is the *Daphnia's* food source. When the signal is given, the *Daphnia* can start feeding by gathering as many paper squares as they can and putting the food into their stomachs.

> Play this game in a large open area, either inside or outside. Give each student a lunch bag and one of the three colors of yarn. The largest group of students should be the *Daphnia*, the next largest group, the sunfish, and the smallest group the cormorants. Make sure each student knows which organism the three colors of yarn represent. Students may want to tie the yarn around their wrists or waists.

C. Once the *Daphnia* have had some time to feed, your teacher will send in the sunfish to start feeding on the *Daphnia*. The sunfish should try to tag the *Daphnia*. When a *Daphnia* is caught, it must give its lunch bag stomach, including all the paper algae collected, to the sunfish. Tagged *Daphnia* are out of the game and must go to the sidelines.

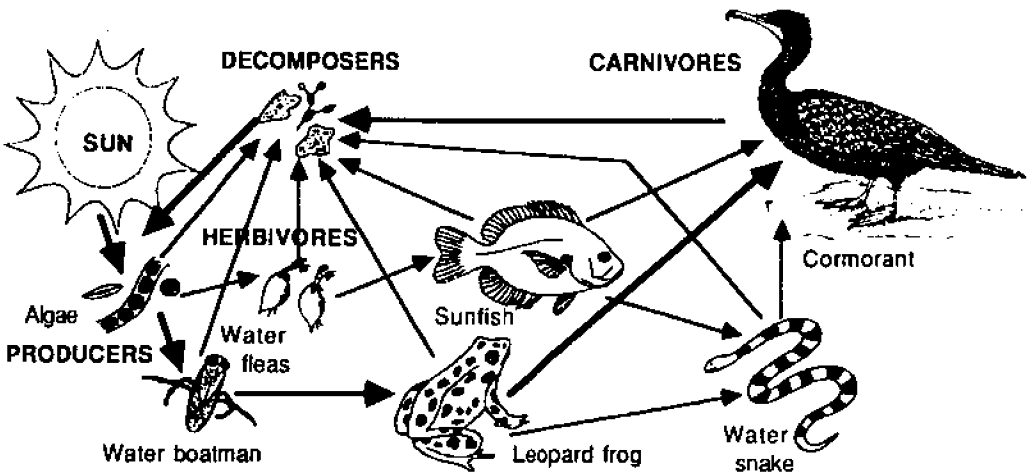
D. Once the sunfish have had some time to feed, your teacher will send in the cormorants to start feeding on the sunfish. When a sunfish is caught, it must give its stomach with all the papers it has collected to the cormorant who will put them into its stomach. The sunfish is then out of the game and must go to the sidelines. The other sunfish should continue to catch *Daphnia* while avoiding the cormorants.

> Allow about 30 seconds for the *Daphnia* to feed before sending the sunfish into the game and about 30 seconds for the sunfish to feed before sending in the cormorants. Let the cormorants feed about one minute before ending the game. You will need to adjust these times depending on how quickly students gather food and catch each other.

E. At the end of the game, gather with the rest of your class to discuss the results. Find out how many of each group were eaten and how many escaped. Have those who escaped empty their stomachs and count the number of contaminated algae papers they collected. The contaminated pieces are marked with an **X**. Use the chart on page 5T to determine how many of each group will "die" because of the amount of poison they have eaten and how many will not be able to reproduce successfully. Discuss which organism has the greatest number of contaminated algae pieces and why this is so. Answer the following questions on your worksheet.

1. Did any *Daphnia* survive being eaten by the sunfish? How many of the *Daphnia* survived but were not able to reproduce? How many *Daphnia* died because they accumulated too much poison?

EFFECTS OF TOXINS		
Organism	**Number of Toxic Algae Papers**	**Status**
Daphnia	Less than 3	Survives
	3-4	Survives but cannot reproduce
	More than 4	Dies
Sunfish	Less than 4	Survives
	4-6	Survives but cannot reproduce
	More than 6	Dies
Cormorant	Less than 5	Survives
	5-8	Survives but cannot reproduce
	More than 8	Dies



A sample food web that includes the food chain in Activity B.

2. Did any sunfish survive being eaten by the cormorants? How many of the sunfish survived but were not able to reproduce? How many sunfish died because they accumulated too much poison?

3. How many of the cormorants survived but were not able to reproduce? How many cormorants died because they accumulated too much poison?

Response to these questions will vary depending on the actual data collected by your class.

4. What kind of organism collected the most contaminated algae pieces in its stomach? Why did this kind of organism accumulate the most toxins?

