

The Educator's Guide to Marine Debris Southeast and Gulf of Mexico



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INTRODUCTION

Each fall, many states and countries have a coastal clean-up day that coincides with the Ocean Conservancy's International Coastal Cleanup campaign. Typically, it occurs on the third Saturday in September. Check the Ocean Conservancy website at www.oceanconservancy.org for information on how to get involved.

Getting students to participate in a coastal or river cleanup is a good step toward environmental **stewardship**. Moreover, aligning actions with learning about marine debris can lead to practical applications of science concepts and careers. Activities within this guide coincide with national science education standards for middle school students and can be incorporated into age-appropriate classroom instruction.

The Educator's Guide to Marine Debris is designed for the U.S. Southeast and Gulf of Mexico coasts and provides the following information: categories of marine debris; middle-school activities that include science, math, language arts, and social studies; local state stories; and regional and national resources. Words in bold are in glossary.

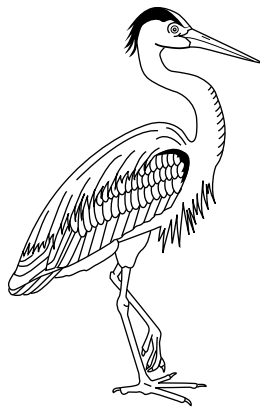
We hope to upgrade the Web-based portion of the guide with new lessons and resources. You can share your ideas and activities with everyone by contacting Lundie Spence, Ph.D., Director, COSEE SE at Lundie.Spence@scseagrant.org.

Each person can make a difference!



The Educator's Guide to Marine Debris is designed for educators in both formal and informal education situations. It is a regional introduction to three main categories of marine debris: litter; **derelict** or abandoned boats; and lost or abandoned commercial and recreational fishing gear. The guide includes information about marine debris, lessons useful for middle school levels, and resources on regional and national levels.

The Educator's Guide to Marine Debris is based on "Turning the Tide on Trash," a special issue of the (Charleston, South Carolina) Post and Courier that was published on August 27, 2007. The special issue was funded by the South Carolina Department of Health and Environmental Control's Office of Ocean and Coastal Resource Management (SCDHEC OCRM) through an award from the National Oceanic and Atmospheric Administration (NOAA).



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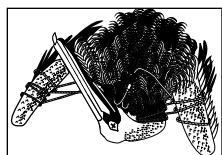
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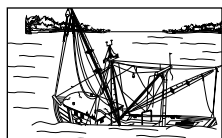
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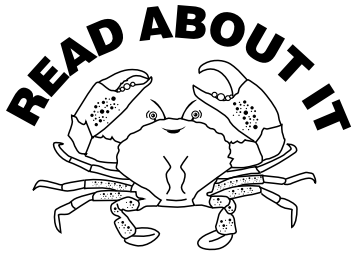
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Marine Debris: A Damper on Coastal Treasures!

We share our coasts with wildlife. The beaches, **estuaries**, and tidal creeks are home to a tremendous diversity of animals. Turtles, birds, crabs, dolphins, and fish use coastal and **estuarine** habitats for shelter and for places to find food, as well as for many parts of the life cycle. We all depend on a clean and healthy ecosystem for a high quality of life.

People can diminish the beauty and safety of the beaches and coasts if they irresponsibly dispose of litter, abandon boats, or lose recreational or commercial fishing gear in the environment. Marine debris is a serious problem, but it is preventable.

There are three main groups of marine debris: (1) **derelict** boats, broken docks, and other structures that end up in the waterways; (2) commercial and recreational fishing gear, such as nets, crab traps, and fishing lines; and (3) litter defined as waste that is disposed in the wrong places. Types of litter range in size from small wrappers and cigarette butts to abandoned appliances and old tires.

Most types of marine debris are made of long-lasting materials—these include plastics, glass, wood, metal, and rubber.

CHAPTER 1: WHAT IS MARINE DEBRIS?

The 2,000 miles of U.S. coastal shoreline along the Southeast and Gulf of Mexico regions offer unsurpassed natural beauty and opportunities for living and recreation. Each year, more than 20 million residents and millions of visitors are enjoying coastal communities and cities in North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi. The economy of these coastal communities depends upon a clean coast, because families have the option to choose other beaches or activities for their vacations.

Mississippi Hauls Out Hurricane Debris

Residents returned to coastal Mississippi after Hurricane Katrina in 2005 to find beaches littered with splintered lumber, appliances, furniture, clothing, and personal items from homes and businesses. High winds, storm surge, and floodwaters devastated oil rigs, refineries, bridges, roadways, cars, and boats. In the process, massive amounts of debris were transported landward and up rivers and creeks, clogging miles of coastal waterways.

Thousands of volunteers helped local residents dispose of most of the shoreline debris caused by Hurricane Katrina. A special debris-mapping program sponsored by the National Oceanic and Atmospheric Administration (**NOAA**) located debris in the waterways of Louisiana, Alabama, and Mississippi. Then the Mississippi Department of Marine Resources, along with the U.S. Coast Guard and the Federal Emergency Management Agency, completed the task of debris extraction in Mississippi waters.



Chapter 1: What is Marine Debris? (continued)

Other types of debris, such as paper products, garbage, and cloth, may decay in a short timeframe. However, all marine debris can be hazardous to people and wildlife, and it spoils our coastal treasure (Please check inserted poster for a time line).

Most marine litter can be attributed directly to coastal recreational activities, such as beach visitation, fishing, and boating. However, some litter is carried downstream by rivers from urban areas through stormwater runoff or recreational activities upstream.

Keeping our beaches and waterways clean and healthy is everyone's responsibility.

Here are a few suggestions:

- ▶ Dispose of trash properly—never leave it on the beach or boat ramp.
- ▶ If you see litter, be sure to pick it up, even if it isn't yours.
- ▶ Never toss fishing line into the environment.
- ▶ Report boats or fishing gear that appear to be abandoned or lost.
- ▶ Leave only footprints in the sand!

Source: Modified from "Turning the Tide on Trash," Special Issue, *Post and Courier* (Charleston, S.C.), August 29, 2007. Original article by Dan Burger, South Carolina Department of Health and Environmental Control, Office of Ocean and Coastal Resource Management.

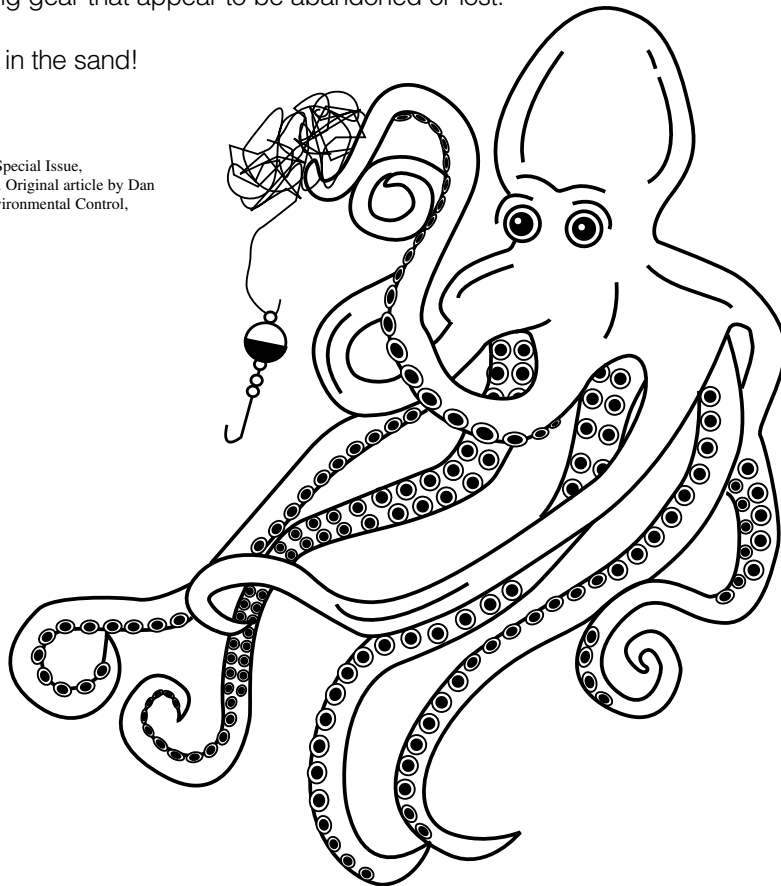
Mississippi Hauls Out Hurricane Debris (continued)

Removal work continues along the Gulf Coast region. Even today, beach visitors are cautioned to wear shoes because shifting sands continue to reveal remnants of the destruction, which even include colorful plastic Mardi Gras beads entangled in driftwood.

For more information on storm debris removal after Hurricane Katrina, visit this website:

<http://gulfofmexico.marinedebris.noaa.gov/>

Sidebar: Jessica Kastler, Ph.D., Center for Ocean Science Education Excellence COSEE Central Gulf of Mexico, University of Southern Mississippi, J. L. Scott Marine Education Center





Activity | WHAT'S ON THE BEACH TODAY?

Marine debris washes up with the tides, along with shells and seaweed. There are three groups of marine debris:

- (1) **derelict** boats, broken docks and other structures that end up in the waterways;
- (2) commercial and recreational fishing gear, such as nets, crab traps, and fishing line; and,
- (3) litter, which is defined as waste disposed of in the wrong place.



PURPOSE

To sort marine debris into the three major groups

OBJECTIVE

The students will:

- ▶ Categorize the type of marine debris
- ▶ Identify the possible source(s) of the marine debris items

MATERIALS

- ▶ Copy the illustration for each student
- ▶ Crayons or colored pencils

PROCEDURE

1. Distribute copies to each student or group
2. Students locate and color the types of marine debris as follows:
Litter – RED
Abandoned fishing gear – GREEN
Derelict boat – BLUE
3. Make a table of items under material type: glass, wood, metal, plastic, paper, rubber, and other materials.
4. Students discuss the source for each of the items.

OBSERVATIONS

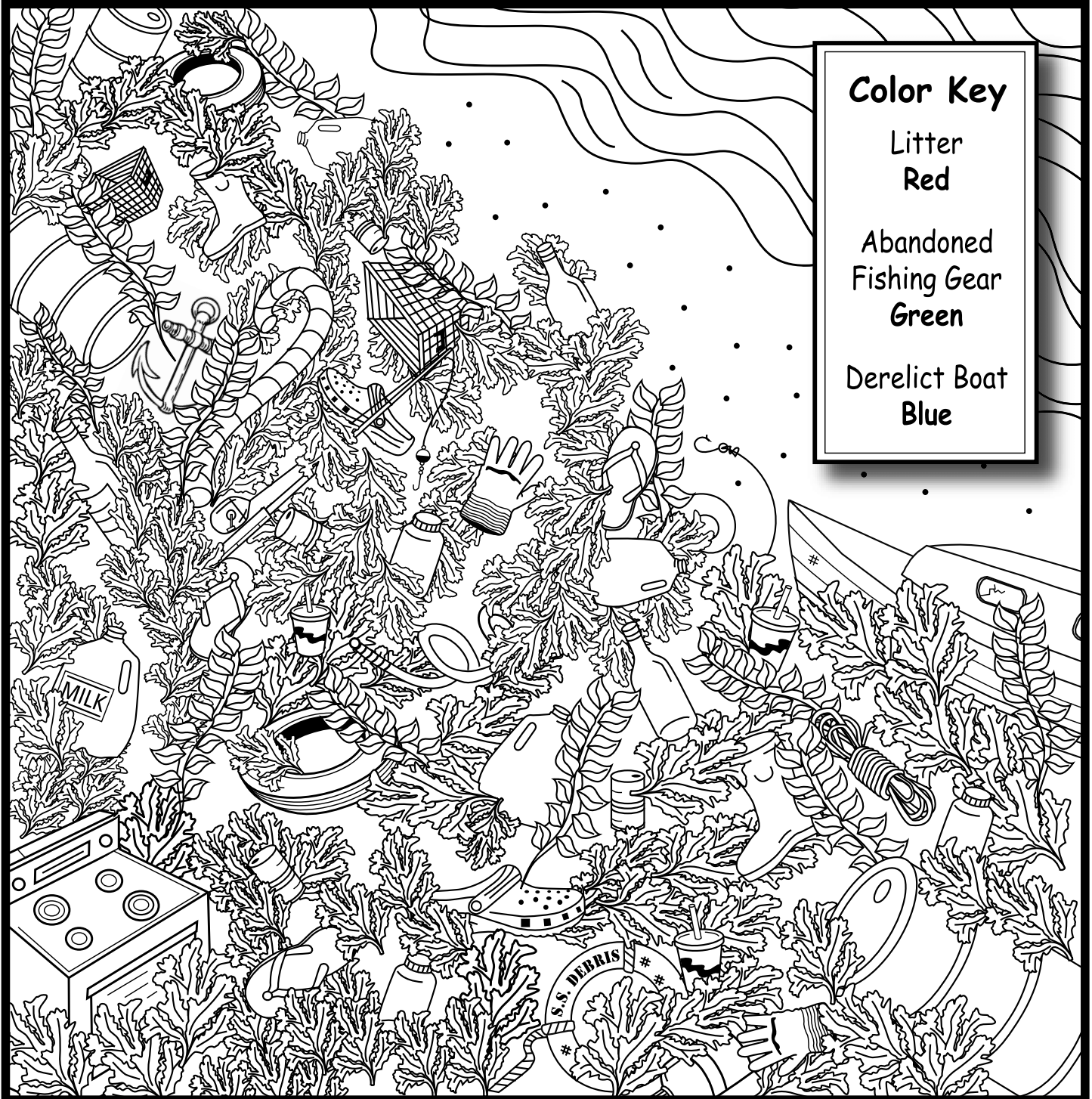
1. What was the most common source for the marine debris that you found?
2. How do you think these items arrived on the beach?

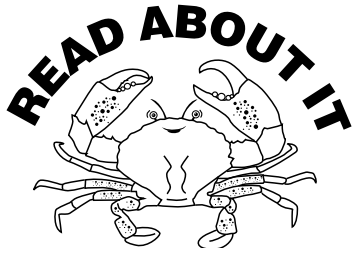
Source: Modified from the following sources: Ripples, North Carolina Big Sweep; and "Turning the Tide on Trash," Special Issue, *Post and Courier* (Charleston, S.C.), August 29, 2007.



What's On the Beach Today?

Student Worksheet





CHAPTER 2: LITTER

Litter, Litter, Everywhere

Litter enters the U.S. coastal waters of the Southeast and Gulf regions from land and from sea. Land-based litter is carried by the wind and water from picnic sites, roads, or shopping centers. Sea-based litter is tossed overboard into the ocean from recreational boats or commercial vessels such as charter boats, commercial fishing vessels, freighters, and container ships. The Gulf Stream carries litter northward from coastal communities in the Caribbean.

Litter can be made of any material, but a majority of litter is made of plastic, and plastic can be deadly for marine animals and ecosystems.

Why is litter so harmful to marine animals?

First, litter can look really appetizing! A plastic grocery bag resembles a floating moon **jelly** that sea turtles love to eat. Too much plastic in its stomach can weaken a sea turtle.

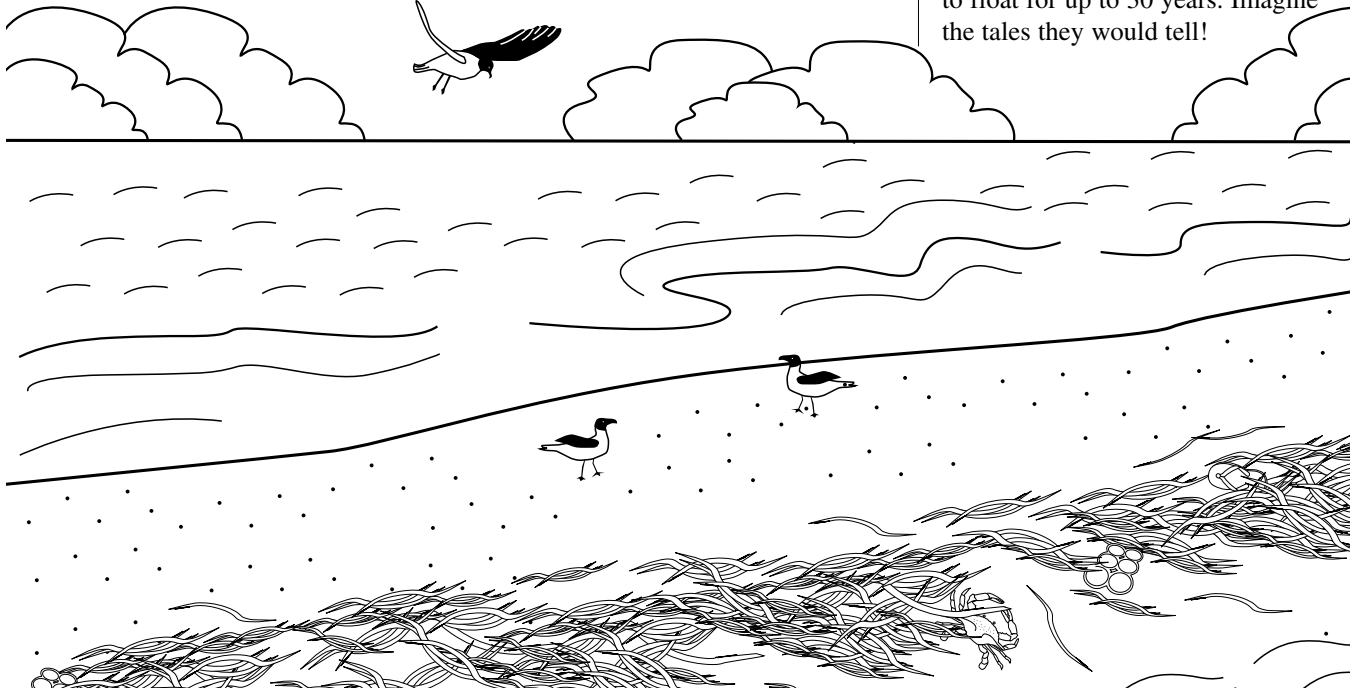
Second, litter can be brought to nests! Cigarette butts and bottle caps are often transported back to nests where the sharp edges or harmful chemicals can injure young seabirds.

