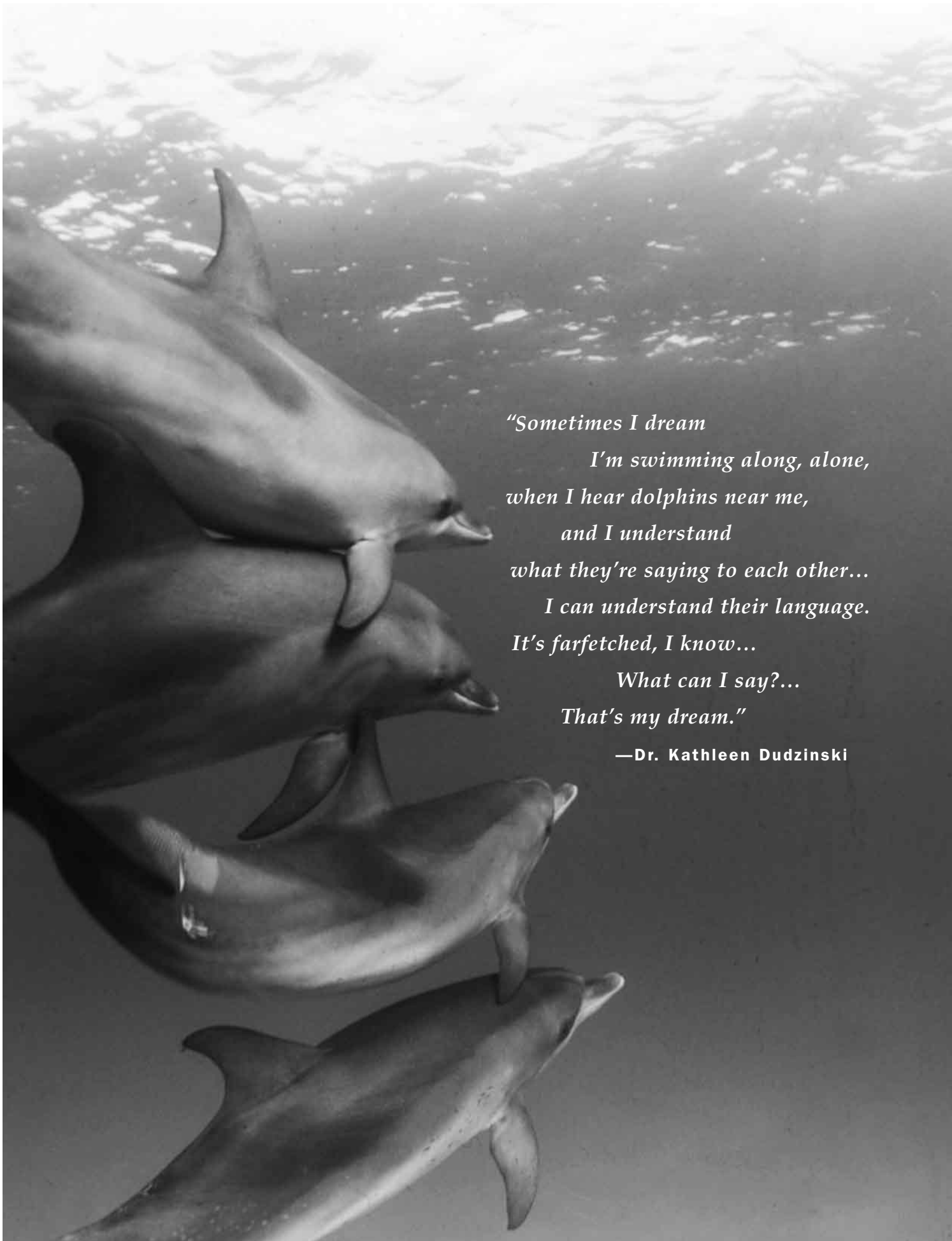


MACGILLIVRAY FREEMAN'S

# DOLPHINS



T E A C H E R ' S   G U I D E



*"Sometimes I dream*

*I'm swimming along, alone,  
when I hear dolphins near me,  
and I understand  
what they're saying to each other...*

*I can understand their language.  
It's farfetched, I know...*

*What can I say?...  
That's my dream."*

**—Dr. Kathleen Dudzinski**

# MACGILLIVRAY FREEMAN'S DOLPHINS™

## An Educational Resource for Teachers

The large format film, *DOLPHINS*, is appropriate for all intermediate grades (4-8). This Teacher's Guide will be most useful when accompanying the film, but is a valuable resource on its own. Teachers are strongly encouraged to adapt activities included in this guide to meet the specific needs of the grades they teach and their students. All activities developed for this guide support National Education Standards for Science, Geography, Math and English, but are not referenced in this guide due to space constraints and differences in standard use throughout the nation.

## Introduction

### Dolphins—Animals We Are Still Trying To Figure Out

Humans cherish and admire beings who possess noble traits. The resourcefulness, confidence and grace of dolphins endear them to our hearts and minds. It is because we search for the same characteristics in ourselves that we cherish these magnificent animals.

We like to think that dolphins enjoy being around us as much as we do them. Is it possible that dolphins share our company simply for diversity? Some species can become bored with their own kind. Who gets more out of the relationship: the human or dolphin? They provide us with insight into the realms of anatomy, behavior and communication. Still, our curiosity pushes us to learn more. Although we admire other animals, dolphins remain high on our list of species that fascinate us.

Scientists believe that marine mammals are descendants of animals that once lived on land. The skeleton of a dolphin supports this theory. There is a modified form of hands in the front flippers of a dolphin. Two small, unattached bones located behind the rib cage are believed to be remains of the pelvic girdle, to which hind limbs once attached. Most people wouldn't know it, but dolphins have a common ancestor with hooved animals, specifically cows. With so many cow lovers out there as well, it wouldn't be a surprise.