The cormorants should have collected the most contaminated algae pieces because they accumulated all those picked up by the *Daphnia* as well as all those picked up by the sunfish.

In this game, you should have seen an increase in the number of toxic algae papers the organisms at different levels of the food chain had collected. The sunfish should have had more toxic algae papers than the *Daphnia* and the cormorant more than the sunfish. This increase in the amount of toxins found at higher levels in the food chain is called *biomagnification*. In addition, older or bigger individuals usually have higher levels of toxins in their bodies than younger or smaller ones. This phenomenon is called *bioaccumulation*.

5. Why do older or bigger animals usually have higher levels of toxins in their bodies than younger or smaller animals?

Older animals have been feeding longer and have had more time to accumulate toxins. Larger animals generally need to eat more food. Thus, they pick up more toxins than animals that consume less food. Older animals are also larger than younger ones of the same species.

Some toxic chemicals consumed by an animal are stored in its body fat and are in turn passed on to any animal that eats it. One alga might pick up and store one molecule of a toxic chemical. A small invertebrate, such as a *Daphnia*, might consume 10 of these poisoned algae and thus accumulate 10 toxic molecules in its body. A fish, such as a sunfish, that eats 10 of these contaminated *Daphnia* will then have 100 toxic molecules in its body. Finally, a cormorant or other bird that eats 10 sunfish would have accumulated 1000 toxic molecules.

6. Why do those animals high in the food chain have higher levels of toxins than animals at lower levels of the food chain?

> Animals high in the food chain have accumulated all the toxins picked up by the animals they feed on as well as the toxins accumulated by all the other organisms lower than them in the food chain.

The chemical poisons accumulated by a fish or bird may not kill it directly but may keep it from reproducing or may cause other problems. In recent years, scientists have found increasing numbers of Great Lakes fish with *cancerous tumors* and fish-eating birds with crossed beaks, a defect that keeps them from being able to eat. Birds may also have *cataracts* in their eyes and deformed feet that prevent them from standing.

Scientists can measure the amounts of toxins in the bodies of different animals to get an idea of how many and what kinds of toxic chemicals are found in the Great Lakes. Although the levels of some chemicals are decreasing through clean-up efforts, other toxins are still found at high levels even though their use or production has been banned. This is because these chemicals take a long time to break down, or because they are blown in from countries where they are not prohibited.

Ideas for Extension Activities:

1. How might the surface on which the birds are feeding affect their feeding success? Conduct more feeding experiments using different surfaces. For example, try grass, concrete, sand, or a wood floor. As another alternative, put the foods in water. Some will float and perhaps have an effect on beak success.

2. If possible, go birdwatching with your class to watch real shorebirds feeding. If a trip to a marsh or mudflat is not possible, try watching birds feeding at a bird feeder. How are these birds using their beaks as feeding tools?

3. Show drawings or photographs of some real birds, the foods they might eat, and the habitats they might live in. Have students match each bird with the food item it would eat and with its habitat.

4. Do library research on the safe use and disposal of household chemicals. Which products are toxic? What nontoxic products can be used instead? Does your community have a household toxic chemical collection site or disposal program?

5. Read more about toxic chemicals in the Great Lakes. How do toxins enter the lakes? What chemicals are of special concern? What is being done to clean up toxins in the lakes?

Suggested References:

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Edwards, Clayton J. "Toxics in Lake Erie" in *The Great Lake Erie*, Rosanne W. Fortner and Victor J. Mayer, editors. The Ohio State University Research Foundation, 1987, p. 136.

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Review Questions

1. An ornithologist (a scientist who studies birds) makes the following observations on the food eaten by three types of ducks: scaup, black, and merganser ducks.

Type of duck	# of fish eaten	# of insects eaten	#of plants eaten
Scaup	2	45	0
Black	0	25	40
Merganser	15	5	0

A. Which bird(s) beak is probably best adapted for feeding on fish?

a. Scaup b. Black duck c. Merganser d. Both a and b

B. If an oil spill killed the insects and fish in the marsh, which bird(s) would be most likely to survive?

a. Scaup b. Black duck c. Merganser d. Both a and b

1A: c. Merganser 1B: b. Black duck

2. How do the beaks birds have affect the kinds of foods they can eat?

Each bird's beak is adapted for catching and eating certain kinds of prey or for feeding on certain kinds of plants. While the bird may be able to feed on other organisms as well, it is probably best suited for certain ones.

3. Why would birds have greater feeding success in a marsh where there are many food types available than in a marsh with only a few kinds of foods available?