What Can You Find on North Carolina's Wrack Line?

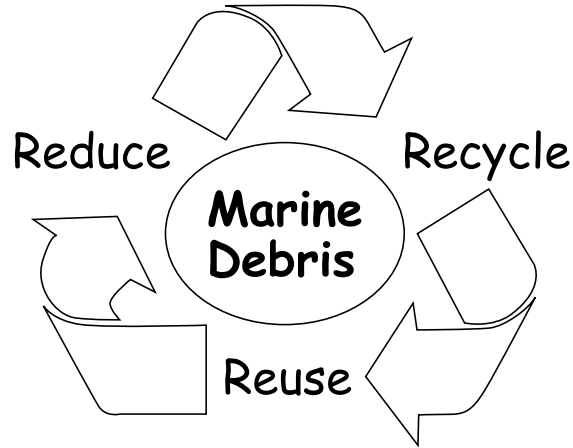
Beachcombing along the **wrack line**, that line of debris on the sand left by the last tide, yields treasure, both natural and manmade!

Bits and pieces travel around the North Atlantic Ocean on surface currents. These wind-driven currents move warm water from the equator northward. The Gulf Stream carries coolers, bottles, old boards, and pieces of trash, but also treasures from tropical rivers in South America.

The North Carolina beach areas of Cape Hatteras and Wrightsville Beach are havens for beachcombers. Many people scan the **wrack line** for seeds from tropical plants that floated from rivers such as the Orinoco to finally land on the sands of North Carolina's coast. Some seeds, called sea beans, have hard outer coverings that protect them from saltwater and predators. Sea beans have the ability to float for up to 30 years. Imagine the tales they would tell!



Chapter 2: Litter (continued)



Third, animals don't have fingers! Littered plastic bands, socks, and elastic items can cause severe entanglement. Animals have no thumbs or fingers to pull these items off their wings, fins, or necks. Stress from becoming entangled and deprived of food can cause animal starvation or exhaustion.

Prevent our amazing coastal and marine animals from becoming harmed by litter. Recycle, reuse, and reduce!

Source: Modified from "Turning the Tide on Trash," Special Issue, *Post and Courier* (Charleston, S.C.), August 29, 2007. Original article was by Meta Van Sickle, College of Charleston.

What Can You Find on North Carolina's Wrack Line? (continued)

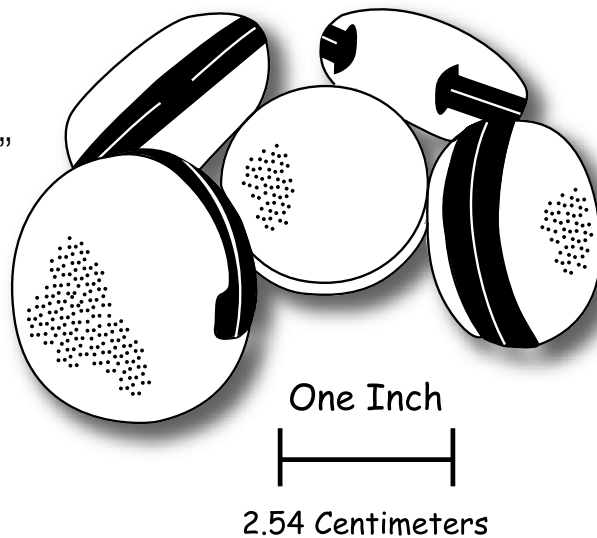
Sea beans and drifting litter found in the wrack line have long captured the imagination of beachcombers.

What's the story behind that plastic soldier found on the sand in Nags Head, NC? How far did the "hamburger sea bean" travel before it was found on Oak Island, NC? Wouldn't you like to know?

For more information on sea beans, visit www.seabeans.com

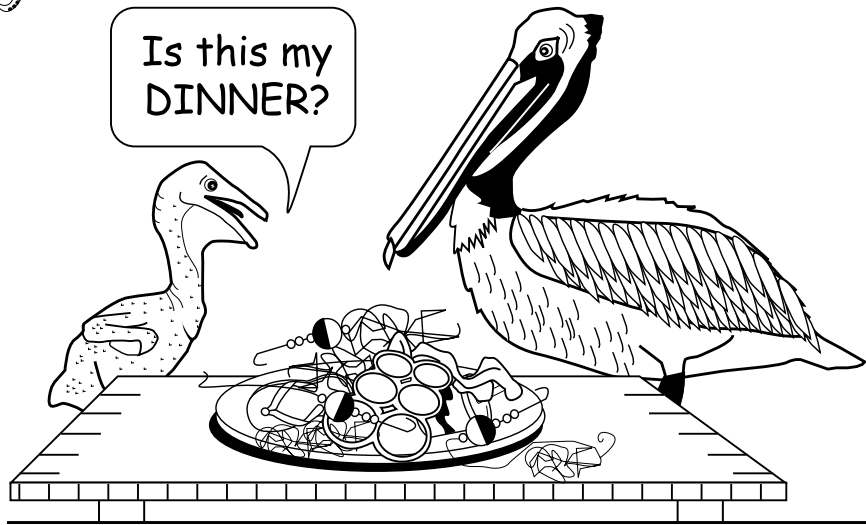
Sidebar: Terri Kirby Hathaway, Marine Education Specialist, North Carolina Sea Grant

"Hamburger"
Sea bean





Activity | EATING PLASTIC IS A DEADLY MEAL



Plastic debris is found along our beaches as fast food containers, foam coolers, plastic foam surfboards, and beverage bottles. These eventually break down into fragments. Oceanic currents carry these tiny plastic particles all over the globe, where they collect inside circular currents (**eddies**) or drift onto beaches. Seabirds feed in a frenzy over schools of bait fish. Often the plastic is swallowed quickly along with the food. Seabirds also bring these plastics back to the nest to feed their chicks. These plastics can build up in their digestive systems, causing harm to adult and young seabirds.



OBJECTIVE

The students will:

- ▶ Investigate why marine birds eat plastic debris
- ▶ Discuss how humans can reduce the amount of plastics going into the ocean

MATERIALS FOR EACH GROUP

OF STUDENTS:

- ▶ One paper plate
- ▶ Fragments of plastic (cups, bags, and beads)
- ▶ Three spoons
- ▶ Three cups
- ▶ One and one-half cups dry rice
- ▶ Stopwatch

PROCEDURE/TEACHER PREPARATION:

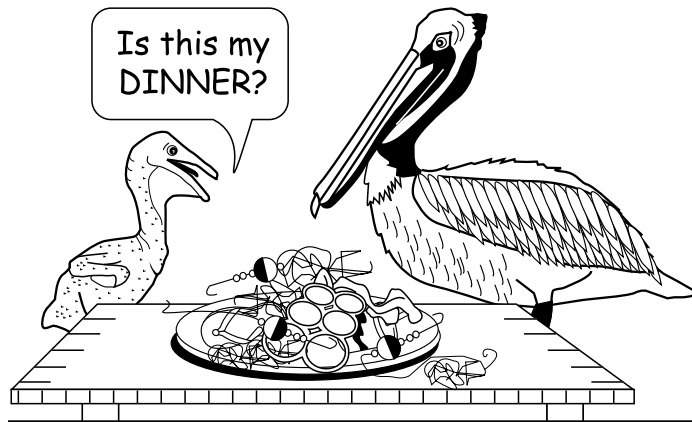
On each paper plate, mix rice with a 1/2 cup of the plastic pieces.

1. Students divide into groups of five.
2. Each group of students gets a plate with the rice and plastic mixture, three spoons and three cups.
3. Spoons represent the bird's beak and the cups represent the bird's stomach. The rice represents food such as bait fish.
4. Three students in each group pretend to be birds and their spoon beaks to feed from the container. They place the food into their "stomach" cups.
5. One student in each group is the timer. The timer indicates to his or her group when to start and stop feeding. Each group feeds for 30 seconds.
6. After "feeding," each group completes the chart in the observation section.

Source: Modified from *Ripples*, published by North Carolina Big Sweep at www.ncbigsweep.org/Ripples.html.



Eating Plastic Is a Deadly Meal



Student Reporting Table

Student "Bird"	# Of Rice Grains	# Of Plastic Debris Pieces	Total # Of Pieces
Bird 1			
Bird 2			
Bird 3			
Total			
Average			

Answer the following questions.

1. Math: What is the ratio of rice to plastic?

2. How could ingesting plastics affect a bird's ability to survive?

3. Discuss how humans can reduce the use of plastics in the ocean.

4. Conclusions: In a short paragraph and in your own words, explain the effects of plastic debris on marine birds.

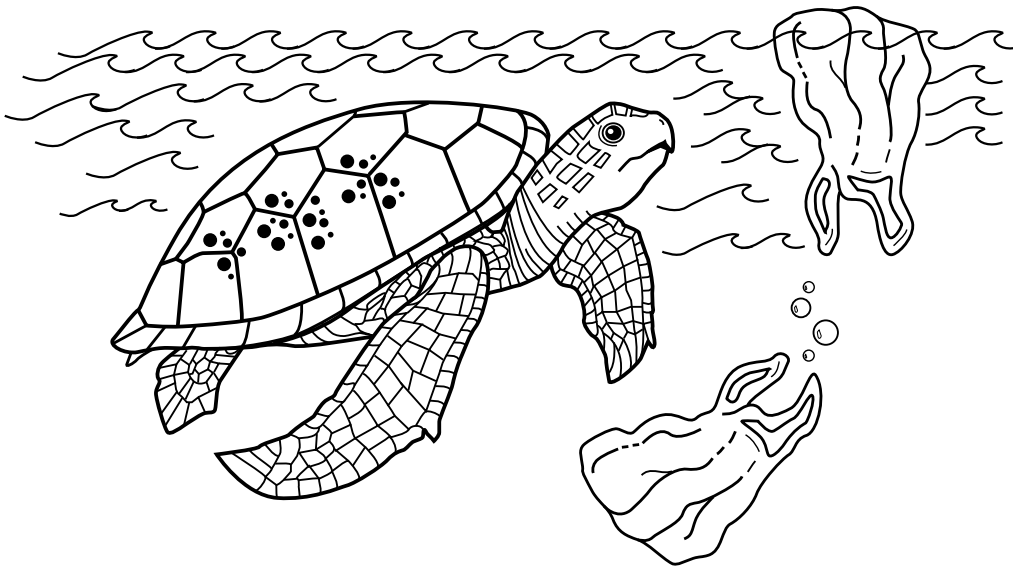


Activity | SINK OR FLOAT

Seabirds catch small fish near the surface. Right whales filter-feed on plankton just below the surface. Dolphins feed on fish from the surface to the bottom of the coastal waters or **estuaries**. Sea turtles like to feed on **jellies** just below the surface and also munch on bottom dwelling plants, sponges and corals.

Marine litter, which is mostly plastic, can drift, sink, float, or remain suspended in the **water column**. Animals that are feeding can find plastics with their food in locations that span the marine surface to the seafloor, depending on a number of factors: the **density** and buoyancy of the material; the presence of trapped air; or the churning of litter by waves.

Source: Modified from "Turning the Tide on Trash," Special Issue, *Post and Courier* (Charleston, S.C.), August 29, 2007.



PURPOSE

To investigate why plastics are located in different parts of the water column and to analyze the feeding habits of marine animals.

OBJECTIVE

The students will:

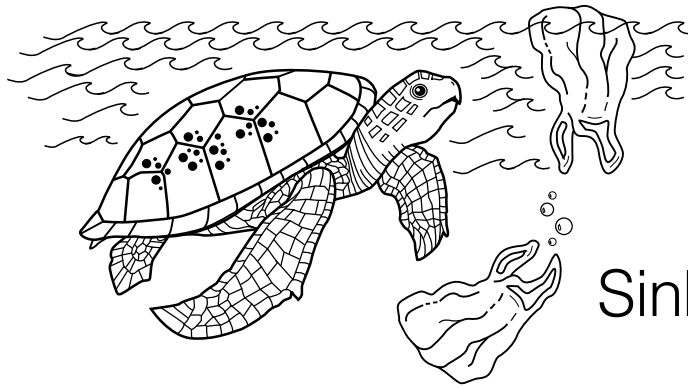
- ▶ Investigate **density** of selected plastic litter.
- ▶ Connect animals and their feeding habits to litter in the **water column**.

MATERIALS

- ▶ Each team needs at least five different plastic items to study.
 - bottle caps
 - small plastic toys
 - six-pack rings
 - sandwich bags
 - plastic grocery sacks
 - foamed bait containers
 - soda bottles—cap or no cap
 - CD cases
 - plastic cups
 - plastic pens or pencils
 - plastic straws or lids
- ▶ A bucket or container large enough to hold the largest item in your collection
- ▶ Water
- ▶ Stopwatch

PROCEDURE

1. Fill the container with water.
2. For each item, predict whether it will sink or float and record prediction on chart.
3. For each item, test whether it sinks or floats and record on chart.
4. For each item that sinks, record the time in seconds it takes to reach the bottom.



Sink or Float

Student Reporting Table

Plastic Item	Predict: sink or float	Test result: sink or float	Time (seconds) to sink to bottom
1.			
2.			
3.			
4.			
5.			

Discussion of Observations:

1. What are the characteristics of items that sank or floated?

2. Which items sank so slowly that they would be suspended in the water column for possibly days?

3. Research some marine animals that would feed on plastic litter at or near the surface, suspended in the mid-water column, and on the bottom.

4. Conclusions: Describe how plastic marine litter can harm marine animals in the water column.

5. Extension: Stir the water in the container and see if the sink or float times change. How does this investigation relate to ocean currents and circulation?

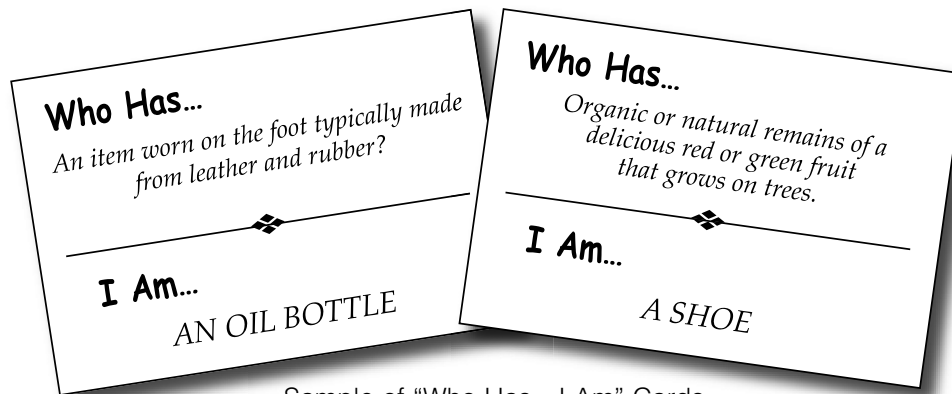


Activity

WHO HAS—I AM: A LITTER-MATCHING GAME

Each year thousands of pounds of litter are discarded inland and along the coast. Bacteria **decompose**—or decay—types of natural litter that include paper, leather, wool, and cotton. Sunlight or ultraviolet light rays degrade more persistent materials, such as wax cartons and plastic grocery sacks. The time for an item to degrade depends greatly on exposure to sun, oxygen, and water (Check the inserted poster for a marine debris timeline).

Metals such as aluminum cans, steel, or iron appliances are not affected by bacteria but undergo a process known as oxidation: we call it **rust**. Salt in coastal waters actually increases the rate at which metals will oxidize. Glass and plastic do not **decompose**, degrade, or oxidize. These items break into smaller pieces, but may remain in the coastal environment for many lifetimes. Glass actually breaks down to join the quartz pieces naturally found in some sands. Small plastic pieces have no natural equivalent.



Sample of “Who Has—I Am” Cards

PROCEDURE:

1. Make and laminate a set of “Who Has – I Am” cards based on each item or image, so each student plus the teacher has one. When making the cards, try to avoid “dead ends” or terminating matches that require restarting the game. One clue: the instructor’s card should contain the first “Who Has” and the last “I Am.”
2. Distribute at least one “Who Has – I Am” card to each student and reserve one for the instructor.
3. Display all items or images on a table.
4. Begin the game. The instructor calls out the description listed on card in the “Who Has” section.
5. Student A—who holds the card with the name of that item in the “I Am” section that matches description—calls out “I am!”
6. Student A selects that item from the table and holds it up for the class to see. Students describe the decomposition time, source, and danger to environment.
7. Student A calls out the description listed on the card, “Who Has... ”
8. Student B—who holds the card with the name of that item in the “I Am” section—calls out “I am!” and the game continues until full circle is made back to the first student and all cards have been read.

PURPOSE

To connect common litter items with the **decomposition** rates.