*"To the dolphin alone, beyond all other, nature has granted what the best philosophers seek: friendship for no advantage."*

—Plutarch, Greek moralist and biographer

### Science On Location

The MacGillivray Freeman Films crew filmed scientists at work for *DOLPHINS*. It's not easy to follow wild dolphins and study them, but Drs. Kathleen Dudzinski and Alejandro Acevedo-Gutierrez are doing exactly that. To study at close range, the researchers must wait for dolphins to come to them, not a simple task since dolphin groups can travel up to 50 miles per day.

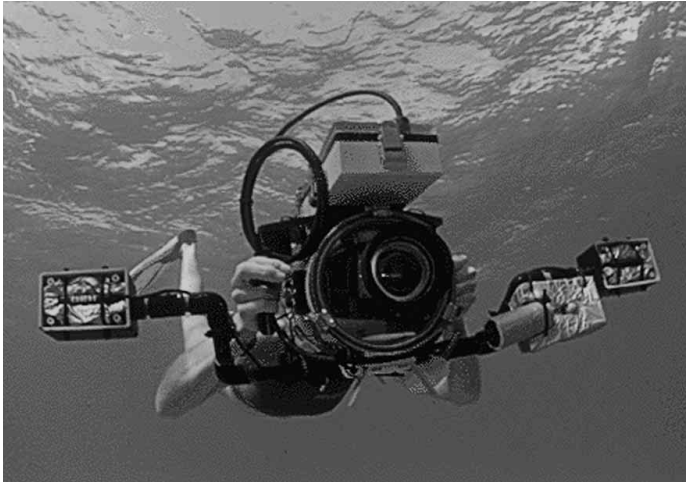
Dudzinski's research focuses on behavior and communication. She spent nearly 2,000 hours in the Bahamas gathering data amounting to only twenty hours of usable recordings. Like Dudzinski, Acevedo earned his doctorate from Texas A&M. He specializes in behavioral ecology of marine mammals and has researched dolphin feeding behavior and foraging techniques.

Adding to the challenge of finding dolphins is the inconvenience of carrying the technical equipment. With more bulk and weight than the average movie camera, the 92-pound IMAX® filming unit is not easy to carry in or out of water. Because of its bulk, it had to be placed in an underwater housing for easier maneuvering and was given the nickname "Miss Piggy" by the film crew.

### Table of Contents

<b>1</b>	Introduction
<b>5</b>	<b>ACTIVITY 1</b> Literacy Sandwich, Hold the Mayo
<b>6</b>	<b>ACTIVITY 2</b> Deep Diving!
<b>8</b>	<b>ACTIVITY 3</b> Save the Dolphins!
<b>10</b>	<b>ACTIVITY 4</b> What's the Chatter?
<b>12</b>	<b>ACTIVITY 5</b> Hidden Identities!
<b>14</b>	<b>ACTIVITY 6</b> Feeling a Little Off Balance?
<b>16</b>	<b>ACTIVITY 7</b> Listen and Learn
<b>18</b>	<b>ACTIVITY 8</b> The Eyes Have It!
<b>20</b>	<b>ACTIVITY 9</b> Uncommon Sense!
<b>22</b>	<b>ACTIVITY 10</b> Talk The Talk
<b>24</b>	Resources, Acknowledgements

**DOLPHINS**  
TEACHER GUIDE



Thanks to her invention of a 25-pound mobile video/acoustic array, Dudzinski had an easier time moving than the film crew. The array was the key component in deciphering which dolphin was making noise. On land, there is a slight delay in sound that allows us to interpret the direction of its origin. Since sound moves 4.5 times faster underwater, the delay is less, making it more difficult to find the source. With a group of dolphins all making noises at the same time, this could be a big dilemma. The array records dolphin vocalizations with two underwater microphones, called hydrophones. They are set on a bar at least 4.5 times the distance between Dudzinski's ears. During the analysis of the videotapes, the delay produced by that distance allowed her to localize the sound source. Combining the hydrophones and a high-tech video camera in a waterproof shelter allowed her to tape the dolphins visually while recording their vocalizations. The unit also contains a smaller box. The box contains a Digital Audio Tape (DAT) recorder and filter with a third hydrophone attached—the click detector. This recorded the signal envelope of dolphin echolocation clicks. Echolocation involves sending out a stream of pulses called a click. The echo sounds are received by the lower jaw of dolphins. From there, the sounds are transmitted to the inner ear via the middle ear. Without this detector, the pitch of the clicks is too high for humans to hear. Despite the extra effort required to carry them, the click detector and array earned their keep by supplying new (or never before recorded) information on how dolphins use sounds and behavior to communicate.

### Locations: Places of Contrast

In the film, dolphins can be seen swimming in bodies of water all over the world. Still, like most animals, dolphins have their preferred homes. Two of these are the Bahamas and Patagonia, Argentina. The Bahamas are a popular vacation destination

for tourists, marine mammals included. The spirit of the people, appealing climate and warm waters make it a pleasing choice for a vacation.

The middle of the Bermuda Triangle, appropriately named Hope Town, was the starting point for the crew. Many fish inhabit this archipelago. It's no coincidence that dolphins spend a lot of time in this area. Known for its calm, warm and clear waters, the Bahamas provide dolphins shelter from tropical storms. The MacGillivray Freeman Films crew filmed Dean Bernal swimming with a bottlenose dolphin named Jojo off the coast of the Turks and Caicos Islands. Off the southern coast of Argentina, Puerto Piramides is battered by a cold, windy ocean. Despite the challenging conditions, this is a key feeding site for dusky dolphins.