When there are more food types available, each species of bird can feed on the kinds of food for which it is best adapted. It may be easier to find food with more types available and there may be less competition from other birds trying to feed on the same food. In general, the more kinds of foods available, the greater the number of birds that can live in the marsh.

4. What does biomagnification mean?

Biomagnification refers to the process by which toxins become increasingly concentrated as they pass up a food chain. Typically, those organisms at lower levels in the food chain have lower concentrations of toxins and those at higher levels have greater concentrations.

5. What are some of the effects that toxins have on fish, birds, or other wildlife?

Toxic chemicals may cause cancerous tumors, cataracts, crossed beaks, misshapen feet, and other birth defects. Toxins may also keep animals from being able to reproduce successfully. If levels are high enough, the chemicals may be lethal.

Ohio Sea Grant College Program

Eating Like a Bird (EP-030T)

Answer Sheet

Activity A: How are shorebirds adapted for feeding?

1. Which beak type gathered the most marbles? ______________________________

   Which gathered the most pennies? ______________________________

   Which gathered the most toothpicks? ______________________________

   Which types of beaks seem to be best adapted for which types of food ______________________________

   ____

2. What could a bird do if the only food item available in the mudflat was marbles, but its beak was not well adapted for eating marbles? ______________________________

   ____

3. What might happen to the birds in the marsh if a chemical spill killed all of the marbles, but did not affect the toothpicks or pennies? ______________________________

   ____

4. In the last experiment, did each beak type obtain some food when all three food items were available at one time? ______________________________

   ____

   Was it easier to get more food with only one type available or with all the food items together?

   ____

   How did success at finding food differ from the rounds with only one kind of food? ______________________________

   ____

5. How are your simulated spoon, clothespin, and popsicle stick beaks like those of real birds?

   ____

Eating Like a Bird (EP-030T)
Answer Sheet

Activity B: How do toxins move through the food chain?

1. Did any *Daphnia* survive being eaten by the sunfish? ____________________

   How many of the *Daphnia* survived but were not able to reproduce? ____________________

   How many *Daphnia* died because they accumulated too much poison? ____________________

2. Did any sunfish survive being eaten by the cormorants? ____________________

   How many of the sunfish survived but were not able to reproduce? ____________________

   How many sunfish died because they accumulated too much poison? ____________________

3. How many of the cormorants survived but were not able to reproduce? ____________________

   How many cormorants died because they accumulated too much poison? ____________________

4. What kind of organism collected the most contaminated algae pieces in its stomach? ____________

   Why did this kind of organism accumulate the most toxins? ____________________

   ____

5. Why do older or bigger animals usually have higher levels of toxins in their bodies than younger or smaller animals? ____________________

   ____

6. Why do those animals high in the food chain have higher levels of toxins than animals at lower levels of the food chain? ____________________

   ____

Oceanic Education Activities for Great Lakes Schools (OEAGLS)

Results of studies of student knowledge about the oceans and Great Lakes environments indicate a need for greater awareness of those environments, and a greater understanding of the impact they have upon the lives of people. OEAGLS (pronounced "eagles") are designed to take a concept or idea from the existing school curriculum and develop it into an oceanic and Great Lakes context, using teaching approaches and materials appropriate for children in grades five through nine.

OEAGLS materials are designed to be easily integrated into existing curricula. Investigations are characterized by subject matter compatibility with existing curriculum topics, short activities lasting from one to three classes, minimal preparation time, minimal equipment needs, standard page size for easy duplication, student workbook plus teacher guide, suggested extension activities for further information or creative expression, teachability demonstrated by use in middle school classrooms; and content accuracy assured by critical reviewers. Each title consists of a student workbook and a teacher guide and costs $3.00 for the publication, postage, and handling. If ordering EP-026, add an additional $4.00 to cover the cost of the computer disk.