OBJECTIVES

The students will:

- ▶ Discuss timelines of decay or breakdown for common litter items
- ▶ Identify strategies to reduce, reuse, and recycle debris

MATERIALS

- ▶ Poster insert (“Marine Debris from Land and Sea: In the Environment a Long, Long Time”)
- ▶ Prepare a series of “Who Has – I Am” cards
- ▶ Collect a sample or image of marine debris items illustrated on the poster.
 - wool socks
 - glass bottle
 - aluminum can
 - fast food wrapper
 - shoe
 - metal pull tab
 - straw or stirrer
 - paper towels
 - buoy or float
 - plywood
 - newspaper
 - apple core
 - cardboard box
 - cotton gloves
 - waxed milk carton
 - washing machine
 - bucket
 - oil bottle
 - foamed plastic cup
 - cotton rope
 - tire
 - inflatable raft
 - battery
 - diaper
 - plastic grocery bag

Source: Margaret Olsen, Education Specialist, COSEE SE

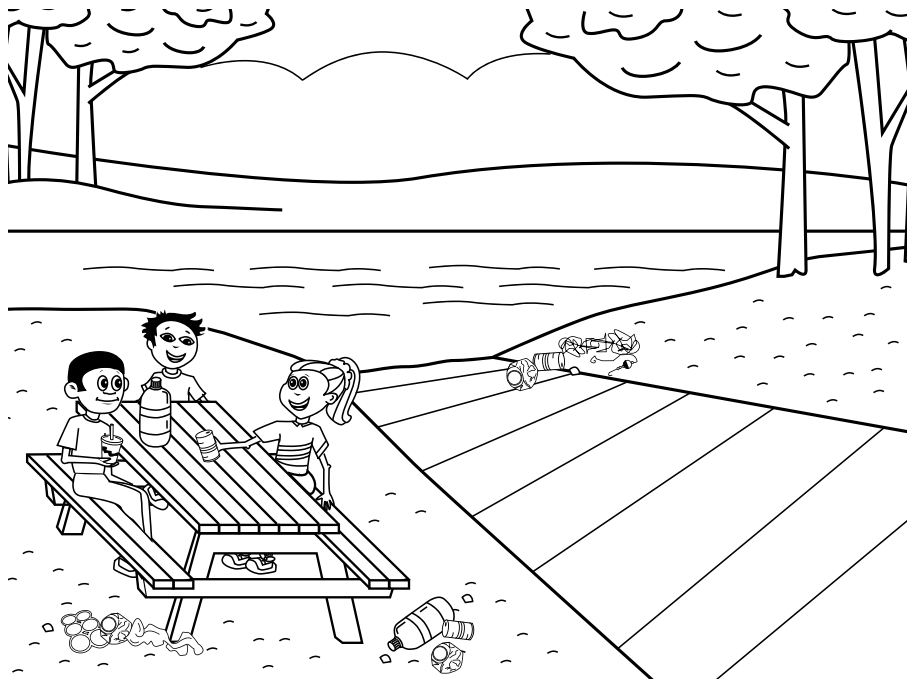


Activity | TRAVELING LITTER

When you visit the beach, would you rather find seashells—or pieces of litter? The answer is obvious.

Litter can be tossed along the road, blown out of a truck, discarded at the beach, or thrown from a boat. Although litter initially may be released far from the coast, it can travel downstream and enter the ocean, where it becomes marine debris. Anyone residing or traveling within the boundaries of a **watershed** is a potential contributor of littered items that increase the problem of marine debris.

Source: Angela Bliss, Adopt-A-Wetland Coordinator, University of Georgia Marine Extension Service, and Margaret Olsen, Education Specialist, COSEE SE



PROCEDURE

1. Students stand shoulder-to-shoulder in a line.
2. Student at the far left of the line is “upstream” at the **headwaters**, student at the far right of the line is the “ocean,” and all students in between represent the river from the **headwaters** to the ocean.
3. Provide one piece of clean litter to each student.
4. Teacher or student reads aloud the story, “It’s All Downstream from Here.”
5. After the first section in the story, the student upstream (**headwaters**) passes the piece of litter to the next student in line. At the next section of the story, that student passes both pieces of litter to the third student, and so on down the line until all litter reaches the last student. The last student will be left holding and juggling all pieces of litter.

PURPOSE

To demonstrate how **watershed** litter migrates to rivers and the sea.

OBJECTIVES

The students will:

- ▶ Predict the movement of litter from river to ocean
- ▶ Identify the importance of personal **stewardship**
- ▶ Articulate how a reduction of litter in communities within a watershed will lead to reduced coastal litter impacts

MATERIALS

- ▶ Story: “It’s All Downstream from Here”
- ▶ Gather a collection of litter from picnic, camping, or recreational activities. Avoid glass or breakable items.
 - Suntan lotion bottle
 - Newspaper
 - Soda bottle
 - Fast food wrapper
 - Drink can
 - Paper plate
 - Paper napkins
 - Candy box
 - Shampoo bottle
 - Foamed drink cup
 - Plastic grocery bags

OBSERVATIONS

1. Ask the student representing the ocean, was it fair for him or her to get all the litter from everyone upstream?
2. Which of these litter items have been recycled or reused?

CONCLUSION

1. What is the nearest river to you, and what is the nearest beach that would get the litter from your community?
2. Describe how you would reduce litter at each part of the story?



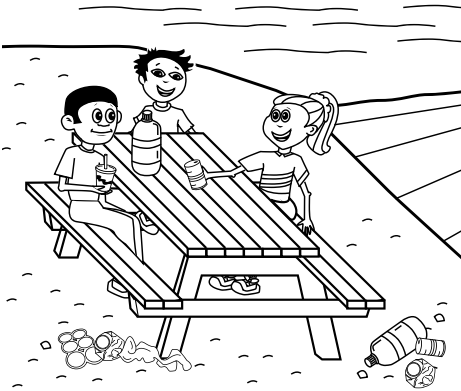
Activity | TRAVELING LITTER (continued)

“It’s All Downstream From Here”

NOTE TO TEACHER: Change the name of the place—mountain, river and barrier island to make the story relevant to your location.

Our class took a field trip to the foothills of the Appalachian Mountains in South Carolina. We visited a small town built next to a beautiful, fast-running trout stream. At the town’s park, we stopped for a picnic. To our dismay, we noticed local folks at the park tossing their picnic waste on the ground. (Action: pass a piece of litter) The wind blew paper plates and napkins into the little trout stream. (Action: Pass another piece of litter). We boldly asked, “Why are you littering?” They replied, “It’s OK, it’s all downstream from here.” The light paper objects floated quickly away and the stream ran clean again. Where did their litter go?

We were curious and decided to follow the stream. We packed our bags and took off down the mountain in search of the litter. As it grew dark, we set up camp alongside a larger stream close to another town. We discovered that this larger stream was actually connected to the little trout stream that we had seen earlier. As we fixed dinner on the camp stove, we noticed people fishing on the stream bank tossing their drink cans into the water. (Action: Pass a piece of litter.) We asked them to stop. They just replied,



“Don’t worry; it’s all downstream from here!”

(Action: Pass a piece of litter.) In an instant, the cans floated out of sight. Where was this litter going?

The next morning, we continued our travels along the stream. The stream emptied into a large river, full of rapids and rocks. As evening came, we camped at a park near a boat landing. What a magnificent sight to watch the sun set over such a beautiful river! After a good night’s rest, we woke up to make a hot breakfast on the camp stove. We noticed a boat owner adding oil to his outboard motor and tossing the can into the river. “Stop!” we yelled. (Action: Pass a piece of litter.) His reply was the same: “What’s wrong? It’s all downstream from here!” In a few moments, the current took the oil can but left the tell-tale rainbow sheen of oil on the surface of the water. (Action: Pass a piece of litter.)

We continued the field trip and drove through an urban neighborhood. Garbage cans were overflowing with litter. We saw a local resident toss more litter on the pile. (Action: Pass a piece of litter.) Didn’t he know that a rainstorm would wash this litter into the gutters and then it would flow into the river? When we asked him why he didn’t pick it up, he replied, “Why should I bother? It is all downstream from here.” (Action: Pass a piece of litter.)

As we drove on the highway alongside the river, we passed a pick-up truck carrying trash to the landfill. Loose paper and plastic grocery bags were blowing out of the back of the truck. (Action: Pass a piece of litter.) We blew the horn at the driver and asked, “Why not cover the trash?” His answer, “That’s not my job, and besides—it’s all downstream from here!” (Action: Pass a piece of litter.)

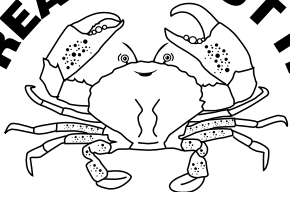
Further on, we saw our wide, slow river spread into the harbor. We stopped for gasoline and water at a convenience store. Rain was pouring down. We could see the trash from the store wash into a storm drain (Action: Pass a piece of litter.)

Our field trip ended at a beach town on a thin barrier island. (Action: Pass all remaining litter to the last student in line.) It seemed like a clean town, but the residents looked mad. As we walked out onto the beach, we understood. They were picking up paper plates, napkins, and drink cans that had washed onto their beach. They said they had to do this every week to keep their beach beautiful.

We asked, “Did you throw this litter on the beach?” One person replied, “No, the litter washed down from the river.” The beach community depended on tourism and clean beaches. In addition to litter on the beach, they have found gulls entangled in plastic line and sea turtles killed by eating plastic bags.

Our class agreed that folks upstream don’t understand the connection to the ocean. Streams are part of their **watersheds**. Upstream litter ends up downstream.

READ ABOUT IT



Get Your Gear Out!

CHAPTER 3: LOST OR ABANDONED FISHING GEAR

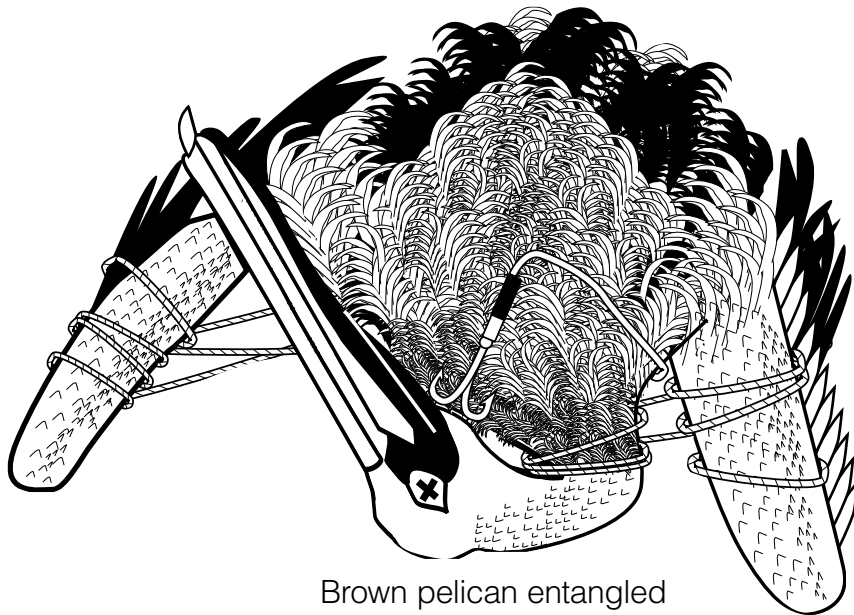
Lost or abandoned fishing gear includes fishing rods, nets, monofilament line, ropes, and crab traps from recreational and commercial industries. Long ago, most fishing gear was made of natural fibers, like cotton or hemp. These materials decayed or **biodegraded** over time. Today's fishing gear is made of, or coated in, synthetic plastics, designed to last a long time. That is great news for the fisherman, but not good news for the animals when the gear is lost or abandoned.

“**Ghost fishing**” occurs when lost or discarded line, nets, and crab traps continue to catch marine crabs, fish, turtles, and marine mammals. This form of “fishing” can cause serious injury to animals and is considered a leading cause of marine animal deaths each year.

Ropes from crab traps, fishing nets, and monofilament fishing line can injure sea turtles, dolphins, seals, and whales.

Even seabirds are harmed by abandoned fishing gear! The thick ropes or plastic lines can cut into fins, flippers or wings.

The animal often becomes completely entangled and is no longer able to swim or fly properly. If the debris is cut free, often times the animals can recover.



Brown pelican entangled in fishing line

Florida is Reeling In the Line: One Inch At a Time

Nylon monofilament fishing line became popular in the 1950s. It is thin, strong, and almost invisible in water. The same characteristics that make it popular with anglers make it deadly to wildlife when loose monofilament line fragments are discarded in the water.

Florida knows the problems with fishing line and started one of the first recovery projects in Brevard County. For almost 10 years, the Monofilament Recovery and Recycling Program (MRRP) has collected discarded line from responsible fishers and tackle shops. Now this program has spread to 43 counties throughout the state.

MRRP sets up monofilament line recycling containers at piers, boat ramps, and places where anglers can deposit loose and unwanted pieces of monofilament line. Volunteers collect and sort the line, then mail bundles to Berkley Pure Fishing Company in Iowa. Since 1990, Berkley has received over 15 million miles of monofilament fishing line for recycling.

Recycled fishing line is turned into plastic pellets, which are used in the manufacture of recycled plastic products such as tackle boxes and toys.

Volunteers can make their own containers for private docks by cutting an “X” into the lid of a tennis ball canister. It’s a small storage bin with a user-friendly opening to poke the pieces of line through.

Every inch counts! Currently, Florida is joined by 25 states, including North Carolina, South Carolina, Georgia, and Mississippi, along with seven countries, in fishing line recycling efforts. What a great way to keep unwanted fishing line out of our oceans and waterways.

Chapter 3: Lost or Abandoned Fishing Gear (continued)

Seabirds, whales, dolphins, sea turtles, and diamondback terrapins are among the air-breathing marine animals that become entangled and often die because of abandoned fishing gear. If air-breathing animals are caught in gear and unable to return to the surface to breathe, they drown.

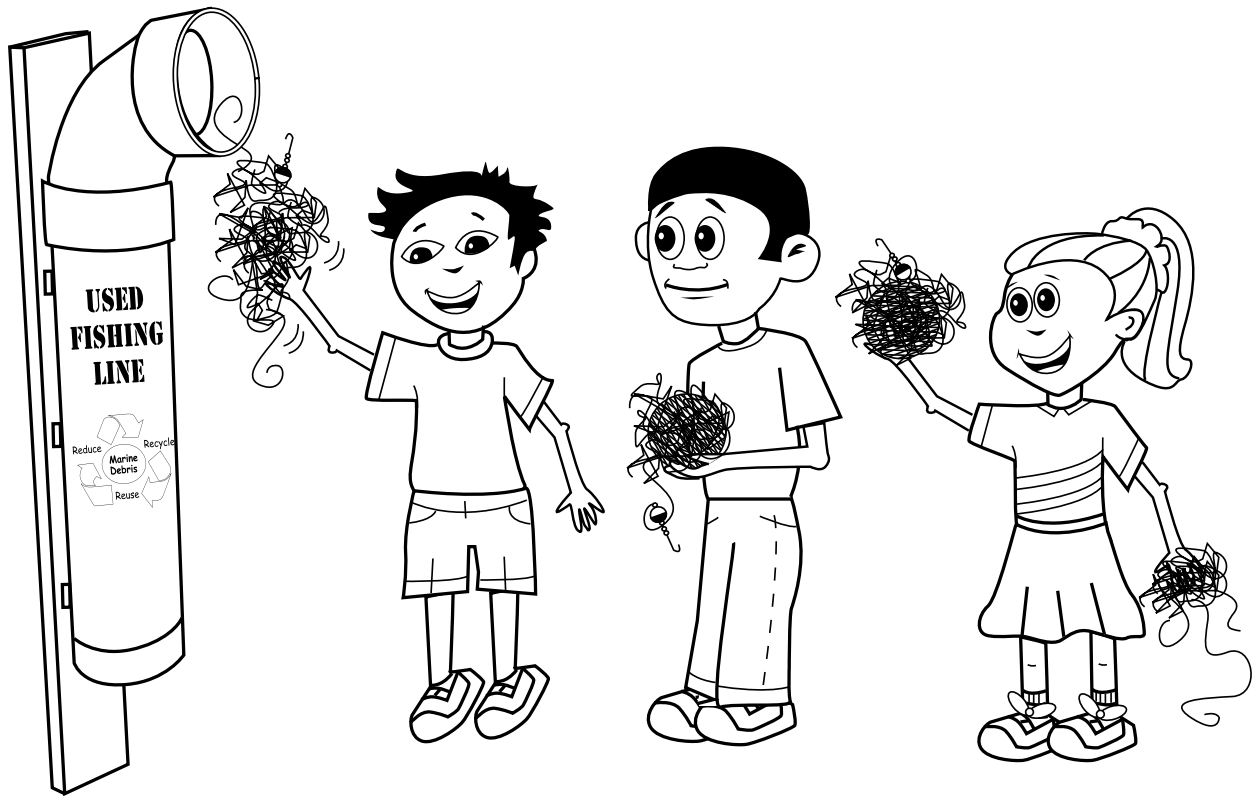
The Ocean Conservancy's 2007 International Coastal Cleanup reported that 235 animals were found entangled in marine debris—either dead or alive. Seabirds were the most-often reported victims of entanglement, and fish were the second most often reported. We can work together to prevent harm to animals and remove marine debris!

Source: Modified from "Turning the Tide on Trash," Special Issue, *Post and Courier* (Charleston, S.C.), August 29, 2007

Florida is Reeling In the Line: One Inch At a Time (continued)

If you collect line and do not have a recycling bin or a cooperating tackle shop, then you can mail your recycled line to Berkley Pure Fishing Company at 1900 18th Street, Spirit Lake, Iowa 51360-1041. For more information on monofilament recycling, visit www.fishinglinerecycling.com.