### Anatomically Correct

The dolphins' use of echolocation sets them apart from most ocean dwellers. Dolphins use echolocation to detect food under sand and maneuver through dark or cloudy water. A dolphin can find a single BB (shot) when dropped at the far end of a 70-foot (21 m) pool in less than 20 seconds. There is also a theory that they can focus sound into a narrow beam that projects out in front of them. The direction of the beam is selected by them.

Dolphins also rely on their eyes for survival. To rest, they close an eye allowing one side of their brain to sleep, while the other eye patrols the water for danger. Staying in a group also makes it easier to rest.

Their eyes help them adjust to their surroundings by opening wide to see in dim light and nearly closing to see in bright sunlight. When they jump above the surface, dusky dolphins can see up to five miles. Also, each eye moves independently of the other, enabling it to follow different objects at once. Finally, there is the ability of the eyes to see directly forward or backward. This is an invaluable tool in helping spot food or detecting an approaching enemy.

All mammals breathe air. Dolphins, unlike most mammals, exchange 80 percent of lung volume with each breath. In comparison, we only use 20 percent with each breath. They also have flexible rib cages that prevent their bones from breaking on deep dives. They can dive up to 1,640 feet (500 m). They can stay under water for more than eight minutes. Stored oxygen is used for diving, while



the efficiency of their lungs allows them to conserve heat and stay under longer. Most humans can spend no more than one minute under water.

These unique mammals provide us with valuable scientific knowledge. Understanding their built-in sonar and its capacity to detect size, shape, texture and density of underwater objects could help in furthering sonar development. The shape of a dolphin's body and its capability to reach great speeds (21 miles per hour or 33.8 km) might assist design of sea vessels. They can achieve these great speeds by bowriding a fast moving vessel. This allows them to surf pressure waves while expending no energy. We can look at the way dolphins swim to assist us in building quicker boats, much like birds have helped us design better aircraft.

### **More Aggressive Than We Realize**

When most people think of dolphins, they think of Flipper from television and film. Words like playful, intelligent, loving and friendly pop in our heads. They are seen as the aquatic version of man's best friend. Although there are many instances of dolphins being friendly, we need to remember that dolphins are wild animals. While humans seek them out, they usually avoid human contact. Dolphin aggression is evidenced in their markings. Some body scars often come from sharks or human infringement; many are obtained in fights with other dolphins. These intense confrontations may include squawking, clapping jaws, body posture, biting and kicking with tail flukes. Scientists think such interactions establish a social hierarchy.

The combative behavior among dolphins goes beyond their own kind. Off the coast of British Columbia, Scotland and in the Pacific, there have been reports of dolphins attacking porpoises. (Dolphins and porpoises are related. However, porpoises are significantly smaller than most dolphin types. They are generally half the size of the average dolphin.) A kill can take up to 45 minutes since some dolphins flip the porpoises up with their beaks and batter them when they land in the water. Off the Moray Firth in Scotland from 1991-93, 42 dead porpoises washed up on the coast. Tests comparing dolphin teeth marks on the porpoises proved an exact dolphin match.

Like any animal, dolphins can attack other animals. What about attacks on us? In 1994, a dolphin in the wild killed one Brazilian man and injured another. One man died from internal hemorrhaging, while the other suffered a broken rib. The following week, the same dolphin injured another swimmer. The men claimed that the dolphin attacked them after they tried to put sticks into the animals' blowhole as they attempted to ride it. As much as we love dolphins, we need to be aware that they can injure us, no matter how rare, if we are not careful. For this reason, it is not a good idea for us to interact with them in this way.



Keeping distance and avoiding pursuit of dolphins is vital for their safety and ours.

### **Random Acts of Kindness**

When a member of a group gets injured, two dolphins may swim underneath and support it below the flippers, then bring it up to the surface for air. Some experts believe that dolphin mothers take turns babysitting as well as disciplining. For instance, if a young dolphin is misbehaving, the mother will hold it underwater and cover its blowhole to teach it a lesson. Dudzinski asserts that dolphins rub each other with pectoral fins to indicate affection.

Years ago at Marine Studio Oceanarium, an 18-foot pilot whale named Bimbo stopped eating and became combative toward smaller dolphins in the tank. The trainers decided that his ego needed adjusting. They drained the tank to the three-foot level. Now stranded in the shallow water, Bimbo began to whistle piteously. All of the dolphins gathered around and comforted him with conversation consisting of whistles and clicks. When the tank was refilled, Bimbo's manners improved immediately. The dolphins facilitated an improvement in the relationship.

In the film *Dolphins*, Dean Bernal and the dolphin Jojo illustrate one example of a positive human-dolphin relationship. Bernal was appointed Jojo's official warden after tourists harassed him. They constantly mimic each other with acrobatic tricks and movements. Bernal let Jojo initiate first contact. Now, he entertains Jojo by blowing bubble rings as they swim together nearly every day. This is an amazing relationship, but we have to remember that it is extremely rare for this to happen.

### **An Exclusive Club**

With an average of seven members, dolphin groups are based largely on age, sex and reproductive condition. For protection, the size of groups usually increases with water depth and larger habitats. It is common to see mother-calf pairs and groups of mature females with their most recent offspring. Young adults usually are found in mixed-sex and single-sex groups. Adult males have often been observed alone, or in pairs or occasional trios. They

commonly move between female groups in their range, and may pair up with females for brief periods. There is no form of apprenticeship, as male dolphins rarely associate with young males. The main factors for group formation are protection and fright, while reasons for division include alertness, aggression and shared feeding.

### **Cetacean Communication**

We know dolphins do a lot of communicating, but are still attempting to figure out what most of it means. We are trying to learn about their intellectual ability. We have seen how fast they learn behaviors and are aware of their ability to repeat our movements. A study of one dolphin in captivity revealed an example of its intelligence. It was trained to rise to the surface and emit a sound when any word was shouted over the surface of the water. Eighteen percent of the sounds the dolphin emitted were considered human emissions.

