



Kure Waste Chase

In the Web-based game Kure Waste Chase, students take on the part of an *Ocean Adventures* expedition member volunteering for the U.S. Fish and Wildlife Service and explore various habitats (beach, water surface and underwater) to collect as much harmful marine debris as possible in a limited amount of time. Use the tips and handouts below to turn the Kure Waste Chase game into a structured learning activity for your students.

SUBJECTS

Science

GRADE LEVEL

Grades 6 through 10

TIME

One to two class periods

OBJECTIVES

Students will be able to

- identify marine debris.
- explain multiple effects marine debris can have on ecosystems.
- illustrate general patterns of ocean currents.

MATERIALS

- Volunteers Wanted! student handout #1
- Location Data Sheet student handout #2
- Marine Debris Data Sheet student handout #3
- Species Data Sheet student handout #4
- Reporting Data student handout #5
- Game Background teacher sheet #1
- Answer Key teacher sheet #2
- Voyage to Kure Viewing Guide (optional, found at pbs.org/oceanadventures/educators)
- Copy of Voyage to Kure episode of the *Jean-Michel Cousteau: Ocean Adventures* series (optional)

In the first two-hour episode of *Jean-Michel Cousteau:*

Ocean Adventures, Voyage to Kure, Jean-Michel Cousteau leads an expedition to the Northwest Hawaiian Islands (NWHI).

Kure Atoll is the primary location where vast amounts of drift marine trash concentrate in the NWHI. Marine debris collects at Kure Atoll because of its northern location, which puts it directly in the path of a major Pacific current. Tons of fishing nets and debris wash up on its reefs and beaches every year, creating a major entanglement hazard for monk seals, sea turtles, seabirds, sharks, fish and crustaceans. Although the other islands in the chain collect debris as well, Kure is the most vivid example because it is the most remote.

Based on the experiences of the *Ocean Adventures* team in the NWHI, Kure Waste Chase is a fast-paced interactive game in which students are the environmental heroes, ridding the NWHI of dangerous marine debris and learning about the ecosystems that they are helping to save. Playing the part of an *Ocean Adventures* team member volunteering with the U.S. Fish and Wildlife Service, students visit three separate locations -- the beaches of Kure Atoll, the surface water surrounding the atoll and the underwater coral reefs neighboring the atoll -- on their quest to gather as much marine debris as possible in an ever-shortening period of time. During their mission, students will have the opportunity to add to their scores by collecting information about the specific items they gather as well as information about the various species and ecosystems they encounter. Upon completion of the game, students will analyze their data and compile a report describing what they have learned, then submit their report to the Volunteer Supervisor (the teacher).

WEB LINKS

Kure Waste Chase Game
[pbs.org/oceanadventures/
episodes/kure](http://pbs.org/oceanadventures/episodes/kure)

**Northwestern Hawaiian Islands
Interactive Map**
[pbs.org/oceanadventures/
episodes/kure](http://pbs.org/oceanadventures/episodes/kure)

Ocean Futures Society
www.oceanfutures.org

STANDARDS

**National Science
Education Standards Grades 5-8**
[http://www.nap.edu/
catalog/4962.html](http://www.nap.edu/catalog/4962.html)

**Science As Inquiry -
Content Standard A**
Abilities necessary to do
scientific inquiry

**Physical Science -
Content Standard B**
Motions and forces
Transfer of energy

**Life Science -
Content Standard C**
Regulation and behavior
Populations and ecosystems
Diversity and adaptations
of organisms

**Earth and Space Science -
Content Standard D**
Structure of the earth's system
Earth in the solar system

**Science in Personal and
Social Perspectives -
Content Standard F**
Populations, resources
and environments
Natural hazards
Risks and benefits

TEACHER PREPARATION

- Using blank student handouts, play Kure Waste Chase yourself, paying particular attention to where you think your students will need extra guidance.
- Review the Game Background and the Answer Key.
- Based on the availability of computers, decide the best way for students to play the game—individually, in pairs or in groups.