Sidebar: Maia McGuire, Ph.D., Extension Agent,
Florida Sea Grant



Fishing line recycling bin and student volunteers with used line



Activity | MONOFILAMENT MAYHEM

Fishing line today is made of monofilament plastic. It is strong, yet stretchy. Different diameter line is designed to have specific breaking points measured in pounds. In theory, a four-pound test line will break when four pounds of force are applied, and a 40-pound test line will break under 40 pounds of force. Lighter weight line—approximately a four-to-eight-pound test—is used when fishing for small fish. For big fish, like marlin or tuna, heavier tackle and a heavy weight—a 40 to 80-pound test line—is chosen.

Monofilament fishing line can stretch before it breaks. Since no one likes losing gear, fishing enthusiasts must know what strength of line to use, based on the type of fish catch that is desired. However, the same qualities that make monofilament line so good for fishing also make it harmful when tossed into the marine environment.



PROCEDURE

Note: If you do not have a fish scale, then you can use the fact that one liter of water weighs 1,000 grams or 2.2 pounds. You may need 10 or more one-liter plastic bottles.) Fill each one-liter plastic bottle with water and cap the bottle. If you are able to do this outside, then there is no need for the bottles of water. Just measure and pour water into the bucket each time.

If a fish weight scale is available:

1. Tie the bucket to the fish weight scale using a four-foot length of one of the sample monofilament fishing lines. Use Palomar Knot figure 1.
2. Tie the other end of the fishing line to a stationary bar or tripod (if done outside: tie to the crossbar of a swing set).
3. Record the weight of the empty bucket.
4. Add water to the bucket until the line breaks. Record the weight from the scale.
5. Repeat your experiment two more times and record the results. Compute the average for the amount of water that was needed to break the line.
6. Repeat each step above with the other weight fishing line and record your results.

PURPOSE

To compare the breaking points of several weights of fishing line.

OBJECTIVES

The students will:

- Investigate the strength of monofilament fishing line
- Discuss how fishing line and entanglement is a danger to wildlife

MATERIALS

- Safety goggles (The fishing line may snap!)
- Gloves for holding onto the fishing line
- Two strengths of monofilament fishing line. Note: visit a local tackle shop and request at least three line strengths, such as light (4-to-10-pound test weight), medium (12-to-20-pound test weight) line, and heavy (40-to-80-pound test weight)
- A 2 liter plastic bucket
- Something to hang the bucket from (a broom handle, tripod, crossbar, or swing set)
- Ten or more one-liter plastic bottles with caps. (You will need enough to break the strength of line you choose)
- Water
- Optional: Fish weight scale (for sale at fishing tackle shops or online at: www.nextag.com/fishingscale/search.html)
- The type of knot is critical. Palomar knots are best for monofilament line: www.animatednots.com/palomar/index.php. See Figure 1. Record if line breaks at knot or elsewhere.



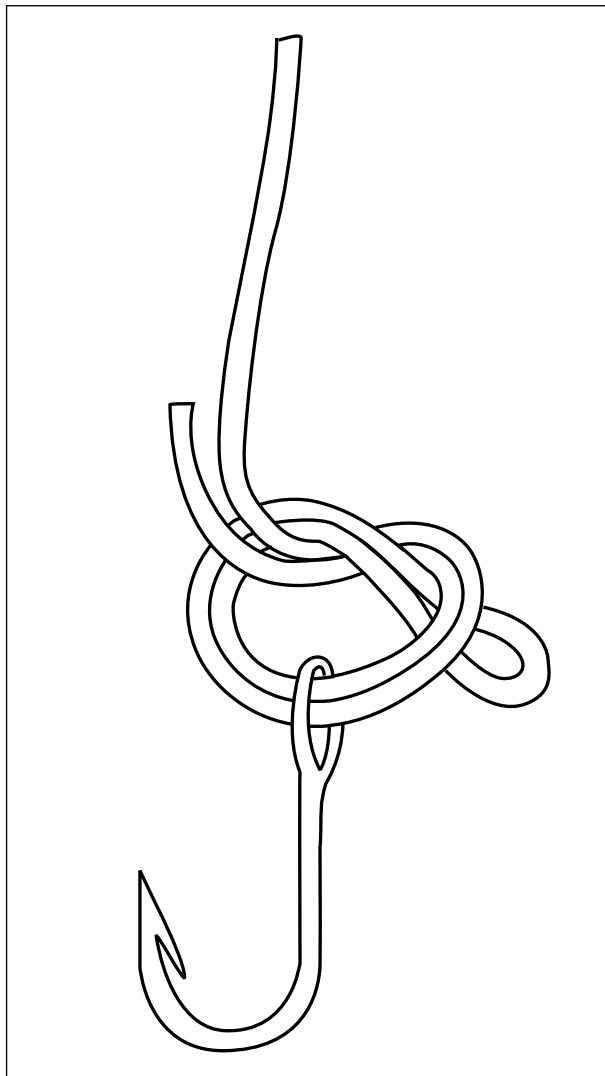
Activity | MONOFILAMENT MAYHEM (continued)

If no fish weight scale is available, then use the metric system to estimate the breaking weight in kilograms (kg).

1. Tie the bucket with the monofilament line to the crossbar.
2. If outside, add water in units of ? liter quantities to the bucket until the line breaks. If inside, put bottles of water in the bucket until line breaks. (One pound is about equal to ? liter of water.)
3. Record the amount of water and its weight at the breaking point.
4. Repeat this test two more times and note an average breaking weight.
5. Repeat each step above with the medium-weight fishing line and record your results.

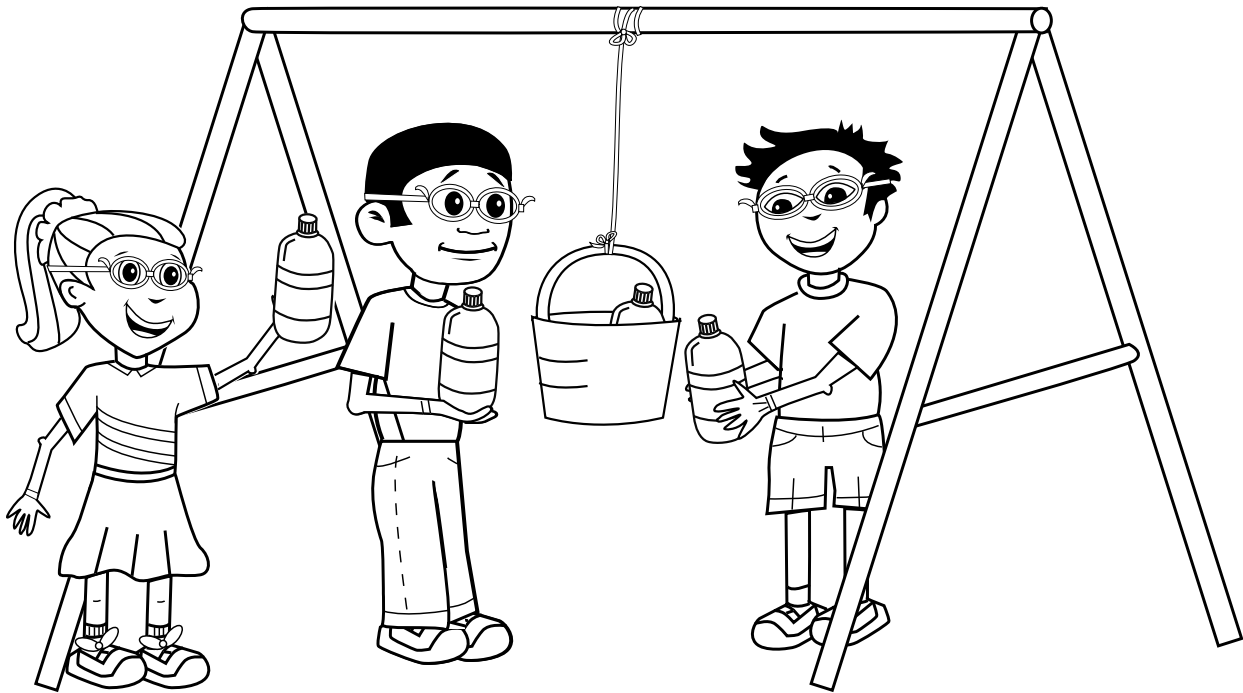
Source: Meta Van Sickle, Ph.D., College of Charleston, and Lundie Spence, Ph.D., COSEE SE

Figure 1.
Palomar knot
attaching line
to hook





Monofilament Mayhem



Student Reporting Table

	Light-weight fishing line	Medium-weight fishing line
Trial One:		
• Amount of water (liters)		
• Weight of water (grams or pounds)		
Trial Two:		
• Amount of water (liters)		
• Weight of water (grams or pounds)		
Trial Three:		
• Amount of water (liters)		
• Weight of water (grams or pounds)		

Math: Record the average weight at which each line breaks.

Light weight line: _____ Medium weight line: _____

Discussion of Observations:

1. Compare the weight of the fishing line to the tested breaking point.

Did the line actually break at the tested weight? _____

2. Where did the line break? Is the knot a factor for breaking?

3. Discuss why different fishing lines are used.

What size fish could you catch with the fishing line strengths that you have tested?

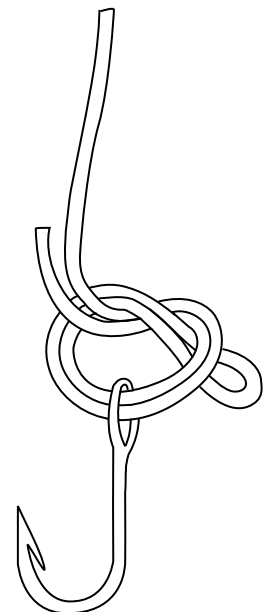
4. Just by pulling on different weight lines with two gloved hands, can you break the line? Do you think an animal can break the line that is wrapped around its beak or flipper? _____

5. Conclusions:

a. Describe what might happen to a dolphin or bird entangle in monofilament fishing line. _____

b. What can be done to prevent fishing line loss and wildlife harm?

“How to tie” website:
<http://www.animatedknots.com/palomar/index.php>





Activity | TIES THAT BIND

Pelicans and people often find themselves fishing the same water. Abandoned monofilament fishing line may entangle seabirds, such as pelicans, and lead to serious injury or death. As monofilament fishing line is difficult to break, the entangled birds have difficulty moving or feeding when entangled by fishing line.

PROCEDURE 1: ENTANGLEMENT AND BEHAVIOR

1. Give each student one large rubber band, and instruct students to wrap the rubber band around the back of one hand (see Figure 1). In this simulation, the hand represents a bird's body.
2. Each student should place the other hand in a pocket or behind his or her back.
3. Instruct the students that they will have 10 seconds to remove these rubber bands.

OBSERVATION

Record how many students were able to remove the rubber bands without assistance.

DISCUSSION FOR PROCEDURE 1:

ENTANGLEMENT AND BEHAVIOR

1. Describe how you felt when trying to remove the rubber band from your hand.
2. How do you think a seabird would behave when it is entangled in fishing gear debris such as monofilament fishing line?
3. What are the consequences of seabirds becoming entangled in monofilament line?

PURPOSE

To simulate the effect of fishing line on an entangled bird.

OBJECTIVES

The students will:

- Simulate how hard it is to remove monofilament fishing line
- Investigate how entanglement affects the ability of a sea bird to feed

MATERIALS

- One large rubber band per student
- Small objects to simulate food (popcorn, dried beans, rice, etc.)
- Paper plate for each pair of students
- Safety goggles for students in case the rubber band breaks.
- Timer

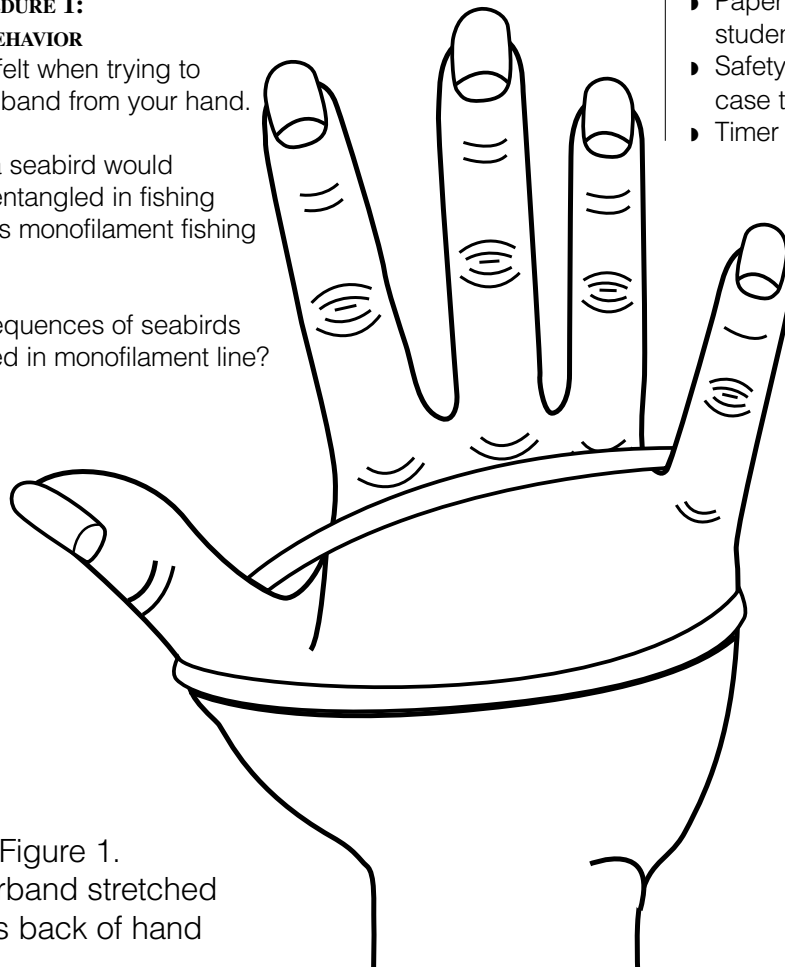


Figure 1.
Rubberband stretched
across back of hand



Activity | TIES THAT BIND (continued)

PROCEDURE 2: ENTANGLEMENT AND FEEDING

1. Give each student pair a paper plate containing a variety of the food items.
2. The fingers represent a bird's beak. Students should wrap the rubber bands once around their fingers (see Figure 2).
3. Time how many simulated food pieces the students can pick up in five seconds.
4. Repeat with the rubber band wrapped two or three times. Time for five seconds and record how many pieces the students can pick up.

OBSERVATIONS

Compare feeding records among the different student pairs.

DISCUSSION FOR PROCEDURE 2: ENTANGLEMENT AND FEEDING

How do you think a seabird would be affected by an entangled beak?

CONCLUSION

1. Describe how monofilament fishing line affects sea birds.
2. What can people do to reduce the impact of plastic debris?

Source: Modified from *Ripples*, a publication by North Carolina Big Sweep: www.ncbigssweep.org/Ripples.html

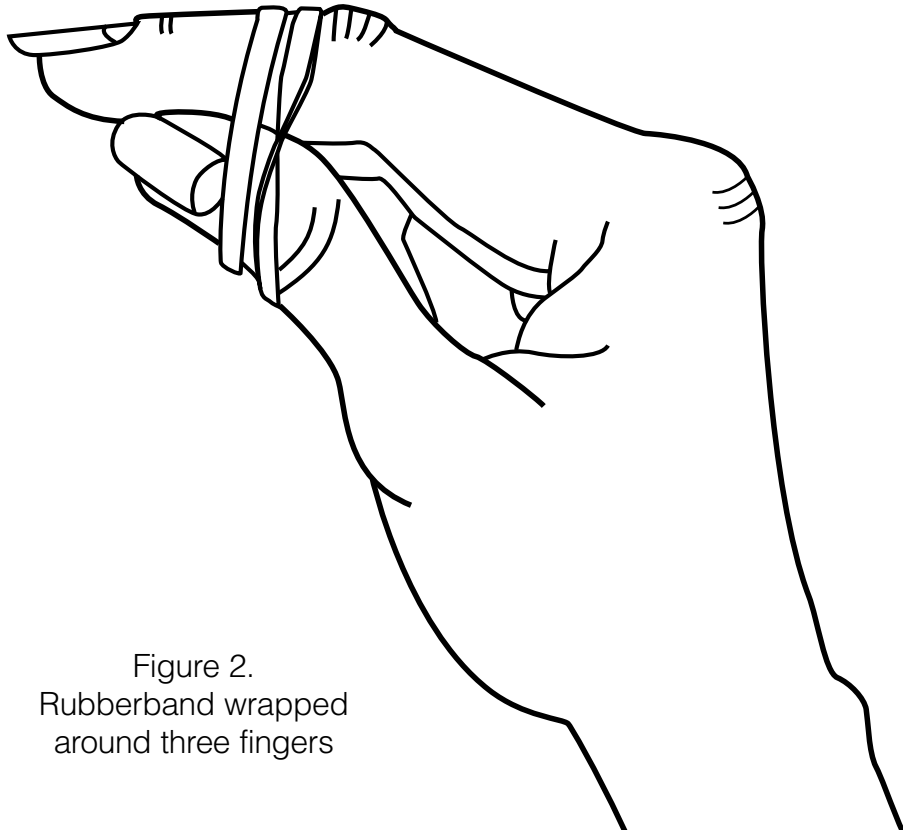
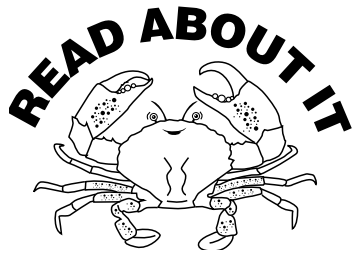
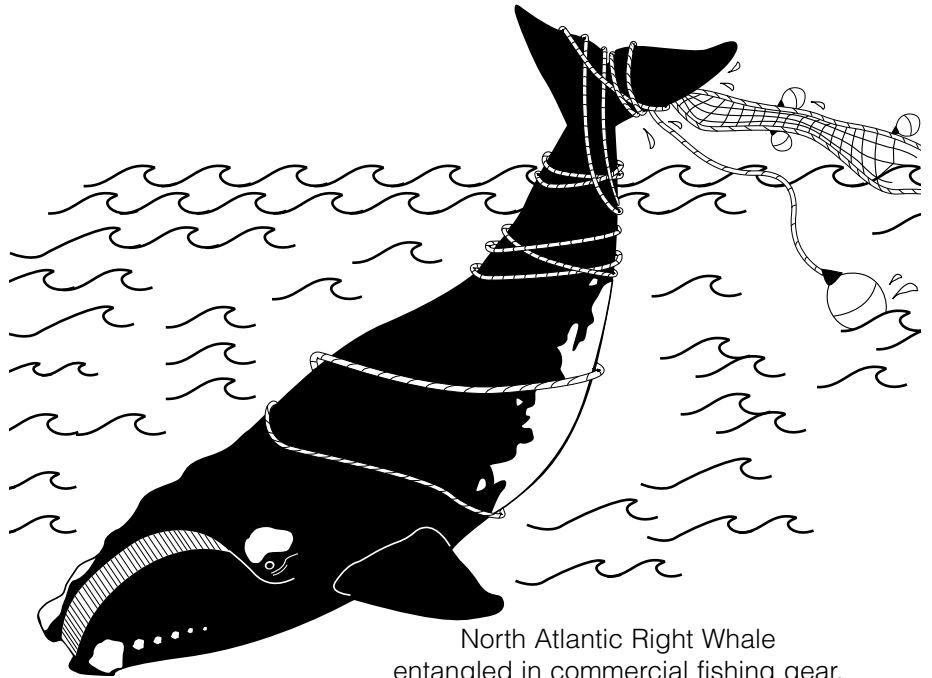


Figure 2.
Rubberband wrapped
around three fingers



Marine Mammals Don't Use Fishing Nets!