THE EFFECT OF THE GREAT LAKES ON TEMPERATURE (EP-001)
THE EFFECT OF THE GREAT LAKES ON CLIMATE (EP-002)
ANCIENT SHORES OF LAKE ERIE (EP-003)
HOW TO PROTECT A RIVER (EP-004)
CHANGING LAKE LEVELS (EP-005)
EROSION ALONG THE GREAT LAKES (EP-006)
COASTAL PROCESSES AND EROSION (EP-007)
POLLUTION IN LAKE ERIE: AN INTRODUCTION (EP-008)
YELLOW PERCH IN LAKE ERIE (EP-009)
EVIDENCE OF ANCIENT SEAS IN OHIO (EP-010)
TO HARVEST A WALLEYE (EP-011)
OIL SPILL! (EP-012)
SHIPPING ON THE GREAT LAKES (EP-013)
GEOGRAPHY OF THE GREAT LAKES (EP-014)
OHIO CANALS (EP-015)
THE ESTUARY: A SPECIAL PLACE (EP-016)
THE GREAT LAKES TRIANGLE (EP-017)
KNOWING THE ROPES (EP-018)
GETTING TO KNOW YOUR LOCAL FISH (EP-019)
SHIPPING: THE WORLD CONNECTION (EP-020)
WE HAVE MET THE ENEMY (EP-021)
IT'S EVERYONE'S SEA: OR IS IT? (EP-022)
PCBs IN FISH: A PROBLEM? (EP-023)
A GREAT LAKES VACATION (EP-024)
STORM SURGES (EP-025)
RIVER TREK with computer program **(EP-026)**
WAVES (EP-027)
LAKE LAYERS: STRATIFICATION (EP-028)
NUTRIENTS IN THE GREAT LAKES (EP-029)
EATING LIKE A BIRD (EP-030)

OEAGLets

In the primary grade range we have three activities. All use Lake Erie information applied to all primary subject areas. Each title costs $5.00 for the publication, postage, and handling.

LAKE ERIE—TAKE A BOW (EP-031)
BUILD A FISH TO SCALE (EP-032)
A DAY IN THE LIFE OF A FISH (EP-033)

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All programs run on Apple II computer series.

EP-24/Disk This program is an optional purchase to accompany OEAGLS A GREAT LAKES VACATION. $4.00
EP-74/Disk To accompany OEAGLS EP-011, 019, 021, and 023. $5.00

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Dr. Jeffrey M. Reutter, Ohio Sea Grant Director