Much of dolphin communication is classified into clicks and whistles. Bubble streams left by dolphins provided an aid for deciphering these. Although not 100 percent accurate, these trails of bubbles often accompany whistles and clicks. Every clue helps us interpret them. This information makes it easier to find out which dolphins are communicating among a large group.

Besides sounds, dolphins use “posture” and “approach” to communicate. Body movements are a major factor in determining what the sounds mean. It is thought that direct or perpendicular approaches represent aggressive and argumentative behavior. Also, communication can change according to the situation and context. A form of communication during feeding would likely be different during playing or mating.

Group communication is a key to finding food for dusky dolphins. After finding a school of fish, such as anchovies, they wrangle them like cowboys herd cattle. They push the fish to the surface, creating an impenetrable barrier. Then they encircle the fish forming a condensed “bait ball” of food. Constant squawking among the dolphins takes place during this process. Large bubbles are blown in unison to trap the fish. One at a time, each dolphin swims through the middle of the ball, consumes as many fish as possible and rejoins the surrounding circle. Eventually, every dolphin gets a turn before the bait ball breaks up or is devoured. Adult bottlenose dolphins eat approximately 4% to 5% of their body weight in food per day.

### **Some Work, Lots of Play**

Dolphins are usually playing when we see them. At least it appears to be play. They jump in the air, execute acrobatic moves, swim with boats and mimic us when we swim with them. Are they doing all of this just for fun? Jumping serves an important purpose. They leap to find food. Their excellent eyesight and leaping allows dolphins to spot flocks of birds feeding on the surface miles away. This tells them that a school of fish is present. Then they join the party and fill up on fish.

Dolphins have mannerisms and actions that define them. Dusky dolphins have signature leaps they repeat. We can identify them according to their jumps. Some show off, while others seem to do whatever makes them happy.

There are certain behaviors of dolphin play that appear to serve no other intent than enjoyment or possibly entertainment. Catching waves and riding surf seem to be for pure entertainment. It takes creativity and ingenuity to come up with new forms of play. Does playing imply higher intelligence?

### **Humans and Dolphins**

Although they can and have been aggressive towards humans, the following anecdotes support the idea that no aquatic animal is a better friend to us than the dolphin. During World War II, a group of American airmen were stranded on a raft when two dolphins showed up and pushed the raft to land. In another example, an eight-year old girl who suffered brain damage at birth, spoke for the first time after the therapy of swimming with a dolphin. Cancer patients have also used dolphin therapy to bring them joy and ease pain.

Dolphins amaze us with their skills and impress us with their intelligence. We continue to learn more about them. In doing this, we need to respect their personal space and remember they are wild animals.





# Literacy Sandwich, Hold the Mayo!



## activity ONE

**Objective:** Students will be able to distinguish between dolphin fact and fiction after reading literature related to the film.

**In The Film:** The dolphin stars of the film seem to be smiling as they play together or interact in happy groups. As these animals swim, it is only human to want to share in their exuberance by giving them human-like characteristics. If we could give them human voices, what might these animals be saying to each other as they play? What would they say as they swim with the film's humans? Are they really smiling when they chatter? Scientists are learning more about their communication patterns but it is still fun to imagine what they might say with those "smiling" faces.

### **Materials: Non-Fiction Children's Books**

*Meeting Dolphins: My Adventures In The Sea*, Dr. Kathleen Dudzinski, National Geographic Books, Washington D.C., 2000.

*All About Dolphins!*, Deborah Kovacs, Third Story Books, Connecticut, 1994.

*Dolphin*, Robert A. Morris, Harper Collins Children's Books, New York, 1975.

*Dolphins!*, June Behrens, Children's Press, Chicago, 1990.

*Dolphins and Porpoises*, Beth Wagner Brust, ZooBooks, Wildlife Education Ltd., San Diego, 1990.

*Dolphins and Porpoises*, Janelle Hatherly and Delia Nichols, Facts On File Publications, New York, 1990.

*Dolphins for Kids*, Patricia Corrigan, Creative Publishing International, National Wildlife Federation, Washington D.C., 1997.

*The Friendly Dolphins*, Patricia Lauber, Scholastic, Inc., New York 1995.

*Whales and Dolphins in Action*, Tanner Ottley Gay, Aladdin Books, New York, 1991.

### **Fiction Children's Books**

*Dolly and the Strange New Something\**, Dina Anatasio, Third Story Books, Connecticut, 1994.

*Shamu and His Friends-A First Book of Baby Animals\**, Ellen Weiss, Third Story Books, Connecticut, 1994.

*Story of a Dolphin*, Katherine Orr, Carolrhoda Books, Inc., Minneapolis, 1995.

*The Arm of the Starfish*, Madeleine L'Engle, Farrar, Straus & Giroux, New York, 1965. (Oldy-but-Goody)

**Teacher Prep Notes:** This activity is designed to allow students an opportunity to read about dolphins both before and after viewing the film. Reading about dolphins, both in fiction and non-fiction literature can increase interest in dolphins for students. The activity is designed to be open-ended, allowing both teacher and student to make the oral presentations as individual as students. Several class sessions may be needed for this activity.

### **To Do Before**

**Viewing:** Have students read a non-fiction book on dolphins. Use the titles listed above, or encourage students to find their own titles from the school or local library. Have students make oral presentations about the book to the class prior to seeing the *Dolphins* film. Develop a class vocabulary list from the class readings and discuss the definitions for each word. Task students to watch for dolphin activities that were discussed in the oral reports as they screen the film.