Western Atlantic and Gulf waters are home for many marine mammals. Toothed whales (sperm, pilot), baleen whales (humpback, right and fin), manatees, and even harbor seals—live or migrate to reach feeding or calving grounds.



North Atlantic Right Whale entangled in commercial fishing gear.

Aerial photographs have shown endangered right whales dragging fishing nets and lines. People in North Carolina report harbor seals lying on the beach with plastic strapping wrapped around their necks. And a bottlenose dolphin was nearly killed due to a discarded swimsuit! Marine debris can entangle marine mammals and cause difficulty in breathing, hunting, and swimming. Unless the animal can shake loose, pressure from the water when the animal swims can cause the marine debris to cut through skin to the bone. This can cause problems in getting food and exposes the animal to infection. Marine debris can also cause harm if eaten by mistake.

Each year, approximately seven hundred marine mammals are found stranded along the Gulf of Mexico and Southeastern states of the Atlantic Ocean--some with symptoms of marine debris interaction.

Veterinarians and certified biologists perform **necropsies** on the bodies. Sometimes they document sad cases of marine mammal stomachs filled with plastic toys, bottles, and rope.

NOAA started the **National Marine Mammal Stranding Network (NMMSN)** that establishes stranding **protocols** or procedures for certified volunteers and researchers to follow once a stranded or injured marine mammal is located. The work of the **NMMSN** has helped to document strandings of marine mammal species along the southeastern Atlantic and Gulf of Mexico coasts.

For more information on marine mammals and the stranding network, visit www.nmfs.noaa.gov/pr/.



Activity | WHAT HURT THIS WHALE?

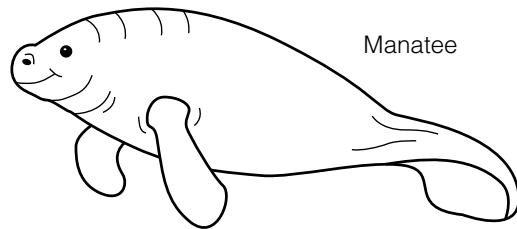
Marine debris of all types can cause injury or death to marine mammals. Crab traps and netting can entangle dolphins and harbor seals as they hunt along the estuarine bottom, manatees can snag fishing hooks discarded in the sea grasses as they graze along the tidal creek banks, and baleen whales can consume large amounts of floating marine debris as they gulp thousands of gallons of water to filter out their plankton dinners. Marine mammals need a safe haven in the waters off the Southeast and Gulf Coasts. Those marine mammals that are unlucky need excellent volunteers and veterinarians to perform **necropsies** and investigate their deaths.

OBSERVATIONS

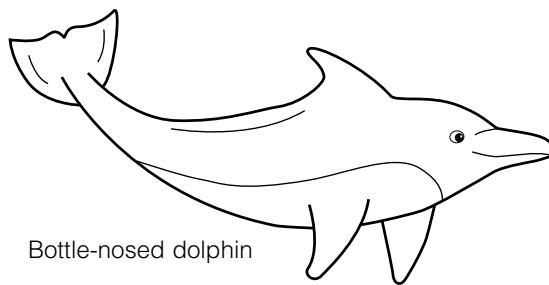
Each “investigate a model” team presents the report for their stranding and compares it with the description from the “build a model” team.

CONCLUSION

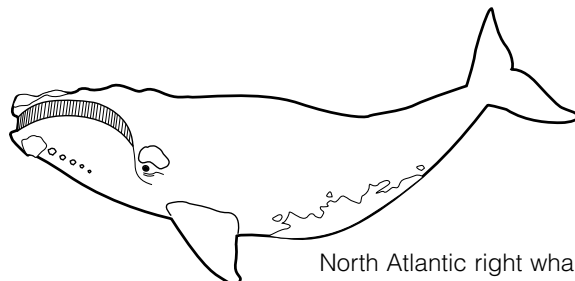
What could be done to reduce the number of injuries and deaths of marine mammals?



Manatee



Bottle-nosed dolphin



North Atlantic right whale

PURPOSE

To investigate the cause of a marine mammal's death

OBJECTIVES

The students will:

- Investigate injuries on a stranded marine mammal model
- Recommend strategies to prevent entanglement problems and ingestion of marine debris by marine mammals

MATERIALS (PER TEAM)

- Paper template of a model of a right whale, dolphin, or manatee
- Paper images of plastics, e.g., bottle caps, bags, foamed cups, toys, and/or commercial fishing gear
- Tape
- Scissors
- Markers

PROCEDURE

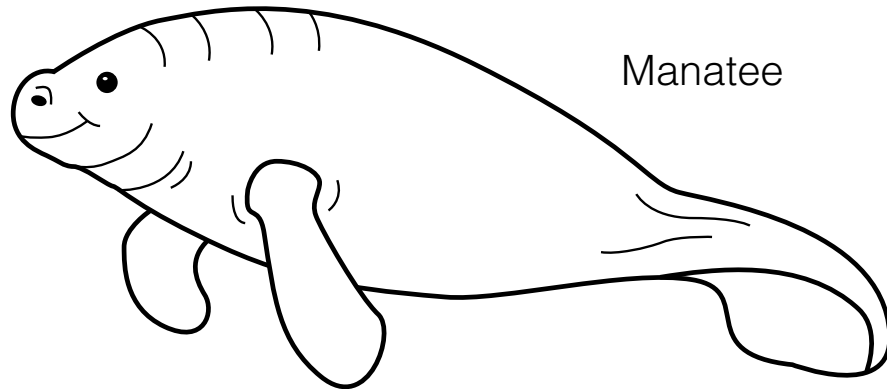
1. Divide the class into teams. Each team has two roles: the “build a model” role and the “investigate a model” role.
2. Each team decides on the scenario for the stranding of their marine mammal and prepares a one-paragraph description.
3. Each team makes a marine mammal 3 dimensional model based on their scenario, stuff the model's stomach with debris or draw or place scaled down fishing gear on the model's body.
4. Teams swap models.
5. Each team now investigates the new model and prepares a brief report on the evidence they find on the stranded model of the marine mammal.

Source: Lundie Spence, Ph.D., COSEE SE and Angela Bliss, Adopt-A-Wetland Coordinator, University of Georgia Marine Extension Service

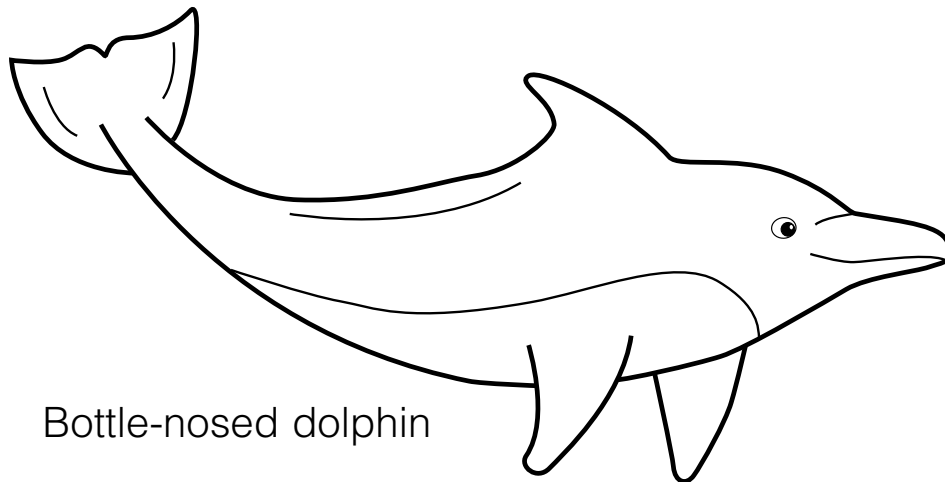


Template for Marine Mammals

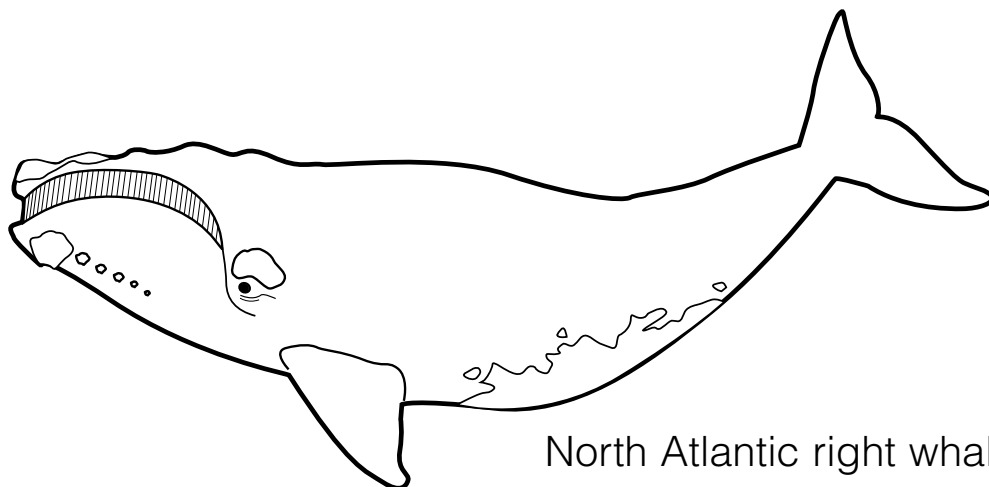
Note: Enlarge as needed



Manatee

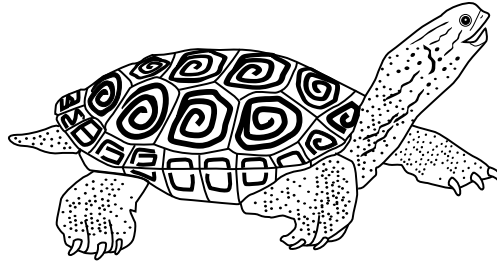
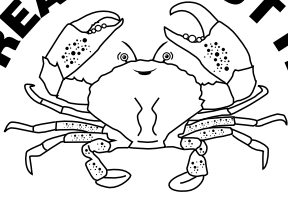


Bottle-nosed dolphin



North Atlantic right whale

READ ABOUT IT



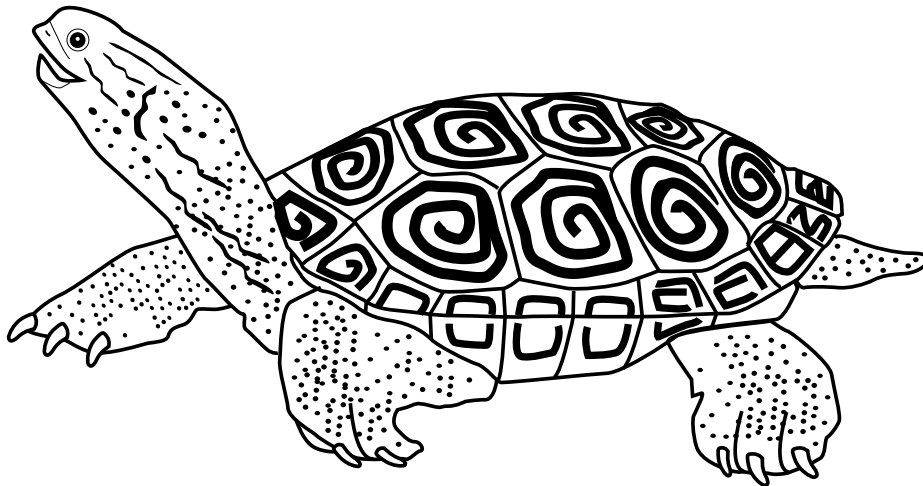
Diamondback Terrapins: Sentinels of the Salt Marsh

The Diamondback Terrapin (**DBT**) is a species of turtle and the only reptile that lives its whole life in the brackish waters of salt marshes and tidal creeks. DBTs have distinctive black and white skin and fleshy beaks, which look a bit like lips. Females have a carapace length of 8 to 10 inches, while males are smaller.

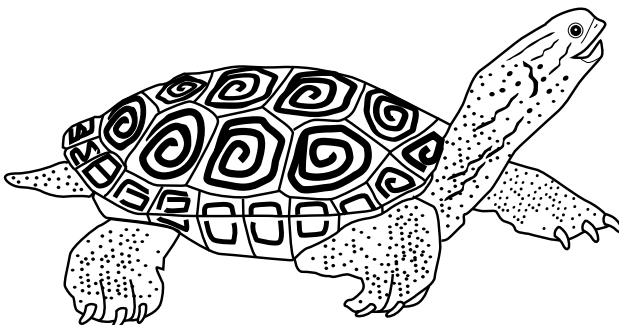
During high tides, **DBTs** crawl into the *Spartina* marsh grass to feed on periwinkle snails, fiddler crabs, and small mollusks. Like all reptiles, **DBTs** have lungs and breathe air. Most people catch glimpses of terrapins when the animals surface to breathe and, sometimes, a person might see a terrapin trying to cross a road.

Years ago, people caught **DBTs** for food. Terrapin stew was so popular that people harvested **DBTs** faster than the animals could reproduce. Terrapin populations declined. However, once terrapin stew was no longer fashionable in the big-city restaurants, the **DBT** population began to recover.

Today **DBTs** face new problems—fewer places to nest, poorer water quality, and crab traps. Diamondback terrapins are inquisitive hunters; and they enter crab traps to eat crabs or the bait. When these crab traps are not checked regularly or have been abandoned, the **DBTs** drown (Figure 1).



Diamondback Terrapin



Diamondback Terrapins (continued)

A large population of diamondback terrapins usually indicates a healthy estuarine ecosystem.

This makes **DBTs** a “sentinel” species.

When populations start to decline, that might indicate problems with water quality, overdevelopment, loss of marshes, or other ecosystem troubles.

How can you help diamondback terrapins (**DBTs**)?

(1) If you are a recreational crabber, check your traps regularly and never leave them in the water. Dispose of your old traps in a responsible fashion.

(2) Insert a Bycatch Reduction Device (**BRD**) into the side of the crab trap to make it harder for **DBTs** to enter.

(3) **DBTs** need dry, sandy nesting locations. If you see a female digging a nest, please do not disturb.

For state and regional information about **DBTs**, contact the Diamondback Terrapin Working Group at www.dtwg.org.

Source: Modified from “Turning the Tide on Trash,” Special Issue, *Post and Courier* (Charleston, S.C.), August 29, 2007. Original article by Meg Hoyle, Director of Learning Through Loggerheads and Past President of the Diamondback Terrapin Working Group.

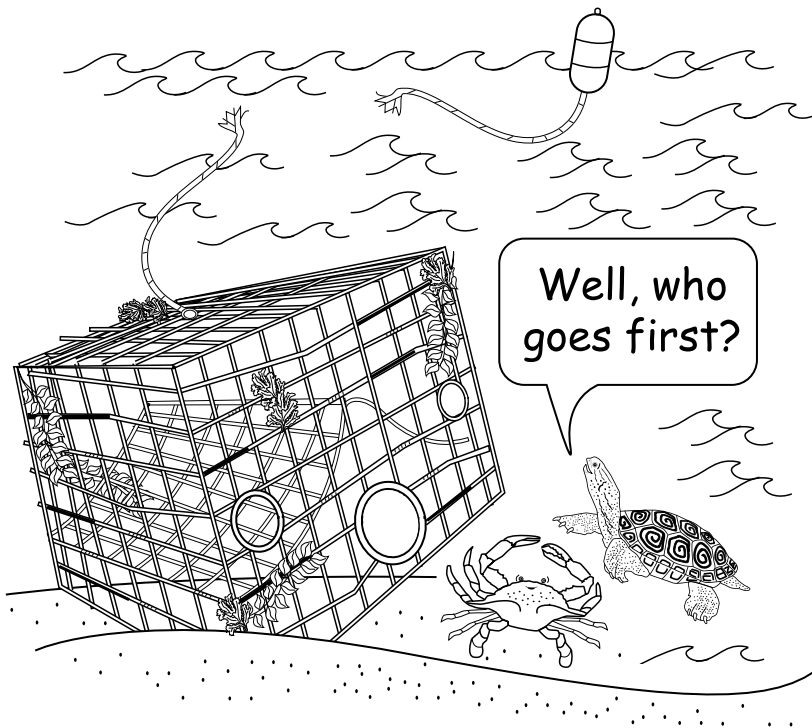


Figure 1. Abandoned crab trap or “ghost pot” that may continue to catch animals.