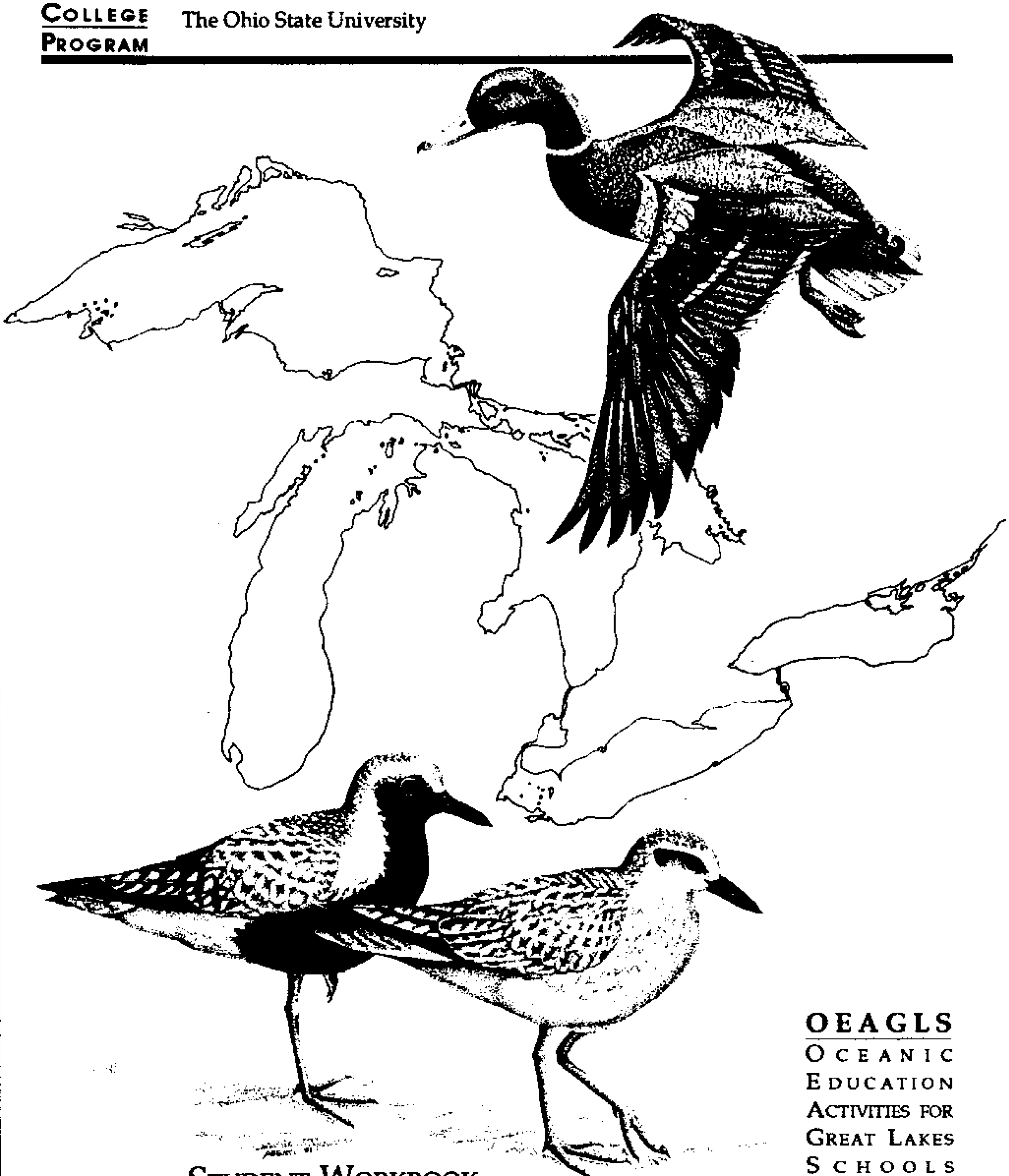
EP-030S

OHIO SEA GRANT COLLEGE PROGRAM

Eating like a bird

Chris Brothers & Rosanne W. Fortner

The Ohio State University



STUDENT WORKBOOK

OEAGLS
Oceanic Education Activities for Great Lakes Schools

OHIO SEA GRANT COLLEGE PROGRAM

OEAGLS EP-030S
Student Workbook
Completed December 1991

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Activity A was adapted from "Bird Beak Buffet," *Exploring the Coastal Environment and Its Resources*, San Francisco Bay Chapter Oceanic Society, 1988.

Activity B was adapted from "Food Chain Tag," *Supplemental Curriculum Activities for use with Holling Clancy Holling's Paddle to the Sea*, The Ohio State University Research Foundation, 1988.

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EATING LIKE A BIRD (EP-030S)
Student Workbook

OHIO SEA GRANT COLLEGE PROGRAM

Chris Brothers & Rosanne W. Fortner
The Ohio State University

Introduction:

Over three hundred different kinds of birds have been seen in the Great Lakes region. Canada geese, bitterns, coots, rails, terns, and many species of ducks nest in the marshes. The islands are important nesting sites for egrets, herons, gulls, and cormorants. Bald eagles nest in trees along the shoreline. Many more species are found in the forests and fields around the lakes. This great variety of birds is found in the Great Lakes region because the area includes so many kinds of habitats, the places in which birds live. Different habitats provide the nesting sites and feeding places that the birds need to live. Each species of bird is adapted for living in a certain kind of habitat and for feeding on certain kinds of foods.

Some of the birds in the Great Lakes region are common birds while others are rare or endangered. The bald eagle became endangered when DDT, a pesticide used to kill insects, caused the birds to lay very thin-shelled eggs. These eggs were easily crushed by the parent bird when it tried to incubate them. Other chemicals found in the Great Lakes affect other species of birds. Cormorant chicks are sometimes born with misshaped beaks that keep them from eating. Although the Great Lakes region supports many nesting and feeding birds, chemicals found in the area may threaten the lives and health of these birds.

Objectives:

When students have completed these activities they should be able to:

1. describe how shorebirds' beaks are adapted for the types of foods they eat,
2. identify how such adaptations determine feeding success and affect survival, and
3. explain how the concentration of toxic chemicals changes through the food chain and how it affects birds.

Terns and some other Great Lakes birds have beaks deformed by toxic pollutants. Could this bird eat a fish?

Each species has a beak especially adapted for the type of food and how the food is gathered.

Long-billed Curlew (*Numenius americanus*)	Marbled Godwit (*Limosa fedoa*)	American Oystercatcher (*Haematopus palliatus*)	Black-bellied plover (*Pluvialis squatards*)	Semipalmated Plover (*Charadrius semipalmatus*)	Least Sandpiper (*Calidris minutilla*)
Body length 50-60cm (20-24in)	**Body length** 42-50cm (16.5-20in)	**Body length** 42.5-50cm (17-20in)	**Body length** 27.5-37cm (11-15in)	**Body length** 15-18cm (6-8in)	**Body length** 12.5-15cm (5-6in)
Food molluscs, worms, and insects.	**Food** grasshoppers, insects and their larvae, molluscs, snails, and crustaceans.	**Food** bivalves, snails, and worms.	**Food** grasshoppers, seeds, and berries.	**Food** worms, insects, crustaceans and seaweed.	**Food** small crustaceans, worms, insects, and larvae.

Each species has a beak specially adapted for the type of food and how the food is gathered.
Adapted from Dee Estuary Conservation Group © 1976

Activity A: How are shorebirds adapted for feeding?