PROCEDURE

- 1. Review Background Information:** It will be helpful if your students have a general understanding of ecological relationships before beginning the interactive—review terms such as “predator,” “prey,” “producer,” “consumer” and “decomposer.” You will also want to introduce students to the location of and facts about the NWHI on the interactive map and Kure Atoll information.
- 2. Introducing Marine Debris:** Use ideas from the *Voyage to Kure* Viewing Guide to set the scene. Pay particular attention to the Segment Suggestions for the marine debris theme (film clips from Laysan Island and Midway Atoll). If you do not have access to the *Voyage to Kure* episode, use the *Ocean Adventures* or *Ocean Futures Society* web sites to find pictures or bring in samples of marine debris to show to students, then lead a class discussion about the danger to animals and ecosystems.
- 3. Game Setup:** Pass out the Volunteers Wanted! notice, a fictional volunteer position posting from the U.S. Fish and Wildlife Service introducing volunteers (the students) to their marine debris removal mission. Explain to students that as part of the *Ocean Adventures* team, they will be a part of this volunteer mission. Give students an overview of how to play Kure Waste Chase, hand out the Location Data Sheet, the Marine Debris Data Sheet and the Species Data Sheet and explain that they will be collecting information for later use on these organizers. Have students record their hypotheses on their Location Data Sheet before game play begins.

**Ocean Literacy:
Essential Principles and
Fundamental Concepts**

[http://coexploration.org/
oceanliteracy/](http://coexploration.org/oceanliteracy/)

**Essential Principle #1:
Earth has one big ocean with
many features.**

c. Throughout the ocean there is one interconnected circulation system powered by wind, the tides, the force of Earth's rotation, the sun and water density differences. The shape of ocean basins and adjacent land masses influence the path of circulation.

**Essential Principle #5: The ocean
supports a great diversity of life
and ecosystems.**

d. Ocean biology provides many unique examples of life cycles, adaptations and important relationships among organisms (symbiosis, predator-prey dynamics and energy transfer) that do not occur on land.
e. The ocean is three-dimensional, offering vast living space and diverse habitats from the surface through the water column to the seafloor. Most of the living space on Earth is in the ocean.

4. Game Play: Allow students sufficient time to play the game and collect data.

5. Data Sharing: Set aside time for students to gather in small groups to review data after game play has ended to ensure all students have understood the game.

6. Reporting Information: Pass out the Reporting Data handout and explain the directions. Students will submit this "report" to you, their Volunteer Supervisor.

TEACHER NOTES

- Depending on the number of computers available, you might want to make adjustments, such as having students play the game on alternate days.
- When students are working in groups, it may be advantageous for each group member to collect different information for the organizer, then share it with the rest of the group (be sure to have group members rotate who actually plays the game). Another option is to have separate individuals/pairs/groups collect different information, then share their data in small groups after game play. For example, pair #1 collects species data, and pair #2 collects marine debris data; after game play, the two pairs join together to share and explain the data they have collected.

EXTENSIONS

- Lead students in the You Are What You Eat: Plastics and Marine Life activity, in which students discover the many ways marine life can be affected by plastics.
- Introduce students to the *Ocean Adventures* expedition team and their diverse careers using the Ocean Careers Exploration lesson.

These and additional educator resources for **Jean-Michel Cousteau: Ocean Adventures** can be found at pbs.org/oceanadventures/educators.

Essential Principle #6: The ocean and humans are inextricably interconnected.

- e. Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution (point source, nonpoint source and noise pollution) and physical modifications (changes to beaches, shores and rivers). In addition, humans have removed most of the large vertebrates from the ocean.
- f. Everyone is responsible for caring for the ocean. The ocean sustains life on Earth, and humans must live in ways that sustain the ocean. Individual and collective actions are needed to effectively manage ocean resources for all.

CREDITS

Jean-Michel Cousteau: Ocean Adventures is produced by KQED Public Broadcasting and the Ocean Futures Society.

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Volunteers Wanted

Join in the effort to remove marine debris from the beautiful Northwestern Hawaiian Islands!

Position

Kure Atoll Marine Debris Removal Volunteer

Location

Kure Atoll, Hawaii

Start Date

Accepting volunteers year-round

End Date

N/A

Partners

Ocean Adventures team and the U.S. Fish and Wildlife Service

Contact

Volunteer Supervisor

Activities

- Operate ATV for removal of beach debris
- Operate wave-runner or Zodiac for removal of surface water debris
- Use scuba gear and tow system for removal of submerged debris
- Collect data on marine debris found in various locations
- Collect data on species and ecosystems affected by debris
- Complete Reporting Data form and submit to the Volunteer Supervisor

Details

Seeking persons with quick reflexes to remove marine debris as rapidly as possible; must have note-taking skills and be detail-oriented.

Suitability

Teens and adults

Difficulty

Average (though difficulty will increase with success)

Location Data Sheet

Directions: Please fill out the following information for the location at which you are volunteering. This information will be used later when completing the report to submit your Volunteer Supervisor.