South Carolina Gets a Grip on Lost Traps

Cruising along the South Carolina waterways, we notice the abundance of football-sized plastic floats, or buoys, in the water. These buoys, a symbol of South Carolina’s thriving blue crab industry, locate the spot where crabbers have set their crab traps on the bottom.

In 2007, several thousand recreational crabbers operated in South Carolina and 351 commercial crabbing licenses were sold in the state. That’s a lot of people with a lot of traps in the estuarine and tidal creek waters. Responsible crabbers check traps once daily, or more often. Others do not. Some traps get lost when the floats get cut off by boats or during storms.

The problem of lost crab traps does not have an easy answer. The impact of **derelict** and abandoned crab traps can be deadly. Fish, turtles, and even dolphins can be caught. Boat propellers can be ruined when boaters run over the unmarked traps. In a pilot project conducted by the Ashepoo-Combahee-Edisto (ACE) Basin National Estuarine Research Reserve, sidescan sonar was used to locate submerged, **derelict** traps. SCUBA divers marked each location and documented the condition of the trap and any organisms on it or in it.

In an effort to reduce the number of **derelict** traps, the Department of Natural Resources has taken several steps. First, solid floats must be used so that they will not sink if struck by a boat. Non-floating line is also required, as it will sink to the bottom and reduce the number of marine animal and boat entanglements. Traps must be placed outside navigational waters.

So what does the future hold? Several ideas have been proposed to help with the growing problem of abandoned crab traps, ranging from installing an escape ring for air-breathing animals such as diamondback terrapins to collaborating with other agencies. **Derelict** crab traps could be retrieved, recycled, and reused into beneficial structures for oyster recruitment!

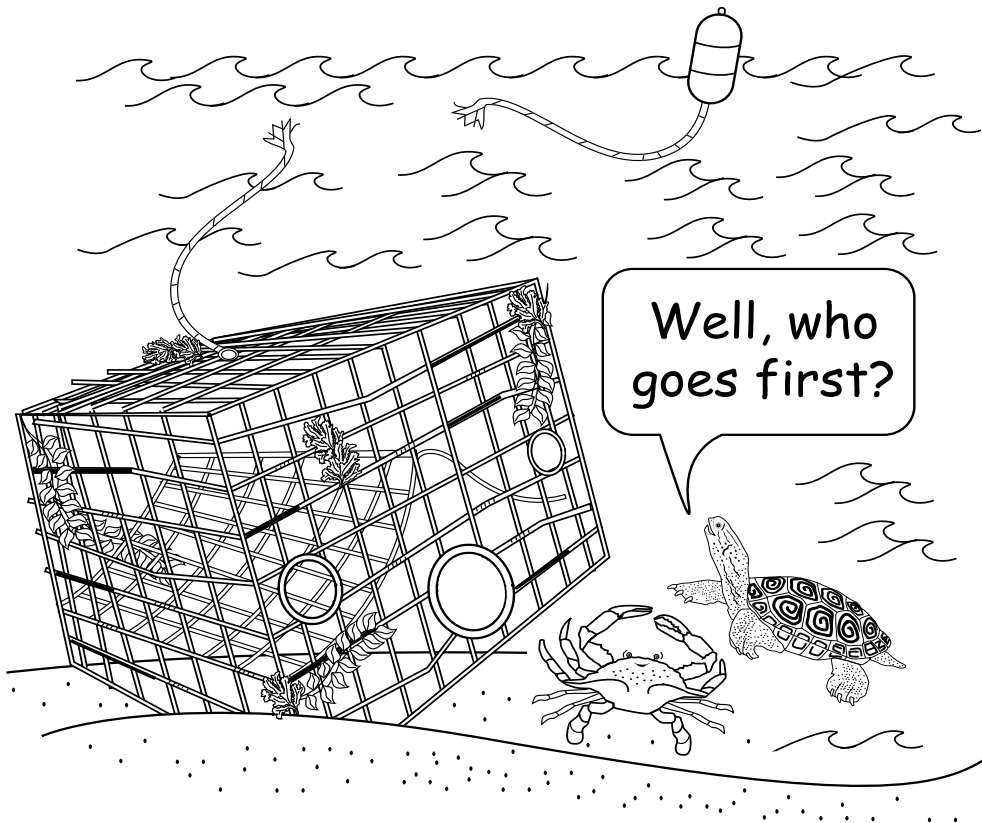
For more information on South Carolina’s natural resources, visit www.dnr.sc.gov.

Sidebar: Kattie McMillan, S.C. Department of Natural Resources



Activity | HOLD YOUR BREATH

DBTs breathe oxygen and, when resting, can hold their breath for many minutes! However, when stressed or exerting energy, **DBTs** use more oxygen and cannot hold their breath as long. As air-breathing animals, they will drown if trapped in an abandoned crab traps. They try desperately to escape.



Student Reporting Table

	Class Average-Time
Inactive	
Moderately Active	
Highly Active	

DISCUSSION OF OBSERVATIONS

1. According to your table, during which exercise can you hold your breath the longest: the inactive, moderately active, or highly active exercise? Why do you think there is a difference?

2. Under what conditions do you think a diamondback terrapin would be able to hold its breath the longest: resting, hunting, or when caught in a trap?

CONCLUSION: How can you keep **DBTs** out of traps?

Source: Angela Bliss, Adopt-A-Wetland Coordinator, University of Georgia Marine Extension Service

PURPOSE

To investigate events that may influence how long students can hold their breath under different conditions—this simulates a **DBT's** ability to hold its breath.

OBJECTIVES

The students will:

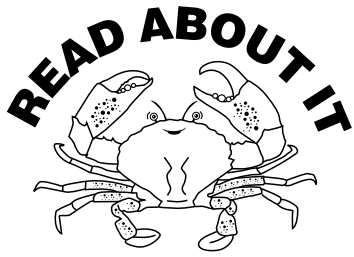
- ▶ Investigate how long they can hold their breath when inactive and active.
- ▶ Relate their findings to an inactive **DBT** and an active **DBT**.

MATERIALS

- ▶ Basketball court, or sports field
- ▶ Stopwatch

PROCEDURES

1. Students stand in place.
Option: Students can work in pairs. Stopwatch ready.
2. Students take and hold a deep breath. Start timing.
 - a. As students release breath, record their times. They can sit.
 - b. Math: Calculate the class' average length of time for breath-holding.
 - c. Record this average in table in inactive row.
3. Students line up, shoulder to shoulder, at one end of the court or field.
 - a. Students take in breaths, hold, and walk as far as they can on that breath.
 - b. When they are releasing breaths, they stop and record their times.
 - c. Math: Calculate the class average and record in table in moderately active row.
4. Have students line up, shoulder to shoulder again, along the end of the court or field.
 - a. Time students as they run and scream as long as one breath will allow.
 - b. Record times, calculate the class average, and record in highly active row.

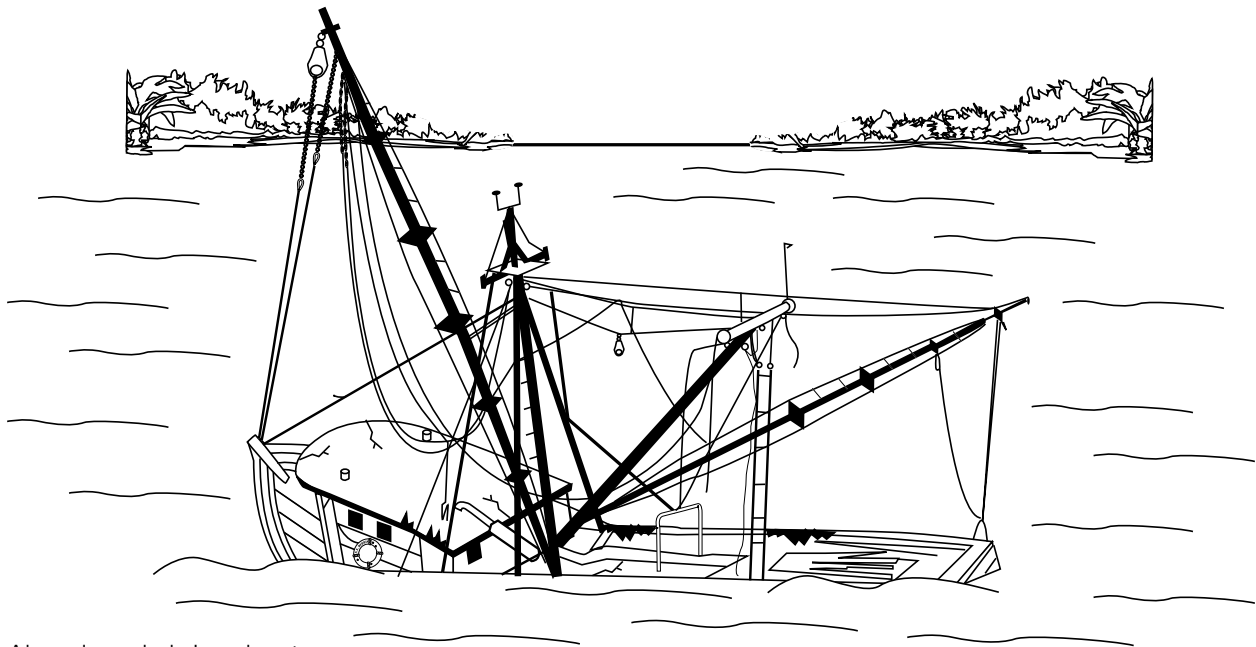


Abandoned and Derelict Boats

CHAPTER 4: DERELICT BOATS

Abandoned boats are a serious problem throughout coastal rivers, **estuaries**, sounds, and tidal creeks in the U.S. Southeast and Gulf of Mexico coast regions. When a boat is **unmoored**, abandoned, capsized, or in a state of disrepair, it can be classified as marine debris.

Abandoned boats are hazardous to the marine environment. They may contain gasoline, oil, and other chemicals that pollute the water. Submerged, abandoned boats pose a navigational danger to boaters. Imagine what running over a sunken boat could do to an outboard motor or water skier! Often, **derelict** boats drift to salt marshes, where they can slowly destroy critical habitat for diamondback terrapins and oysters.



Abandoned shrimp boat

How do boats become abandoned?

Sometimes storms break boats from their **moorings** or docks. Sometimes an owner just abandons a neglected boat. Owner neglect is the most common reason a boat becomes abandoned, as the sun and saltwater are harsh on boats and require owners to make constant repairs. When an owner can't afford to make these repairs, the boat falls into a state of disrepair and becomes unsafe to use. Owners sometimes break **moorings**, sink boats, or drive boats to **stranding** locations and leave them for someone else to find.

Georgia Estuaries Are Not a Junk Yard!

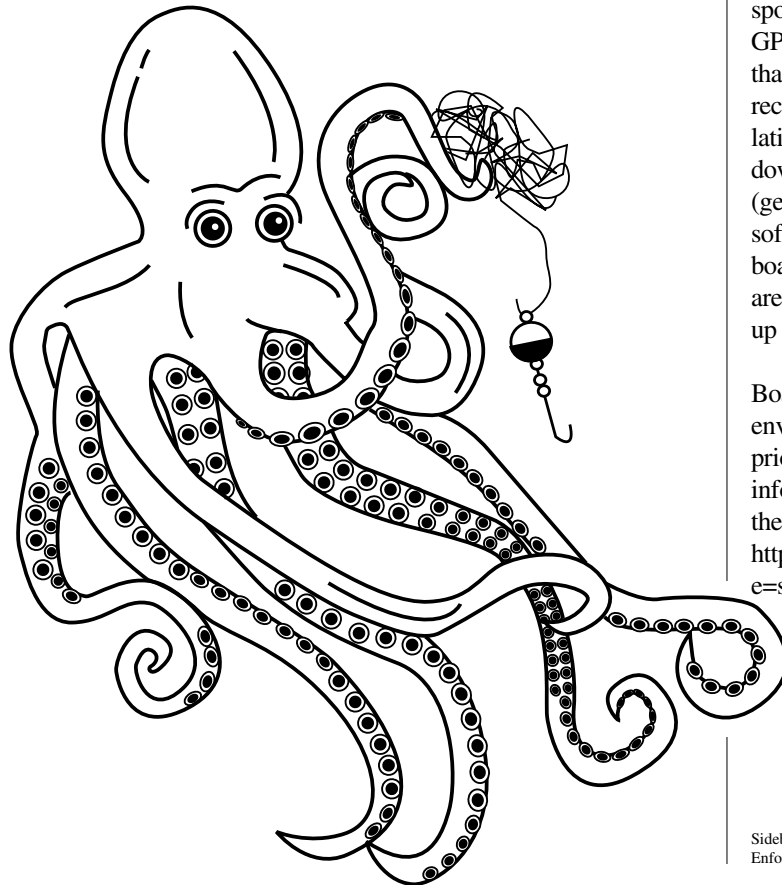
In 2008, sixty-five abandoned and derelict boats littered Georgia's coast and tidal rivers. These wrecks range from small powerboats to large shrimp boats. The extreme tidal range of Georgia's coast (six to nine feet) means that these wrecks are often hidden during high water. Abandoned vessels can be dangerous to commercial navigation, as well as to recreational boating and skiing. A large

Chapter 4: Derelict Boats, (continued)

What happens when an abandoned or **derelict** boat is found?

Every effort is made to locate the owner and arrange for proper removal and disposal. However, locating the owner of an abandoned boat is often difficult, as owners or harsh conditions may remove all identification from the boat. If an owner is found, he or she may be required to pay for removal or may be prevented from acquiring future boating licenses. If the abandoned boat is a threat to the habitat or navigational safety and owners cannot be located, the boat can be removed by a state or national agency at a high price!

Source: Modified from "Turning the Tide on Trash," Special Issue, *Post and Courier* (Charleston, S.C.), August 29, 2007.
Article by Dan Burger, S.C. Department of Health and Environmental Control, Office of Ocean and Coastal Resource Management.



Georgia Estuaries Are Not a Junk Yard! (continued)

vessel rubbing up against the marshes can tear up critical habitat of grasses or oyster reefs.

The Georgia Department of Natural Resources (GA DNR) locates and removes some of these hazardous structures. Although the coastline is only 118 miles long, there are more than 2,400 miles of tidal creeks and more than 400,000 acres of marshland. That is a lot of water in which to search and locate these boats.

Finding a wreck is one problem. Removing a **derelict** boat is another. It is expensive, often costing \$50,000 per boat. The Georgia Legislature allocated money in 2006 that assisted GA DNR in locating many abandoned boats and provided equipment to map the boats' locations. Once a boat is spotted, its position is marked by a GPS (Global Positioning System) unit that uses at least three satellites to record the boat's precise longitude and latitude. These data are then downloaded to a computer with GIS (geographic information system) software. Now the location of each boat can be plotted onto a map of the area. What an incredible way to keep up with **derelict** boats in Georgia!

Boats posing the greatest threats to the environment or to navigation are given priority for removal. All of the information that has been collected by the GA DNR is available to view. Visit <http://dev.gadnr.org/dev/imf/imf.jsp?site=sunk>.

Sidebar: Charles "Buck" Bennett, Compliance and Enforcement Manager, Coastal Resource Division, GA DNR



Activity | SPEAK UP AND STATE YOUR CLAIM

Coastal residents and visitors have a stake in legislation pertaining to **derelict** boats along the Southeast and Gulf of Mexico coasts. Navigational hazards, impacts on marshes, and poor water quality are among the potential problems.

PROCEDURES

1. Delegate student(s) to specific roles for this activity. If it is a large role, then students can work together as team for one role.
2. Allot time for research based on the role. Students should incorporate into their role-playing the current situations and regulations in their state and the nation. Students should also get in the proper frame of mind, so that they can better represent that sector of coastal society. Students could communicate with natural resource outreach staff members.
3. Set up classroom or auditorium in a forum style.
4. Remind students that this exercise represents a mock hearing to amend or sustain current regulations on **derelict** vessels and boats.
5. Each role is given five minutes (so you need a timer) to present information representing the position. Students could use PowerPoint presentations, posters, or oral presentations.
6. All sides will be heard before any decisions are made by the representative(s) of the state legislature.
7. After the debate and the decision on the policy, students should discuss their real opinions and respond to the observation and conclusion process.

OBSERVATION

1. What are the current regulations on **derelict** boats for your state?
2. Do you think that **derelict** boats are a large problem in your state?

CONCLUSION

1. After role-player has made his or her claim in amending or sustaining derelict vessel regulation, discuss at least one point made by each role-player.
2. Have students "shed" their roles and discuss the pros and cons for amending or sustaining regulation. Those playing members of the legislature must remember to be unbiased and make any decision based on the arguments provided by the students.