Marshes and mudflats in the Great Lakes support many shorebirds. All seem to feed in the same area, yet the different species of birds rarely compete for food. Where shorebirds feed together, their sizes, shapes, food tastes, and behavior help them gather the food items for which they are best adapted. In a marsh or mudflat, many different kinds of birds can feed together because there are many different kinds of food items available. Each type of bird is best suited for eating a certain type of food.

Small birds, like sanderlings and dunlin, pluck tiny insects from the surface or first inch of mud. Plovers and dowitchers pick up worms and mollusks a little deeper in the mud or sand. Willets and godwits with longer bills pull out small clams, worms, and other animals that burrow still deeper in the mud.

Materials:

(For a class of thirty)—30 paper cup "stomachs"; "food items": 150-200 marbles, 300 toothpicks, 150-200 metal washers or pennies; "beak types": 10 spoons, 10 clothespins, 20 popsicle sticks or tongue depressors; newsprint paper for a large graph.

Procedure:

A. In this activity, you will play the part of a hungry shorebird. You have a special kind of "beak" for getting "food" to go in your paper cup "stomach." Other birds will be feeding in the same area and may be trying to get the same kind of food. Discuss how each beak might be used to pick up food.

B. Your teacher will distribute one of the food types (pennies, marbles, or toothpicks) on the floor. When the teacher gives the signal, start picking up food from the floor "mudflat." You must use only your beak to pick up the food and put it in your stomach.

C. At the end of round one, count the number of food items in your stomach. On your answer sheet, add and record for each type of beak the number of food items eaten by the students having that kind of beak.

D. Feed two more times using each of the other two food items. Again, add and record on your answer sheet the total number of that food item eaten by students with different types of beaks.

E. Try testing all three food items at the same time. Record on your worksheet the total of each type of food eaten by each type of beak.

F. Draw a bar graph of the results of your experiments. Discuss the results of your feeding experiments with your class. Answer the questions on your worksheet.

1. Which beak type gathered the most marbles? Which gathered the most pennies? Which gathered the most toothpicks? Which types of beaks seem to be best adapted for which types of food?

2. What could a bird do if the only food item available in a mudflat was marbles, but its beak was not well adapted for eating marbles?

3. What might happen to the birds in the marsh if a chemical spill "killed" all of the marbles but did not affect the toothpicks or pennies?

4. In the last experiment, did each beak type obtain some food when all three food items were available at one time? Was it easier to get more food with only one type available or with all the food items together? How did success at finding food in the last round differ from the rounds with only one kind of food?

5. How are your simulated spoon, clothespin, and popsicle stick beaks like those of real birds? Look at photographs or drawings of birds in field guides, books, magazines, or on posters to find out.

Activity B: How do toxins move through the food chain?

Many of the chemicals we use in our homes and on our farms are poisonous, or **toxic**. These chemicals include insecticides, weed killers, oil-based paints, nail polish remover, silver polish, motor oil, and many cleaning products. Our factories also produce many toxic chemicals as wastes in manufacturing. What happens when these chemicals enter the environment? How do they affect the plants and animals in a food chain? How are birds in the Great Lakes affected by these toxins?

Materials:

(For a class of 20-30 students)—At least 200 small squares of paper; one paper lunch bag for each student; and short pieces of yarn in three colors.

Procedure:

A. In this game you will play the part of a *Daphnia* (water flea), sunfish, or cormorant. The *Daphnia* will feed on paper square algae, the sunfish on the *Daphnia*, and the cormorants on the sunfish. The organisms form a food chain in the food web shown. Since this is a tag game, you will be trying to get enough food into your lunch bag stomach to survive without being eaten yourself. *Daphnia* can only gather algae, the sunfish may only catch *Daphnia*, and the cormorants may only catch sunfish. Each organism in the game will be identified by a different color piece of yarn.

B. Decide where the boundaries of the game will be. Your teacher will scatter the paper algae over the ground within these boundaries. This algae is the *Daphnia*'s food source. Some of the algae has been contaminated with toxins, but the *Daphnia* can't tell which ones they are. *Daphnia* must eat all the algae they can gather. When the signal is given, the *Daphnia* can start feeding by gathering as many paper squares as they can and putting the food into their stomachs.

C. Once the *Daphnia* have had some time to feed, your teacher will send in the sunfish to start feeding on the *Daphnia*. The sunfish should try to tag the *Daphnia*. When a *Daphnia* is caught, it must give its lunch bag stomach, including all the paper algae collected, to the sunfish. Tagged *Daphnia* are out of the game and must go to the sidelines.