**After Viewing:** Have students read a fiction book about dolphins. Again, students may use titles listed or find their own in the library. After reading the fiction selection, ask students to determine the elements of the story that make it fictitious. Ask them if the actions of the dolphins or other sea life portrayed in their literature selection were realistic and demonstrated what dolphins really do. How could students rewrite their stories basing them more on actual animal behaviors?

**Taking it Further:** Task students to write their own literature with dolphins as the characters. The literature could be both fiction and non-fiction.



Ask students to anthropomorphize the dolphins in the film or in the literature by having them choose actors to play the dolphin's role. Who would they choose to act out dolphin roles and why?

\*This listing is also appropriate for limited English students or low level readers.

### **Key Words:**

**anthropomorphize** to give human characteristics to non-human objects or animals.

**literature** prose or verse written of imaginative character that have permanent value and an excellence in form.



# Deep Diving

## activity TWO

**Objective:** Students will use the scientific method to investigate and understand two physical principles (bradycardia and myoglobin storage) involved in a dolphin's deep-diving adaptations.

**In The Film:** As we catch glimpses of the world of the dolphin, we see how incredibly well their species has adapted to a marine lifestyle. Watching their smooth bodies glide through the water, we forget these mammals breathe air like humans. They rise to the ocean surface often to gulp breaths of air. There are obvious physical adaptations that allow the dolphin to live entirely surrounded by water. Fin placement and body covering are only some of the adaptations that aid in its survival. Internal organ adaptations are not evident on film but their benefits can be understood as the sleek mammals plunge to the ocean depths.

**Materials:** Per four students:

- Stop watches (use watches with second hands as alternatives)
- Copies of Dolphin Data Grid
- Pencils

**Teacher Prep Notes:** Students will take and record pulse rates. One way to take a pulse measurement is to lightly hold the right arm of another person. Gently grasp the arm by the wrist with the fingers. Place the tip of the middle finger over



the artery located inside the wrist near the tendons that run along the center. Adjust the placement of the fingers along the wrist until the gentle throbbing of the pulse is felt. If there is a limited number of stop watches available, allow students to record a 15-second test and multiply the result by four to determine a one minute score.

Pulse rates can also be taken at the carotid artery. Locate the carotid artery at the front of the neck just below the jaw.

Students can use Data Grids provided or lay out their own to record data.

**NOTE:** To get an accurate pulse measurement, DO NOT use the thumb because its large blood vessels confuse pulse measurements.

**Background:** Like most marine mammals, dolphins have special adaptations that allow them to dive deep in the ocean and remain underwater for long periods of time. In fact, bottlenose dolphins are

able to stay under water for eight minutes and can dive to depths of 1,640 feet (500 meters)! The dolphin's adaptations allow it to survive in a marine environment where the oxygen needed to exist is not accessible.

In order to live underwater, a dolphin's body must conserve oxygen for the duration of each long dive. One way oxygen is conserved is through a process called bradycardia, which slows the animal's heart rate. When the heart rate slows, the body uses less oxygen. During bradycardia, blood is also diverted to where it is most needed (heart, lungs and brain).

During a dive, the dolphin's blood is diverted to the heart, lungs and brain from the muscles. The animal is not in danger thanks to another adaptation that allows their muscles to use stored oxygen for energy. The dolphin's body has adapted to use myoglobin throughout the body when air from the surface is not available. Myoglobin is a protein, like hemoglobin, that assists in the storage of oxygen. Myoglobin can actually store as much as four times the number of oxygen atoms than hemoglobin. Because their muscles have adapted to retain high levels of this special protein, dolphins naturally store more oxygen in their muscles. Large amounts of myoglobin found in the muscles allow a dolphin to conserve oxygen from each breath and to survive long dives. Without the elevated levels of myoglobin, a dolphin would have to wait after each deep dive until their muscles gathered more oxygen from the blood stream before they could dive again.

Relate this to how a human feels after a long swim or a deep dive. Compared to dolphins, humans have a low level of myoglobin in their muscles. The extreme fatigue felt after a rigorous underwater workout illustrates the need for oxygen. When we swim under water, we limit the amount of oxygen we breathe, and the amount of breaths we inhale (as with regulated breathing intervals). Our muscles become fatigued. When our muscles become fatigued they require even more oxygen rich blood to be pumped by the heart.

**To Do:** Divide students into groups of six. Give each group a copy of the Data Grid and a pencil. Make sure that one person in each group has a stopwatch. Discuss how the dolphin adaptations of bradycardia and the levels of myoglobin aid the animal. Explain that they will be performing a series of tests to illustrate the differences between humans and dolphins demonstrating how dolphin adaptations help them to survive long, deep dives.



- 1 Write the names of team members in the spaces provided on the grid. Measure the resting pulse rates (one-minute test) for each team member. Record results in the designated space on the grid. Resting pulse rates give a starting point for the tests in the investigations.
- 2 Team member pairs will now test and record pulse measurements after holding their breath for 15 seconds. One student in each pair will hold his or her breath while the other student measures their pulse. Multiply the 15-second test number by four to convert the pulse rate to beats-per-minute. Record the beats-per-minute in the appropriate space on the grid. Repeat the process so each student has data recorded in the grid. Discuss the findings of this activity. What did students experience? Discuss the benefits of having a slower heart rate.
- 3 Next, have team member pairs test and record how long they can continuously flex and extend their index finger. (Generally it takes about one to two minutes.) Have students record the length of time (minutes and seconds) it took for the finger to become immobile in the designated location on the grid.
- 4 Repeat the process for each remaining team member. Who could participate for the longest time with the flex/extension exercise? What did the students experience? Discuss the importance of myoglobin found in a dolphin's muscles.
- 5 Share results of group data sheets with other groups. Discuss the similarities and differences in the data collected.
- 6 Have students take another resting heart rate 30 to 60 seconds after they have completed the experiments listed above. How does the heart rate recorded at the beginning of the activity relate to records taken at the end?