PURPOSE

To debate public policy on **derelict** boats

OBJECTIVES

The students will:

- Research positions on derelict boats based on state and federal regulations and public opinions
- Practice public-speaking skills

PREPARATION

- Computer or library time to research roles and regulations
- Roles for students:
(Please adjust for your state or situation)
 - Wildlife biologist who researches migratory waterfowl that use an **estuary** full of abandoned vessels
 - Water quality chemist who tests water quality around an abandoned boat
 - Commercial shrimp fisherman who is facing tough times due to rising gas prices for boats. He or she is considering just sinking the boat.
 - Recreational boat owner who doesn't know how to moor the boat during a storm. This person does not want to be financially responsible for a lost vessel.
 - Waterfront property owner who noticed three **derelict** boats afloat near her or his property
 - Live-aboard boat owner of a newly purchased, retired shrimp boat who is planning to anchor in a waterway and wants to live on the boat with two golden retrievers
 - Avid kayaker who has explored the tidal creeks for 11 years and is finding evidence of oil spills
 - Restaurant owners at the waterfront marina who are concerned over marsh view
 - Oyster farmer who is concerned about damaged oyster reefs and dying oysters
 - Local natural resource management officer who deals with complaints from students playing each of the different roles
 - Legislature members (this role could be played by the instructor or a group of students who did not have roles).
Need to know the state laws.
- Space that can be set up in a forum style so all groups can hear the claims of other groups



Activity | “PING” YOUR WAY THROUGH THE DERELICT BOAT MAZE

In the past, ship captains had a difficult time navigating through **turbid estuarine** waters with low visibility, as they couldn't spot submerged marine debris. Today, instruments such as fish finders and depth recorders use **sonar** to reveal structures, as well as schools of fish, on the bottom. Technical instruments with even greater resolution, such as **side scan sonar**, allow state and federal agencies to locate additional submerged structures.

Sonar is similar to echolocation in dolphins, as a pulse of sound is emitted from the transmission side of the instrument. The sound wave moves through the water and “pings” as it reflects off underwater structures. The reflected waves return to the **sonar's** receiver. Based on the speed of sound, a location for the submerged vessel can be determined and, using GIS coordinates, marked on a chart.

PROCEDURE

1. Mark off boundaries for this activity. One half of a basketball court or a portion of your classroom will be sufficient. This space represents an estuary littered with submerged marine debris hazards. There is a dock at one side of the court (*start*) and another dock at the other side (*finish*).
2. One student represents the *navigating boat*, and the remaining students represent *underwater hazards* such as sunken oil rigs, abandoned recreational boats, fragmented commercial boats, old docks, etc.
3. Rules:
 - a. Navigating boat: Eyes shut. No running. Walk slowly with hands in front. Listen carefully to your surroundings.
 - b. Underwater hazards: Eyes open. Once spot is chosen, no moving. Must reply to all emitted “pings” with “pong”.
 - c. All students are quiet except for “ping” and “pong.”
4. The start: Navigating boat stands with eyes closed while the underwater hazards select a spot within the designated boundaries.
5. With eyes shut, the navigating boat moves about the course without bumping into any underwater hazards.
6. While moving, the navigating boat calls “ping.” All underwater hazards within arms length of the navigating boat, must reply “pong.”
7. To avoid bumping into an underwater hazard, the navigating boat must turn and continue moving. (Note: During the course, the instructor may need to guide the navigating boat within the boundaries.)
8. Should an underwater hazard be bumped by the navigating boat, then the navigating boat sinks and becomes an underwater hazard.
9. Another student becomes the navigating boat and tries his or her skill at navigating the course.
10. The course is successfully completed when the navigating boat travels from *start* dock to *finish* dock without bumping into any underwater hazards.

PURPOSE

To simulate **sonar** technology in marine navigation course.

OBJECTIVES

The students will:

- ▶ Work as a team to complete the simulated course
- ▶ Investigate technological advances that assist with underwater **derelict** vessel mapping projects.

MATERIALS

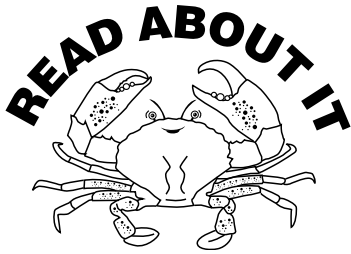
- ▶ Classroom or basketball court

OBSERVATIONS

1. As the navigating boat, how did your listening skills help?
2. As an underwater hazard, how did you feel when the navigating boat was nearby?

CONCLUSION

1. If you owned a boat, how would you feel to have it damaged by a sunken vessel or marine debris?
2. How did captains navigate marine debris hazards in shallow waters before **sonar** technology?



CHAPTER 5: STEWARDSHIP & RESPONSIBILITY

In 2007, clean-up volunteers in North Carolina, South Carolina, Georgia, Florida, and Mississippi collected 1,711,803 pieces of marine debris along the coasts during the fall international marine clean-up day. That's more than 1.7 million items out of place—not reused and not recycled.

What Can We Do?

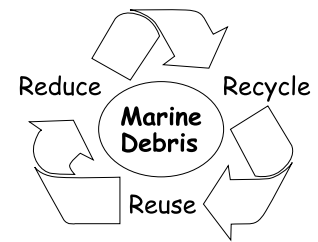
We all are affected by marine debris, which means we all must work together to prevent and reduce the growing problem of marine debris.

So, if we don't like it, how are we going to change it?

We need to develop strategies to reduce the amount of marine debris entering the environment.

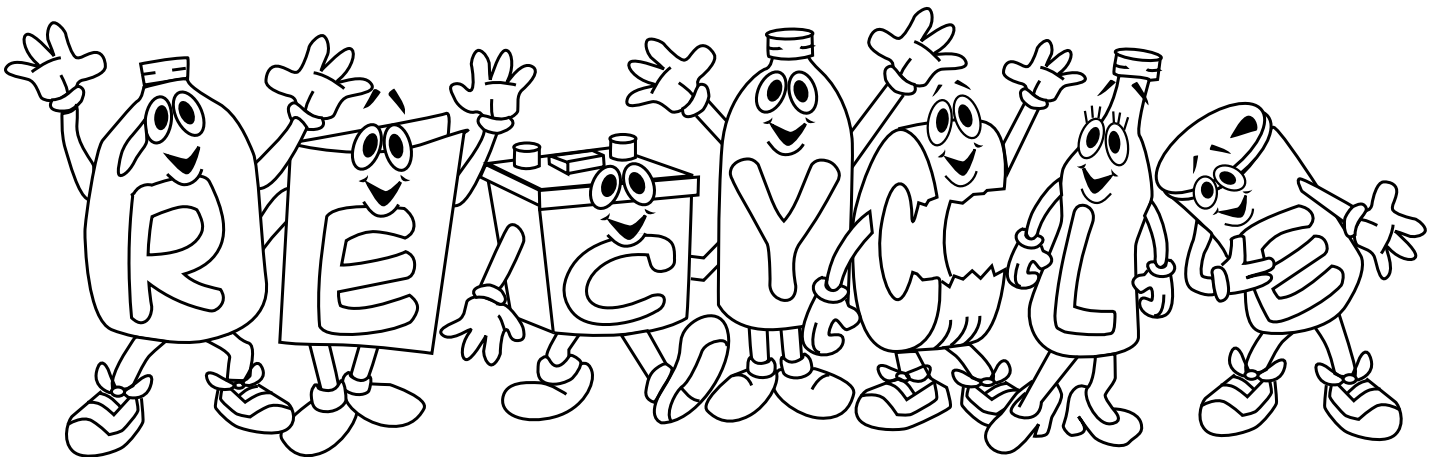
We need to recycle marine debris. This task is easier now that many plastic, glass, and metal items can be recycled. Also, we need to reuse items to prevent them from becoming marine debris.

Many tons of marine debris items are recovered each year in clean-ups on our beaches and inland shores. Thousands of volunteers assist local agencies with **stewardship** by picking up litter. These volunteers are role models and their actions influence other people.



Join the North Carolina Big Sweep. Participate in the South Carolina Beach Sweep/River Sweep. Find the regional clean ups in Georgia, Florida, and Mississippi. Join one of the many state Adopt a Beach programs. Build fishing line recycling boxes and put them on private docks and boat ramps—don't forget to recycle the contents regularly. Ask for more trash containers on public beaches and boat ramps. Take care of your own litter.

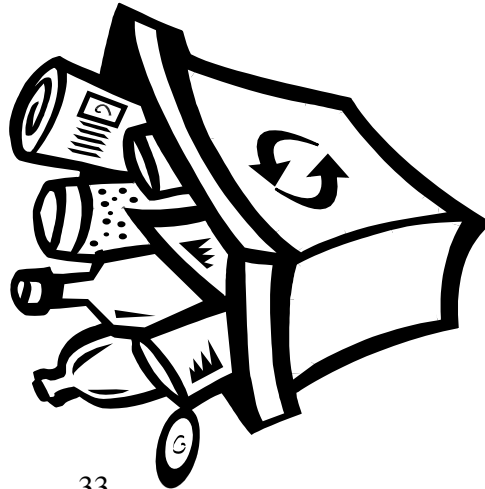
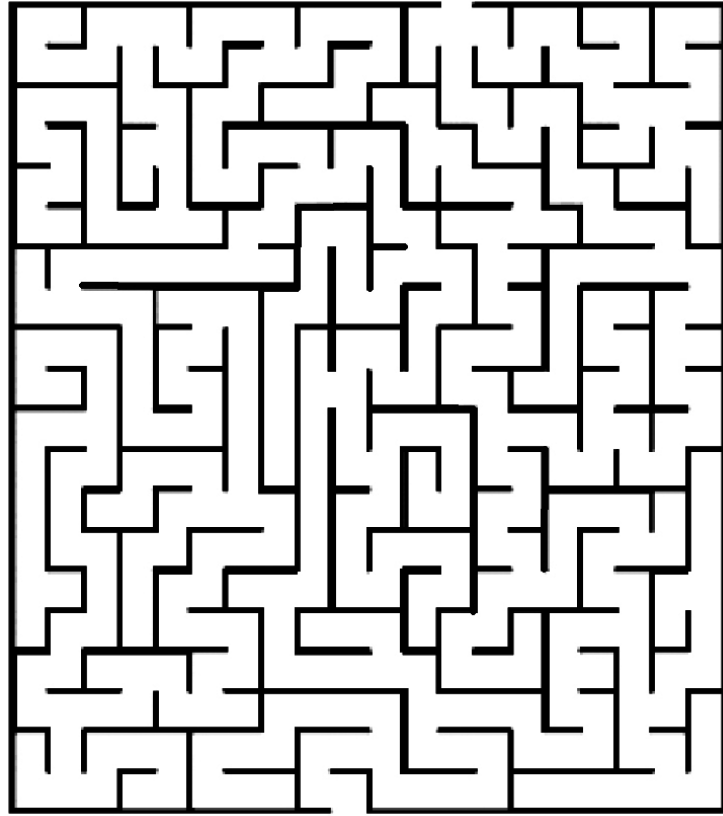
Enjoy our wonderful coast. Leave only footprints.



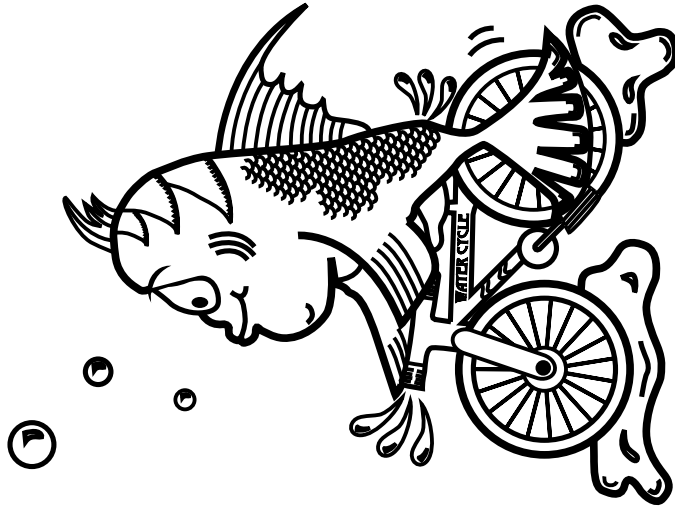
(Note: color this word or make your own poster. Graphic credit: SCHEC)



Help the Rojo Reach the Recycle Center



Recycle Center



Rojo on his water cycle
(Illustration by Samantha Shepard)



Activity | DON'T TEACH YOUR TRASH TO SWIM!

Keeping litter out of the coastal waterways is very important. Reuse aluminum cans for art projects, tree ornaments or mobiles.

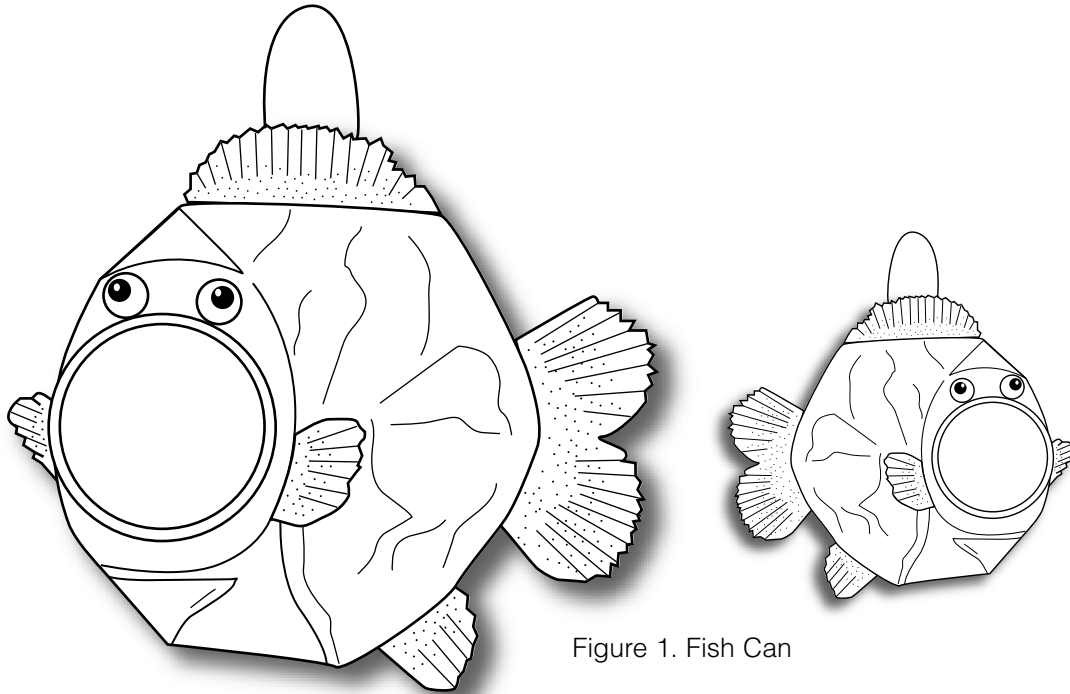


Figure 1. Fish Can

MATERIALS

- ▶ Aluminum soda cans, rinsed and dried
- ▶ Craft glue
- ▶ Art paper, leaves, and twigs
- ▶ Scissors
- ▶ Plastic eyes (from a hobby shop)
- ▶ Spray paint for the fish body
- ▶ Acrylic paints for body parts
- ▶ (Note: metallic acrylic paint can give the fish a slight shimmer)

PROCEDURE

1. Flatten the can first by hand, making sure the bottom of the can faces up (see Figure 1) and the bottom crunches up behind the body of the can. Finish the flattening process by stepping on it.
2. Paint the can with spray paint. Dry.
3. Add painted details. The bottom of the can should be black, to create the fish's mouth. Options: add pink tongue, scale, gills, etc. Dry.
4. Make fins from paper, leaves, and/or silk flowers and attach to can with glue. Dry.
5. Glue the eyes in place. Dry.
6. Finish by glueing a loop of string or wire for hanging.

Source: Modified from the South Carolina Department of Natural Resources, S.C. Aquatic Education Program Web site (<http://screelkids.dnr.sc.gov>)



Activity

CALCULATE MARINE DEBRIS FROM LAND OR SEA

The chart lists marine debris items from the 2007 international clean-ups in North Carolina, South Carolina, Georgia, Florida, and Mississippi as tabulated by the Ocean Conservancy

Some debris comes from the ocean—boaters who litter, coastal communities in other countries, and ships that toss waste overboard. Some debris comes from beach visitors or from people at boat ramps returning after a day's outing. Some is swept along from upriver sources. Still other debris may be the result of storm, run-off, washing debris into drains and then into creeks.

Results from the 2007 Clean Up:

Florida, Georgia, Mississippi, North Carolina, and South Carolina

DEBRIS ITEMS	TOTAL	ESTIMATE % FROM LAND	ESTIMATE % FROM LAND
Bags	87,981		
Balloons	9,417		
Beverage Bottles (Glass)	90,399		
Beverage Bottles (Plastic) Two Liters or Less	92,104		
Beverage Cans	82,395		
Caps/Lids	146,021		
Clothing/Shoes	18,179		
Cups/Plates/Forks/ Knives/Spoons	66,042		
Food Wrappers and Containers	130,579		
Pull Tabs	24,767		
Shotgun Shells/Wadding	4,392		
Six-Pack Holders	5,499		
Straws/Stirrers	62,113		
Toys	10,662		
Bait Containers/Packaging	7,948		
Bleach/Cleaner Bottles	2,661		
Buoys/Floats	4,503		
Crab/Lobster/Fish Traps	1,108		
Crates	916		
Fishing Line	22,390		
Fishing Lures/Light Sticks	5,205		
Fishing Nets	2,049		
Light Bulbs/Tubes	1,583		
Oil/Lube Bottles	2,720		
Pallets	593		
Plastic Sheeting/Tarps	14,616		
Rope	18,573		
Strapping Bands	6,853		
Cigar Tips	51,527		
Cigarette Lighters	7,359		
Cigarettes/Cigarette Filters	677,085		
Tobacco Packaging/Wrappers	18,837		
55-Gallon Drums	284		
Appliances (Refrigerators, Washers, Etc.)	770		
Batteries	4,006		
Building Materials	20,827		
Cars/Car Parts	2,764		
Tires	3,132		
Diapers	2,346		
Syringes	598		
Totals	1,711,803		

PURPOSE

To have students assess the sources of marine debris

OBJECTIVES

The students will:

- ▶ Use graphing and categorizing skills
- ▶ Identify sources of marine debris

MATERIALS

(for each student or team of students)

- ▶ Copy of "Results for the 2007 Clean Up for Southeast Atlantic and Gulf of Mexico"
- ▶ Pencil
- ▶ Graph paper

PROCEDURE

1. Provide a copy of the "Results" publication to teams of students.
2. Decide the source for the items if from land or sea. Estimate a percentage from land or sea based only on the team's opinion.
3. Identify the top 10 most numerous items on the chart.