D. Once the sunfish have had some time to feed, your teacher will send in the cormorants to start feeding on the sunfish. When a sunfish is caught, it must give its stomach with all the papers it has collected to the cormorant who will put them into its stomach. The sunfish is then out of the game and must go to the sidelines. The other sunfish should continue to catch *Daphnia* while avoiding the cormorants.

E. At the end of the game, gather with the rest of your class to discuss the results. Find out how many of each group were eaten and how many escaped. Have those who escaped empty their stomachs and count the number of contaminated algae papers they collected. The contaminated pieces are marked with an **X**. Use the chart on page 7S to determine how many of each group will "die" because of the amount of poison they have eaten and how many will not be able to reproduce successfully. Discuss which organism has the greatest number of contaminated algae pieces and why this is so. Answer the following questions on your worksheet.

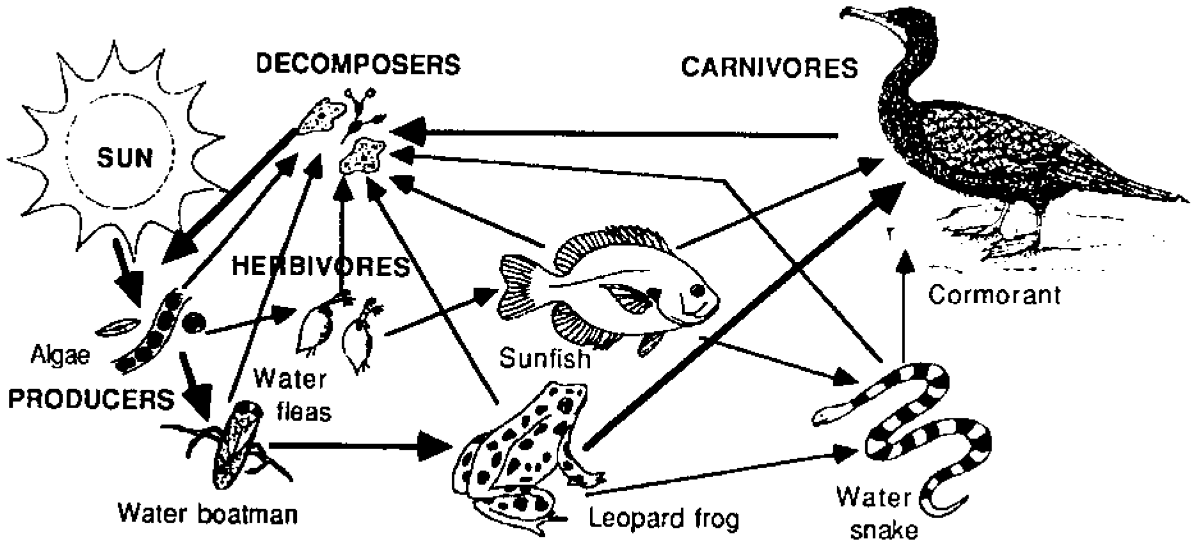
1. Did any *Daphnia* survive being eaten by the sunfish? How many of the *Daphnia* survived but were not able to reproduce? How many *Daphnia* died because they accumulated too much poison?

2. Did any sunfish survive being eaten by the cormorants? How many of the sunfish survived but were not able to reproduce? How many sunfish died because they accumulated too much poison?

3. How many of the cormorants survived but were not able to reproduce? How many cormorants died because they accumulated too much poison?

4. What kind of organism collected the most contaminated algae pieces in its stomach? Why did this kind of organism accumulate the most toxins?

In this game, you should have seen an increase in the number of toxic algae papers the organisms at different levels of the food chain had collected. The



A sample food web that includes the food chain in Activity B.

sunfish should have had more toxic algae papers than the *Daphnia* and the cormorant more than the sunfish. This increase in the amount of toxins found at higher levels in the food chain is called *biomagnification*. In addition, older or bigger individuals have higher levels of toxins in their bodies than younger or smaller ones. This phenomenon is called *bioaccumulation*.

5. Why do older or bigger animals usually have higher levels of toxins in their bodies than younger or smaller animals?

Some toxic chemicals consumed by an animal are stored in its body fat and are in turn passed on to any animal that eats it. One alga might pick up and store one molecule of a toxic chemical. A small invertebrate, such as a *Daphnia*, might consume 10 of these poisoned algae and thus accumulate 10 toxic molecules in its body. A fish, such as a sunfish, that eats 10 of these contaminated *Daphnia* will then have 100 toxic molecules in its body. Finally, a cormorant or other bird that eats 10 sunfish would have accumulated 1000 toxic molecules.