Volunteer Position: Kure Atoll Marine Debris Removal Volunteer

Before you begin your volunteer job, please make a hypothesis:

Why do you think all of this marine debris is ending up here, on Kure Atoll, when it is so far from where people live?

Longitude/Latitude: _____

(note: check expedition diary information for Kure Atoll or an atlas)

Country/State: _____

Name of surrounding ocean basin: _____

Problem you are helping with: _____

Why is this problem happening in this location? _____

Marine Debris Data Sheet 1 of 2

ITEMS	PURPOSE OF ITEM	WHAT DO YOU THINK IT IS MADE OUT OF?	WHAT ANIMALS DOES IT AFFECT?	WHAT CAN PEOPLE DO TO HELP?
Computer/ TV monitor tube				
Butane lighter				
Plastic bottle				

Marine Debris Data Sheet 2 of 2

ITEMS	PURPOSE OF ITEM	WHAT DO YOU THINK IT IS MADE OUT OF?	WHAT ANIMALS DOES IT AFFECT?	WHAT CAN PEOPLE DO TO HELP?
Plastic toy/buoy				
Balloon/plastic bag				
Ghost net				
Fishing line/hook				

Species Data Sheet 1 of 2

SPECIES	HABITAT	WHAT IT EATS	WHAT EATS IT	NICHE <small>(producer, consumer or decomposer)</small>	EFFECTS OF MARINE DEBRIS ON THE SPECIES
Plankton					
Christmas tree worm					
Green sea turtle					
Laysan albatross					
Hawaiian monk seal					

Species Data Sheet 2 of 2

SPECIES	HABITAT	WHAT IT EATS	WHAT EATS IT	NICHE <small>(producer, consumer or decomposer)</small>	EFFECTS OF MARINE DEBRIS ON THE SPECIES
Nesting bird					
Pelagic, or Portuguese man-of-war					
Tiger shark					
Galapagos shark					
Spinner dolphin					
Coral					

Reporting Data

Directions: Once you have fulfilled your volunteer duties and collected the proper data, please answer the following questions on a separate sheet of paper and submit with all of your data sheets to your Volunteer Supervisor.

1. Explain how debris ends up near the Northwestern Hawaiian Islands. Draw a diagram to clarify your answer.
2. Which species do you think is most affected by the marine debris? Why?
3. Which type of marine debris do you think causes the most damage? Why?
4. Draw a possible food chain from the animals that you have studied.
5. If large amounts of tiny plastic pieces are mistaken for plankton, what will happen to the ecosystem that they enter?
(Hint: What will happen to the animals that normally eat plankton and what will happen to the animals that eat the animals that eat plankton?)
6. One danger of marine debris is that it entangles animals. Many groups, like the Ocean Conservancy, conduct cleanups. The following data was collected in a 2004 cleanup. Make two pie graphs showing this data.

Chart 1: Number of Entangled Animals Found

- Invertebrates - 52
- Fishes - 62
- Reptiles - 7
- Birds - 46
- Mammals - 19

Chart 2: Number of Animals Found in Different Types of Debris

- Balloon ribbon/string - 9
- Rope - 30
- Fishing line - 88
- Fishing nets - 21
- Crab/lobster/fish traps - 9
- Other - 29

7. According to the graphs you have made:
 - a. Which animals ran into the most trouble?
 - b. What is the most dangerous type of debris found?
Why do you think it is so dangerous?
8. List some things that you and your friends can do to help prevent marine debris even if you do not live near the ocean.
9. Write a story from the point of view of a piece of marine debris. Start your story when you are bought by a person in a store. Tell about how you got used, how you were thrown away, how you became marine debris and how dangerous you now are. What do you wish the original person had done with you so you didn't end up in the ocean? Present your story to the class (read it, act it out or draw a poster/illustration).

Game Background

This is a dexterity game in which players take on the role of an *Ocean Adventures* team member volunteering with the U.S. Fish and Wildlife Service on a mission to collect as much unnatural marine debris as possible. Players start the actual game portion collecting debris at the beach and rocky terrestrial sites using an ATV and progress to offshore locations after the completion of the first level. Points are awarded based on speed of recovery and types of items recovered. As players progress to the second level, they collect near-shore at the surface using a wave-runner or Zodiac. The third level takes place underwater -- players, clad in scuba gear, are towed underwater to collect debris on the coral reef.

Assisting the players will be hint balloons from Jean-Michel Cousteau, offering additional information on the organisms encountered and the marine debris items collected. Players can pause game play to click on these hints (which they must do to gather data for their data sheets) and score additional points. This information is also available at level changes so as to not interrupt game play if desired.