**What's Going On & Why?** In this activity, when students hold their breath they simulate diving. Student findings for this portion of the activity will show that the pulse rate for humans increases when regular breathing does not occur. The heart rate will increase as the heart, brain and muscles demand more oxygen. In contrast, a dolphin's heart rate slows as it dives, conserving oxygen.

The part of the activity involving the finger movements illustrates what happens when oxygen is depleted from muscles. As the finger muscles flex, they use oxygen. As the amount of oxygen gets used up, the muscles no longer are able to function. If the test permitted a rest period between flexes, the muscles would have time to store oxygen needed; but when the flexing continues the amount quickly becomes depleted. This illustrates that humans have small amounts of myoglobin in their bodies. An average person could not make long dives under water without coming to the surface for air. A dolphin, however, can exercise its muscles for longer periods of time under water without fatigue, due to the amount of myoglobin present in their muscles.

**Key Words:**

**adaptation** the modification of an organism or its parts that make it better fit for existence under the conditions of its environment.

**bradycardia** a term used to describe a heart rate that is slowing down.

**myoglobin** a muscle protein/pigment that carries oxygen. Myoglobin is known as muscle hemoglobin.

**NOTE:** This activity was adapted from materials provided by SeaWorld, Inc. and was used with permission. If you would like more information on marine animals and classroom activities, please contact the Sea World San Diego Education Department: (619) 226-3834.

<b>DATA GRID</b>		
<b>name</b>	<b>resting pulse rate</b>	<b>pulse rate after holding breath</b>



# Save the Dolphins

## activity THREE

**Objective:** Students will learn about (both natural and human-made) hazards to dolphins and discuss ways to ensure safe environmental conditions.

**In The Film:** We see picturesque ocean-scapes where clear blue-green water glistens under the bright sun. The surf greets the shore crashing to the sand or rock. The dolphins' vast home is beautiful, but don't be fooled by these serene images! As dolphins travel around their watery world, they encounter many hazards, be it seine fishing nets, water and noise pollution or sharks—even killer whales.

**Teacher Prep Notes:** This activity is designed to be the catalyst for student discussion about both natural and human-made hazards to the dolphins' way of life. Discussion questions may be addressed to the entire class, or you may choose to break students into action groups to facilitate more participatory discussion. Questions may be reproduced onto cards or onto a separate page for student use. Students may visit the library to research topics stated in questions and report findings back to the class.

**To Do:** Address each of the following discussion questions with students. Ask them to determine if the hazard is natural or human-made and ask them to indicate how specific hazards might harm dolphins or other sea life. After sufficient discussion, task students to develop possible ways to minimize

**FACT BOX:** Did you know that it is illegal to swim with dolphins in United States waters? You must stay at least 300 feet (91.44 meters) away from dolphins swimming in the wild for safety reasons, both yours and the animals'!

hazards to the dolphins' home. Ask them to list what they could do to preserve the Earth's oceans for all sea life.

**Discussion Questions:** In some parts of the world, dolphin and whale meat is considered a delicacy. Because of this, international poachers pursue and kill pods of dolphin and whales. What are the implications of this practice? What can you do to help?

The international fishing industry is working hard to provide enough fresh fish for a hungry world. Fishing boats often capture fish other than those they intended. Although the use of large floating nets (gill nets or purse seine nets) is, for the most part, illegal in fishing. Dolphins and other large animals still drown when they are



caught in the fishing nets. Why is this a problem and what can you do to help?

With growing awareness of dolphins and their unique abilities, many humans are drawn to swim with them. What are the dangers of this practice for both humans and dolphins? Are we loving the dolphins to death?

Much of the crude oil used by the world's major powers is shipped via oil tanker across waterways where dolphins live. The tankers, often carrying hundreds of gallons of oil, face storms and other hazards while on the voyage. When the unthinkable happens and the oil from a tanker leaks into the ocean, what could happen to the dolphins living nearby? What can be done to assist if/when this occurs? What about the noise pollution from these huge tankers? What can be done to address this issue?

Killer whales (also cetaceans) rely on clean oceans for survival. If the environment of the killer whale is polluted, these animals may migrate to different areas, or may die off. What effect would that have on the populations of other animals who live within the same ecosystem? What can you do to address this issue?

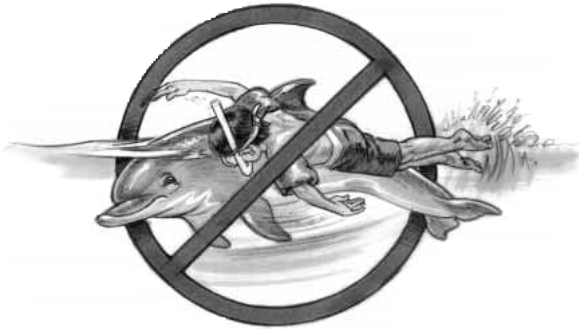
Some species of dolphins and whales beach themselves and die on the sand. This is called "stranding". Why might these animals do this and what hazards to people occur when they do beach themselves? What can you do if you see a beached dolphin?

As more and more tourists visit the warm climate regions where some species of dolphins live, what implications does the increased boat traffic have on the ocean environment? What precautions can people take to protect this environment?

**What's Going On & Why?** Humans often pose the biggest threat to dolphins. The amount of garbage produced by humans that works its way into the waterways is staggering. Oil and gas leaking from fishing or tourists boats pollute the oceans. Run-off from land and rivers is often polluted with chemicals before it makes its way to the oceans. Gill nets and drift fishing nets (out-lawed in many countries) still present a huge threat to dolphins. Heavy boat traffic can affect the breeding and travel patterns of dolphin pods,

causing them to migrate to other areas. Dolphins can become ill if they ingest trash or any other water pollution.