6. Why do those animals high in the food chain have higher levels of toxins than animals at lower levels of the food chain?

The chemical poisons accumulated by a fish or bird may not kill it directly but may keep it from reproducing or may cause other problems. In recent years, scientists have found increasing numbers of Great Lakes fish with *cancerous tumors* and fish-eating birds with crossed beaks, a defect that keeps them from being able to eat. Birds may also have *cataracts* in their eyes and deformed feet that prevent them from standing.

Scientists can measure the amounts of toxins in the bodies of different animals to get an idea of how many and what kinds of toxic chemicals are found in the Great Lakes. Although the levels of some chemicals are decreasing through clean-up efforts, other toxins are still found at high levels even though their use or production has been banned. This is because these chemicals take a long time to break down, or because they are blown in from countries where they are not prohibited.

EFFECTS OF TOXINS		
Organism	**Number of Toxic Algae Papers**	**Status**
Daphnia	Less than 3	Survives
	3-4	Survives but cannot reproduce
	More than 4	Dies
Sunfish	Less than 4	Survives
	4-6	Survives but cannot reproduce
	More than 6	Dies
Cormorant	Less than 5	Survives
	5-8	Survives but cannot reproduce
	More than 8	Dies

Review Questions

1. An ornithologist (a scientist who studies birds) makes the following observations on the food eaten by three types of ducks: scaup, black, and merganser ducks.

Type of Duck	# of fish eaten	# of insects eaten	#of plants eaten
Scaup	2	45	0
Black	0	25	40
Merganser	15	5	0

A. Which bird(s) beak is probably best adapted for feeding on fish?
a. Scaup   b. Black duck   c. Merganser   d. Both a and b

B. If an oil spill killed the insects and fish in the marsh, which bird(s) would be most likely to survive?
a. Scaup   b. Black duck   c. Merganser   d. Both a and b

2. How do the beaks birds have affect the kinds of foods they can eat?

3. Why would birds have greater feeding success in a marsh where there are many food types available than in a marsh with only a few kinds of foods available?

4. What does biomagnification mean?

5. What are some of the effects that toxins have on fish, birds, or other wildlife?

OHIO SEA GRANT COLLEGE PROGRAM

Eating Like a Bird (EP-030S)
Worksheet

NAME

Activity A: How are shorebirds adapted for feeding?

1. Which beak type gathered the most marbles? ____________________

   Which gathered the most pennies? ____________________

   Which gathered the most toothpicks? ____________________

   Which types of beaks seem to be best adapted for which types of food? ____________________

   ____

2. What could a bird do if the only food item available in the mudflat was marbles, but its beak was not well adapted for eating marbles? ____________________

   ____

3. What might happen to the birds in the marsh if a chemical spill killed all of the marbles, but did not affect the toothpicks or pennies? ____________________

4. In the last experiment, did each beak type obtain some food when all three food items were available at one time? ____________________

   Was it easier to get more food with only one type available or with all the food items together?

   ____

   How did success at finding food differ from the rounds with only one kind of food? ____________________

   ____

5. How are your simulated spoon, clothespin, and popsicle stick beaks like those of real birds?

   ____

Eating Like a Bird (EP-030S)
Worksheet

NAME ______________________

Activity B: How do toxins move through the food chain?

1. Did any *Daphnia* survive being eaten by the sunfish? ______________________

   How many of the *Daphnia* survived but were not able to reproduce? ______________________

   How many *Daphnia* died because they accumulated too much poison? ______________________

2. Did any sunfish survive being eaten by the cormorants? ______________________

   How many of the sunfish survived but were not able to reproduce? ______________________

   How many sunfish died because they accumulated too much poison? ______________________

3. How many of the cormorants survived but were not able to reproduce? ______________________

   How many cormorants died because they accumulated too much poison? ______________________

4. What kind of organism collected the most contaminated algae pieces in its stomach? ______________________

   Why did this kind of organism accumulate the most toxins? ______________________

   ____

5. Why do older or bigger animals usually have higher levels of toxins in their bodies than younger or smaller animals? ______________________

   ____

6. Why do those animals high in the food chain have higher levels of toxins than animals at lower levels of the food chain? ______________________

   ____

Oceanic Education Activities for Great Lakes Schools (OEAGLS)

Results of studies of student knowledge about the oceans and Great Lakes environments indicate a need for greater awareness of those environments, and a greater understanding of the impact they have upon the lives of people. OEAGLS (pronounced "eagles") are designed to take a concept or idea from the existing school curriculum and develop it into an oceanic and Great Lakes context, using teaching approaches and materials appropriate for children in grades five through nine.

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