LEVEL 1

Beaches: Coastal shorelines concentrate debris but fewer animals are directly affected by it, so fewer points per debris item collected are awarded. Very few animals ingest debris directly from the beach, but this debris either is scattered back into the sea by waves and wind or breaks down into microparticles under the sun's UV radiation and wave action. Although these processes are not visible, they are the biggest and most significant issues in the marine environment. These microparticles are believed to affect the entire food web because of high concentrations in filter-feeding organisms that inadvertently ingest them with their planktonic and detrital food. These filter feeding fish and invertebrates are fed upon by predators that concentrate the particles and associated toxins in their guts and tissues, reducing absorption of nutrients, often causing long-term illness and eventual death. This occurs all the way up the food web, including bony fish, sharks, seabirds, seals, dolphins and whales.

- **Creatures at risk:** Plankton, Christmas tree worm, green sea turtle
- **Collection vehicle:** ATV
- **Obstacles to collection:** Green sea turtle, Laysan albatross, Hawaiian monk seal, additional nesting birds
- **Debris items:** TV/computer tubes, butane lighters, plastic bottles, plastic toys/buoys

Game Background

LEVEL 2

Water surface: Debris lines, also called convergence zones (where two currents coincide, there is a temperature/salinity gradient or wind drives surface waters into each other), concentrate debris and therefore marine life that feeds on the debris is in a higher concentration here too. This area will carry a higher point value for each piece of debris collected since organisms can and will ingest or be trapped by the debris. Sea turtles will feed directly on plastic bags, balloons and bottles, mistaking them for near-surface jellyfish and salps that look like jellies. Seabirds have a tendency to eat natural debris (wood and so on) on which fish and invertebrates have laid their eggs; therefore, seabirds ingest large numbers of lighters and small plastic items. The birds are adapted to regurgitate indigestible debris, but with the large amount of plastic in the ocean, they ingest more than they can handle, much of it lacking the nutritious eggs they were looking for.

- **Creatures at risk:** Green sea turtle, Laysan albatross
- **Collection vehicle:** Wave-runner or inflatable Zodiac
- **Obstacles to collection:** Jellyfish, Hawaiian monk seal
- **Debris items:** Balloons/plastic bags, butane lighters, plastic bottles

LEVEL 3

Underwater: Underwater reefs snag nets, fishing line and hooks. These items will receive the highest point value because of their continuous trapping tendency. Fishing gear entangles a variety of species, often trapping and drowning them. The decomposing carcasses attract numerous other scavengers and predators, entangling them, thus continuing the trapping process. This debris is the hardest and most time-consuming to find and difficult to retrieve because of its underwater location and entanglement on the reef, but it is extremely important and rewarding to remove.

- **Creatures at risk:** Tiger shark, Galapagos shark, spinner dolphin, Hawaiian monk seal, coral
- **Collection vehicle:** Scuba tow
- **Obstacles to collection:** Time underwater, divers' entanglement, Tiger shark, Galapagos shark (often attracted to the nets)
- **Debris items:** Ghost nets, fishing lines/hooks

Answer Key

LOCATION DATA SHEET ANSWERS

Longitude/Latitude—Approximately 28°25'N latitude and 178°20'W longitude

Country/State—United States/Hawaii

Ocean Basin—Pacific Ocean Basin

Problem—Marine debris

Why here—Kure is at the center of the north Pacific gyre; counterclockwise-moving currents converge here, bringing animals, nutrients and debris

MARINE DEBRIS DATA SHEET ANSWERS

ITEMS	PURPOSE	MADE OUT OF (Note: answers will vary, data from game is listed below)	WHO DOES IT AFFECT?	WHAT CAN PEOPLE DO TO HELP?
Computer/ TV Monitor Tube	Entertainment	Cathode ray tube has toxic metals (lead, mercury, cadmium, chromium)	All types of marine animals	Dispose of responsibly
Butane lighter	Starting fires	Plastic and metal	Primarily birds, but small particles can accumulate in the food chain	Make sure to dispose of properly
Plastic bottle	Hold liquid	Plastic	Sea turtles and tiger sharks; tiny particles accumulate in the food chain as well	Reduce use (find alternatives) and recycle
Plastic toy/buoy	Entertainment/ marketing materials	Plastic	Birds, fish, sponges, other animals up the food chain	Reduce use (find alternatives), dispose of properly
Balloon/ plastic bag	Entertainment/ holding materials	Plastic	Turtles, fish, dolphins, seabirds, plankton, filter feeders, other animals up the food chain	Avoid releasing balloons into the air, use paper or cloth bags
Ghost net	Catching fish	Primarily plastic (note: data not provided in game)	Coral, fish, sharks, dolphins, turtles	Buy fish from companies that don't release nets into the ocean (note: answer not provided in game)
Fishing lines/hook	Catching fish	Primarily plastic (note: data not provided in game)	Seals, dolphins, turtles, sharks, birds	Dispose of fishing gear properly