Even people who love and respect dolphins may be harming the animals unintentionally. An increasing number of "swim with the wild dolphin" programs are being set up around the world. Some of these may not be run by reputable organizations and animals kept in captivity may actually become harmed. The dolphins in captivity are in constant



contact with humans and may be exposed to human-borne illness; at the same time, they may not be monitored for health concerns. Some animals kept in captivity are isolated from other



animals and are unable to live their lives as they would in the wild. Dolphins are powerful untamed animals that can inflict serious damage with their teeth and flukes. People who enter the water with any dolphin take serious risks unless they are in a closely monitored environment.

Since the ecosystem of the ocean is complex, the movement or elimination of even a single species will affect the rest of the system. For example, if the number of shark predators was decreased, the number of sick or weak dolphins might increase. This could make the entire dolphin pod less



able to survive adversity as it slows down the rate at which the pod can travel. The recently increasing number of beached dolphins is alarming. Scientists are unable to determine why these animals are dying. Could it be that these are the weakest animals in the pod and are not eaten by natural predators due to changes in their (the predators') environments?

#### **Taking It Further:**

Ask a representative from a local ocean conservation group to visit the class. Partner with the organization for beach/river clean-up events.

Visit another classroom sharing ways to keep our waterways and oceans clean. Share ways each student can help keep the ocean clean, even if they live in a land-locked region.

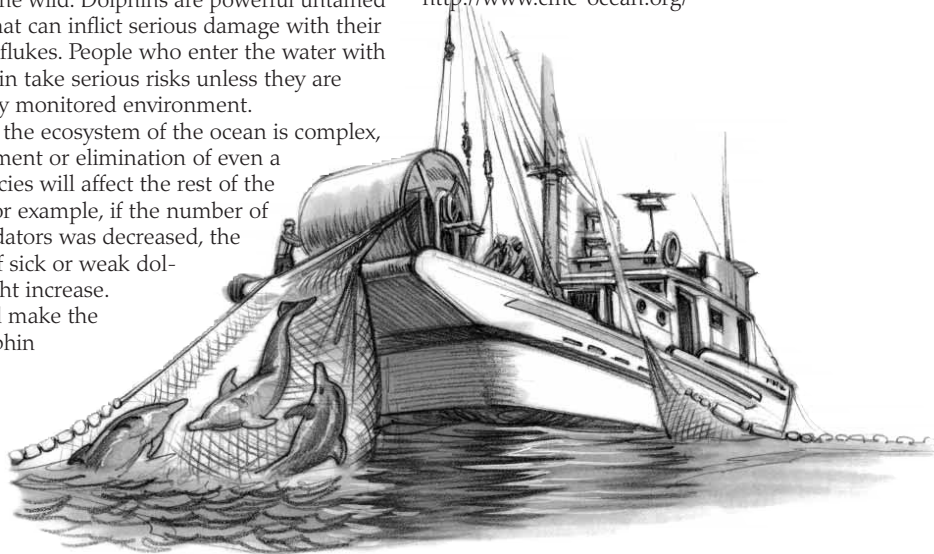
Develop an ad campaign for saving dolphins and preserving their environment. Students can create posters, bumper stickers, banners and songs to inform others of the need to keep the oceans and waterways free from pollution.

Visit the Center for Marine Conservation web site for marine mammal protection at <http://www.cmc-ocean.org/>

#### **Key Words:**

**biome** A complex community of organisms covering a large geographic region that is characterized by distinctive life forms of specialized species.

**marine** Having to do with or pertaining to the sea.



# What's the Chatter?



## activity FOUR

**Objective:** Students will listen to sounds as the waves travel through a variety of objects.

**In The Film:** Standing at the water's edge, you are tempted to think that everything you hear while on land is not audible under water, that somehow that peaceful world is silent. In actuality, the number of sounds that can be heard under the water's surface is astounding! The animated clicks made by the dolphins in the film are very well heard, and according to Dr. Dudzinski, travel great distances under water. So do the sounds of the entire underwater community.

**Materials:** Assemble sets of the following items, one per group of four students:

- A waterproof watch that ticks
- A wooden dowel 31 inches (80 cm) long
- A metal rod 31 inches (80 cm) long
- Glass jar full of water (mayonnaise jar)

**Teacher Prep Notes:** NOTE: Do not use watches that could be damaged by water for this activity. This activity is designed to be done by small groups of students, but can be adapted to be a demonstration or a learning center station. For this activity students need a quiet environment, free from loud sounds. Ticking clocks, kitchen timers, or other devices that emit frequent sharp sounds may be used. Sturdy zip-lock bags can be

**FACT BOX:** Water is an excellent sound carrier. Sound waves (energy) actually travel  $4\frac{1}{2}$  times faster in water than in air!

used to keep these devices dry. If using a zip-lock bag, remove as much air from the bag as possible to allow the noisy object inside to sink to the bottom of the glass jar.

**Background:** The source of all sound is movement or vibration. When an object vibrates or moves rapidly, its moving parts emit sounds as they

vibrate. For example, a rubber band emits a low buzzing sound if it is stretched and plucked. Sound travels in waves that vary in length, which determine the pitch of a sound. Higher pitched sounds travel in shorter wavelengths, while lower pitched sounds travel in long wavelengths.