CONCLUSION

1. For the top 10 items, do you think they are typically from land or sea?
2. These 10 items comprise what percentage of the total 1.7 million pieces?
3. How do you think these items listed in the chart became marine debris?
4. Plan a campaign to reduce, recycle, or reuse the top 10 items.

Source: Modified from "Turning the Tide on Trash," Special Issue, Post and Courier (Charleston, S.C.), August 29, 2007.



Student Reporting Table

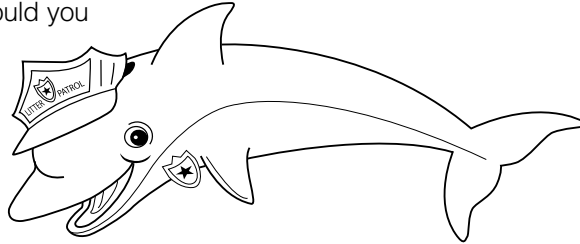
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Activity

MAKE YOUR OWN MARINE DEBRIS LAWS

Are existing laws on litter and marine debris adequate? What happens to those who litter or abandon gear and boats? Each state and city manages litter regulations differently. How does your city or state manage litterbugs? If you were in charge, would you maintain these rules or create your own?



Action	What is your law and what is your legal consequence for a person who violates this law?	What are the effects of this litter on the environment?

Look up state litter regulations. Here are some suggested Web sites on state litter regulations.

GEORGIA

Summary of Georgia's Comprehensive Litter Prevention and Abatement Act of 2006: www.litteritcostsyoudo.com/change_enforcement.aspx#abate

Litter and Illegal Dumping in Georgia:

www.dca.state.ga.us/environmental/kgb/illegal_dumping.html

SOUTH CAROLINA

Litter Laws for South Carolina:

www.palmettopride.org/litterlaws.asp

www.keepthemidlandsbeautiful.com/litterprevention/sclitterlaws.asp

NORTH CAROLINA

www.ncga.state.nc.us/Sessions/2001/Bills/Senate/HTML/S1014v9.html

www.ncdot.org/doh/operations/dp_chief_eng/roadside/Beautification/litterlaws/

MISSISSIPPI

<http://billstatus.ls.state.ms.us/documents/2000/pdf/SB/2001-2099/SB2074IN.pdf>

www.mscode.com/free/statutes/97/015/0029.htm

www.mscode.com/free/statutes/97/015/0030.htm

FLORIDA

<http://laws/flrules.org>

http://flrules.org/files/ch_2006-295.pdf

PURPOSE

To have students become aware of local and state litter regulations.

OBJECTIVES

The students will:

- Create their own laws and legal consequences concerning marine debris.
- Identify the litter laws and legal consequences of litter in their own state.

MATERIALS

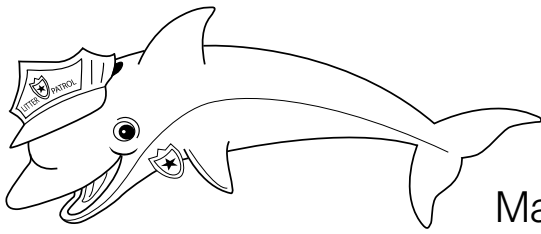
- Internet access
- Chart paper
- Markers

PROCEDURE

(done in teams):

1. Research your state's laws on litter and marine debris. Note the consequences for littering.
2. Develop a list of actions related to littering, e.g., dumping garbage on the side of the road, leaving picnic waste at a beach, throwing gum out of a car, leaving a boat in a tidal creek for years.
3. Develop a law and a legal consequence of this action. For example, offenders might pay a fine, perform community service, go to jail, etc.
4. Create a chart to display your results to the rest of the class.
5. Send your ideas to your local elected officials.

Source: Modified from the *Post and Courier* Special Issue, "Turning the Tide on Trash," August 29, 2007



Make Your Own Marine Debris Laws

Student Reporting Table

Marine Debris Problem	What is your law and what is the possible legal consequence for a person who violates this law?	What are the effects of this litter on the environment?

Answer the following

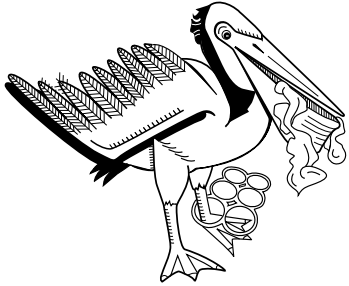
1. When you developed your own laws on littering, how did you decide the appropriate legal consequences?

2. Have you ever seen the current laws of your state enforced on the beach? _____

3. Conclusion:

In a short paragraph, describe your thoughts on the adequacy of your state's existing laws on litter and marine debris. Describe what you could do to ensure that the laws are enforced. Invite a law enforcement person to your class to discuss your results.

What's
the word?



Glossary

► **BRD**

Acronym for Bycatch Reduction Device, a device that makes it difficult for diamondback terrapins to enter crab traps.

► **BIODEGRADE**

Breakdown of living or organic substances typically by microorganisms, such as bacteria.

► **COSEE**

Acronym for Center for Ocean Science Education Excellence.

► **DECOMPOSE**

Breakdown of dead organisms into simpler components.

► **DBT**

Acronym for diamondback terrapin, a species of turtle.

► **DENSITY**

The mass of a substance per unit volume.

► **DERELICT**

Abandoned by owner.

► **EDDIES**

Circular currents, often spin-offs from the Gulf Stream.

► **ESTUARY**

Semi-enclosed coastal body of water with rivers flowing on the mainland side and having a connection to the sea. Estuaries have a mix of saltwater and fresh water that changes with the tides.

► **GHOST FISHING**

Unintentional catch of wildlife by discarded nets, traps and lines.

► **HEADWATERS**

The very beginning of a river, often a tiny stream or spring.

► **JELLIES**

Jellyfish, invertebrate animals with stinging tentacles that swim weakly and drift with currents in the water column.

► **MOORED**

Tied up to a dock or anchor.

► **NMMSN**

Acronym for National Marine Mammal Stranding Network.

► **NOAA**

Acronym for National Oceanic and Atmospheric Administration.

► **NECROPSY**

A thorough examination of a corpse to determine the cause and manner of death and to evaluate any disease or injury that may be present. It is usually performed by a specialized medical doctor called a pathologist.

► **PERSISTENT**

Lasting a long time.

► **PROTOCOL**

A standard way or procedure to communicate or transfer information or data.

► **RUST**

Chemical process that is a reaction of iron with oxygen in the presence of water or air moisture.

► **SENTINEL SPECIES**

A plant or animal whose presence or absence provides information about environmental conditions.

► **SIDESCAN SONAR**

Instrument towed by research vessels that sends out sound waves to detect changes in relief of the seafloor or obstacles on the bottom, e.g., boats or crabtraps.

► **SONAR**

Acronym for Sound Navigation And Ranging. SONAR instruments send and receive reflected sound waves to determine distance, depth or location of objects or even fish.

► **STEWARDSHIP**

The careful and responsible management of something entrusted to one's care.

► **TURBID**

Water that is very cloudy with particles.

► **UNMOORED**

When a boat is drifting not under a captain's command.

► **WATER COLUMN**

Vertical water from surface to seafloor.

► **WATERSHED**

All of the tiny streams, creeks, and rivers that flow together into an estuary. Ridges divide one watershed from another.

► **WRACK LINE**

A line of natural and man-made debris deposited at the last high tide.

RESOURCES ON MARINE DEBRIS

NATIONAL RESOURCES:

WEB SITES

Algalita Marine Research Foundation: <http://algalita.org>

Glossary, images, informational materials

DVD: *Synthetic Sea*

American Plastics Council: www.plasticbagrecycling.org

Recycling plastic film and bag

Beachcombers' and Oceanographers' International Association: www.beachcombers.org

Clean Beaches Council: www.cleanbeach.org

Diamondback Terrapin Working Group: www.dtwg.org/Regional.htm

Regional crab trap information

Digital Library for Earth System Education: www.dlese.org/library/query.do?q=marine%20debris&s=0

Classroom activities

Keep America Beautiful: www.kab.org

Ocean Conservancy: www.oceanconservancy.org/

International Coastal Clean Up

Surfrider Foundation: www.surfrider.org/

The Bridge: www2.vims.edu/bridge/search/bridge1output.cfm

Portal to marine activities

U.S. Department of Commerce National Ocean and Atmospheric Administration (NOAA):

Office of Ocean and Coastal Resource Management, Marine Debris Information Office:

http://coastalmanagement.noaa.gov/issues/md_ocrm_activities.html

Derelict vessel removal, derelict fishing gear removal

Office of Response and Restoration: <http://response.restoration.noaa.gov>

Marine debris emergency

Marine Debris Program: <http://marinedebris.noaa.gov/welcome.html>

Understanding Marine Debris (activity booklet, 21 pages)

Marine Mammal Stranding Network Contacts

Southeast Regional Hotline: 1-877-433-8299

(Includes Florida, Georgia, Mississippi, North Carolina, and South Carolina)

U.S. Environmental Protection Agency: www.epa.gov/owow/OCPD/Marine/contents.html

Marine debris information and lessons

U.S. Coast Guard: www.uscg.mil/top/downloads/coloring.asp

The Adventures of Captain Clearwater (coloring book)

Inky the Whale (coloring book)

PUBLICATIONS/MEDIA

Burns, Loree G. *Tracking Trash: Flotsam, Jetsam, and the Science of Ocean Motion*. Boston: Houghton Mifflin Co., 2007. ISBN 13-978 0 618 58131-3.

Coe, James M., and D.B. Rogers, editors. *Marine Debris: Sources, Impacts, and Solutions*. New York: Springer-Verlag, 1997. ISBN 0-387-94759.

Environmental Media Corp., Beaufort, South Carolina: www.envmedia.com

DVD: *Journey of the Loggerhead* (life cycle and threat)

Video: *Death of a Whale*

Video: *The Yellow Hat* (debris from river to sea)

REGIONAL RESOURCES:

FLORIDA

Florida Coastal Cleanup: www.floridacoastalcleanup.org

Florida Department of Environmental Protection: www.dep.state.fl.us/coastal/programs/coral/debris1.htm
Monofilament line recycling, hurricanes, and marine debris

Florida Fish and Wildlife Conservation Commission Monofilament Recovery and Recycling Program:
www.fishinglinerecycling.com

Florida Sea Grant: <http://flseagrant.org> and http://stjohns.ifas.ufl.edu/sea/marine_marine.html
Monofilament line recycling, clean-up events, crab trap

Mote Marine Lab: www.mote.org
Marine debris impacts on marine mammals

University of Florida Agricultural Center: http://stjohns.ifas.ufl.edu/sea/marine_debris.html
Monofilament line recycling and recovery, clean up events, marine debris timeline

University of South Florida College of Marine Science: www.marine.usf.edu/beachbuddies/index.html
Marine debris lesson plans

Water Action Volunteers: <http://sjrwmd.com/education/wav/calendars/index.html>
Community clean-up calendar of events

GEORGIA

Georgia Department of Natural Resources

Coastal Resources Division: www.CoastalGaDNR.org

Fishing line recycling, documenting abandoned and derelict vessels
“Know the Connection Marine Debris Activities”

www.knowtheconnection.com/pdf/GA%20Wetlands%20Treasures.pdf

Environmental Protection Division

Rivers Alive Clean-Up Events: www.riversalive.org

Georgia Power: www.georgiapower.com/lakes/volunteer.asp

Clean-up events

Keep Georgia Clean and Beautiful: www.keepgeorgiabeautiful.org/default.asp

Clean-up events Litter—It Costs You Campaign: www.litteritcostsyou.org

Downloadable education resources

Clean-up events

University of Georgia Marine Extension Service

Marine Advisory Services: www.uga.edu/marex/advisory/

Monofilament fishing line recycling maps and services

MISSISSIPPI

Mississippi Coastal Cleanup: www.masgc.org/cleanup/index.htm

Mississippi Department of Marine Resources: www.dmr.state.ms.us

Monofilament line recycling

Keep Mississippi Beautiful: www.kmbpal.org/index.html

Clean up events

Gulf of Mexico Program, Environmental Protection Agency

www.epa.gov/gmpo/edresources/debris_t.html

Marine debris timeline

Gulf of Mexico, NOAA: <http://gulfofmexico.marinedebris.noaa.gov/>

Marine debris mapping project

NORTH CAROLINA

North Carolina Maritime Museum: <http://capelookoutstudies.org/NCMRRP/ncmrrp.shtml>
Monofilament line recycling program, wildlife entanglement

North Carolina Big Sweep: www.ncbigssweep.org/
Clean up events
Publications:

Ripples: A Big Sweep Elementary Activity Guide
Splash Splash: A Big Sweep Aquatic Primer
Undercurrents: A Big Sweep Middle School Teacher's Guide

SOUTH CAROLINA

Center for Ocean Sciences Education Excellence SouthEast:
www.cosee-se.org
"Litter from Land and Sea" marine debris poster
National Marine Educators Association, "Marine Debris for Educators" PowerPoint presentation

Keep South Carolina Beautiful and Palmetto Pride: www.palmettopride.org/kscb.htm
Clean-up events

South Carolina Aquarium: www.scaquarium.org
Marine debris exhibit
Marine debris programs

South Carolina Department of Health and Environmental Control
Office of Ocean and Coastal Resource Management: www.scdhec.gov
Marine debris: www.scdhec.gov/environment/ocrm/outreach/marine_debris.htm
Adopt-A-Beach Program:
www.scdhec.gov/environment/ocrm/outreach/marine_debris.htm/outreach/cleanbeach.htm
"Marine Debris from Land and Sea" poster:
www.scdhec.gov/environment/ocrm/outreach/docs/debris/SC_MARINE_DEBRIS_POSTER.pdf

South Carolina Department of Natural Resources
Monofilament recycling program: <http://saltwaterfishing.sc.gov/monofilament.html>

South Carolina Sea Grant Consortium: <http://www.scseagrant.org>
South Carolina Beach Sweep/River Clean Up Event: www.scseagrant.org/content/?cid=49

"Turning the Tide on Trash," Special Issue, *Post and Courier* (Charleston, S.C.), August 29, 2007.

Alignment of Activities to Ocean Literacy and National Science Education Standards

OCEAN LITERACY

An understanding of the oceans influence on you and your influence on the ocean.
(web source: <http://www.coexploration.org/oceanliteracy/>)

An ocean-literate person understands:

- ▶ the essential principles and fundamental concepts about the ocean;
- ▶ can communicate about the oceans in a meaningful way; and,
- ▶ is able to make informed and responsible decisions regarding the oceans and its resources.

Alignment of marine debris activities with ***Ocean Literacy Essential Principle 6.***

The ocean and humans are inextricably linked.

NATIONAL SCIENCE EDUCATION STANDARDS

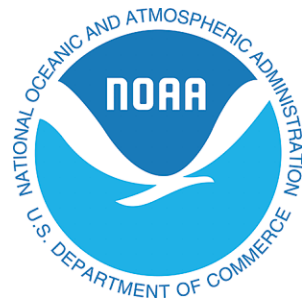
Alignment of marine debris activities with National Science Education Standards

Wed source: www.nap.edu/html/nses/

ACTIVITY TITLE	NATIONAL SCIENCE EDUCATION STANDARDS MIDDLE SCHOOL OR GRADES 5-8
What's On The Beach Today?	NS.5-8.1, NS.5-8.2
Eating Plastic Is A Deadly Meal	NS.5-8.1, NS.5-8.3, NS.5-8.6
Sink Or Float	NS.5-8.1, NS.5-8.2
Who Has/I Am	NS.5-8.2, NS.5-8.6
Traveling Litter	NS.5-8.2, NS.5-8.6
Monofilament Mayhem	NS.5-8.1, NS.5-8.5
Ties That Bind	NS.5-8.1, NS.5-8.3, NS.5-8.6
What Hurt This Whale?	NS.5-8.1, NS.5-8.3, NS.5-8.6, NS.5-8.7
Hold Your Breath!	NS.5-8.1, NS.5-8.3, NS.5-8.6
Speak Up And State Your Claim	NS.5-8.1, NS.5-8.6, NS.5-8.7
Ping Your Way	NS.5-8.5
Help RoJo	NS.5-8.6
Don't Teach Your Trash To Swim	NS.5-8.5
Calculate Marine Debris From Land Or Sea	NS.5-8.2, NS.5-8.6
Make Your Own Marine Debris Laws	NS.5-8.1, NS.5-8.6, NS.5-8.7

GRADES 5 - 8

- ▶ **NS.5-8.1** Science as Inquiry
- ▶ **NS.5-8.2** Physical Science
- ▶ **NS.5-8.3** Life Science
- ▶ **NS.5-8.4** Earth and Space Science
- ▶ **NS.5-8.5** Science and Technology
- ▶ **NS.5-8.6** Science in Personal and Social Perspectives
- ▶ **NS.5-8.7** History and Nature of Science



DNR



KEEP OUR WATER CLEAN—
USE PUMPOUTS