Species Data Sheet Answers

SPECIES	HABITAT	WHAT IT EATS	WHAT EATS IT	NICHE (producer, consumer or decomposer)	EFFECTS OF MARINE DEBRIS ON THE SPECIES
Plankton: diatoms copepods	Live in ocean	Copepods eat diatoms	Jellies, clams, sardines, sand dollars, anemones, some sharks and even the largest whales	Diatoms: producers Copepods: consumers	Absorb tiny plastic particles that then get transferred to other consumers
Christmas tree worm	Live in ocean	Plankton	Information not in game	Consumer	Can filter marine debris microparticles that travel up the food chain
Green sea turtle	Live in ocean; lay eggs on beaches	Plankton, fish eggs, sea grass, algae, seaweed	Crabs, reef fish, birds, sharks, people	Consumer	Sometimes eats plastic by mistake
Laysan albatross	Islands in the Pacific Ocean	Squid, fish, fish eggs, crustaceans	Tiger sharks	Consumer	Can die of starvation and dehydration by eating marine debris, longline fishing kills as well
Hawaiian monk seal	Beaches and ocean	Spiny lobsters, eels, octopus, flatfish and other small reef fish	Sharks	Consumer	Nets and longlines can trap seals underwater; ingestion of marine debris is another danger
Mackerel Scad	Deep water; coral reefs; warm oceans	Plankton	Snappers and trevally jacks	Consumer	May ingest tiny plastic particles that resemble plankton; the plastic can accumulate in their bodies and be passed along to their predators
Tiger shark	Deep water; tropical and temperate oceans	Squid, sea turtles, other sharks, bony fish, birds and crustaceans	Other sharks	Consumer	May eat marine debris; get caught in lines and nets
Galapagos shark	Deep water; tropical and temperate oceans near island shores in clear waters around coral or rocks	Bottom-dwelling animals, like eels, triggerfish, squid, octopuses, rays, bony fish and even juvenile monk seals	N/A	Consumer	Fishing nets and lines can entangle and kill sharks
Spinner dolphin	Deep water	Fish, squid and shrimp, feeding mostly at night	Tiger and cookie-cutter sharks	Consumer	May drown when fishing lines and nets trap them underwater
Coral	Warm waters	Plankton	Parrotfish	Consumer	Damaged and killed by nets tangled on reefs; may consume pollutants, such as chemicals oozing from marine debris instead of nutrients; damaged by oils naturally found on human hands and in sunscreen lotion

Reporting Data Answers

1. Ocean currents, driven by wind and Earth's rotation, keep seawater in motion. Seawater moves in predictable patterns that resemble enormous, slow-moving whirlpools, called gyres. The north Pacific's gyre is 2,000 miles wide and moves counterclockwise. At the center of this gyre lies Kure Atoll, the most remote of the Northwestern Hawaiian Islands, where currents—and their passengers—converge. In the past, currents carried nutrients and natural materials—for example, driftwood—to Kure animals. But today, more and more plastic trash is traveling with ocean currents, swirling into what some people call a toilet that doesn't flush.
2. Answers will vary.
3. Answers will vary.
4. Answers will vary.
5. Animals higher up in the food chain/web will accumulate larger and larger amounts of plastic particles as they eat the animals that are consuming the plastic instead of plankton.
6. Percentages for pie charts:
Number of entangled animals found - Invertebrates (28%), fishes (33%), reptiles (4%), birds (25%), mammals (10%)
Number of animals found in different types of debris - Balloon ribbon/string (5%), rope (16%), fishing line (47%), fishing nets (11%), crab/lobster/fish traps (5%), other (16%)
7. a. Fishes
b. Fishing line because it can tangle more than one animal at a time. This may not always be the case; in this example cleanup was done in coastal areas, where more people fish with fishing line.
8. Answers will vary and may include recycling, buying products with less packaging, making sure trash is deposited in proper receptacles and joining public cleanup efforts.
9. Answers will vary.