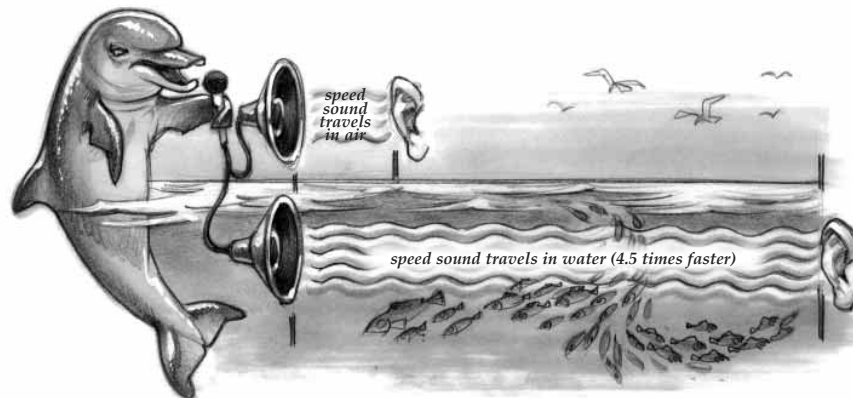
Sound and sound waves can travel through gas, solids and liquids, but objects that contain air pockets tend to carry the sound waves poorly. Acoustic tiles, carpet and heavy drapes are examples of materials that are sound insulators.

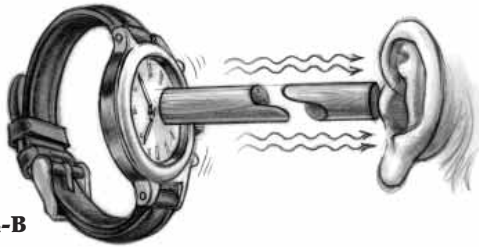
In order for humans to hear sounds, the vibrations travel through the air to our ears. Human ears have specialized sound receptors that are highly sensitive to these vibrations. These sound receptors become stimulated by the vibrations and register them as sound in the brain.

**To Do:** Have one student in each group hold a ticking watch at arms length and determine if they can hear the watch ticking from that distance. Have them move the watch closer to them, until they can hear it ticking. At what length could they actually hear the watch ticking? Depending on the volume of the tick, the watch will be audible at various points. Allow all students in each group to do this and have them determine who was able to hear the ticking from the furthest distance.

**1** One student in each group will hold the watch so its back (the metal side) is flush with one end of the wooden dowel. Ask them to hold the other end of the wooden dowel against the little flap of skin that is beside the opening of their ear (see *Diagram 4-B*). NOTE: Do not put the dowel in the ear!

**2** Ask students to determine if they are able to hear the ticking sound of the watch through the wooden dowel. Have all students in the





4-B

group perform the same procedure until all students have heard the watch ticking through the dowel.

- 3 Repeat the procedure, this time placing the watch back flush with one end of the metal rod. Again, have one student in each group hold the other end of the rod to the flap of skin near the ear, until they hear the ticking. Have all students perform the procedure until they have all heard the ticking, using the metal rod.
- 4 Now, place the WATERPROOF watch at the bottom of the jar of water. Ask one student from each group to put his or her ear near (but not touching) the jar. Can they hear the watch ticking? Carefully, ask them to place their ear directly onto the side of the jar. Can the ticking be heard now?



4-C

- 5 Place one end of the wooden dowel against the outside of the jar and the other to the flap of skin on the ear (see Diagram 4-C). Ask the students to predict if they will hear the ticking as before with both the wooden dowel and the metal rod. Is the ticking as clear as before? Have them try the same procedure with the metal rod. Continue the experiment until all students have listened for the ticking from within the glass jar. NOTE: Masking tape may be used to secure the wooden dowel and metal rod to the side of the jar for this portion of the activity.

What happens if one end of the wooden dowel is put into the water inside the jar?

Have students predict if placing the dowel will conduct the ticking vibrations better from the bottom of the jar, or from just under the surface of the water. Perform the same procedure with the metal rod. Ask students to determine which part of the experiment allowed them to hear the ticking of the watch the clearest. Which of the materials provided the best sound-carrying ability when heard from the glass jar of water? Was sound carried best when the dowel or rod was placed further into the water? Challenge students to experiment with other items such as plastic sticks or string to see if these items can conduct sound as effectively as the dowel or metal rod.

#### Key Words:

**sound** noise that is heard because of stimulation of auditory nerves in the inner ear by vibrations.

**sound insulator** a material that is a poor conductor of sound waves or vibrations.

**pitch** the “highness” or “lowness” of a sound which corresponds to its frequency.

**frequency** the number of vibrations per second, or the distance between each wavelength of a designated sound. Low frequency sounds have long wavelengths, high frequency sounds have short wavelengths.

**amplitude** the size of each vibration of a designated sound. Loud sounds make deep vibrations, increasing the amplitude.

**What’s Going On & Why?** Students may not hear the ticking when the watch is held at arm’s length, unless the watch produces a very loud ticking sound. More often, the sound is too soft to be heard at this distance so the ticking can be heard more clearly when the watch is held closer to the ear. The ticking is also clearly audible when it is transmitted through the wooden dowel. The wooden dowel is a solid that conducts sound well. The sound waves that are generated in the watch travel through the wood to the ear, registering in the brain as sound. The metal rod is a denser solid and is an even better conductor of sound allowing students to hear an even stronger ticking sound.

When the watch is placed into the jar of water, they will not hear the ticking of the submerged watch unless they place their ears directly onto the jar. Depending on the watch, however, careful visual observation may show tiny ripples in the water. These ripples illustrate the watch vibrations.

When students place their ears directly onto the glass jar they will hear stronger ticking because water is a good conductor of sound. Individual results will vary when students introduce the wooden dowel and metal rod to the water. The strength of the sound depends on the initial volume and strength of the ticking sound. It also depends on the amount of contact between the dowel or the rod and the surface of the glass jar.

Dolphins can hear sound both in air and in water. They are able to take advantage of the increased sound conductivity of water and are able to hear sounds more clearly underwater.



## activity FIVE

# Hidden Identities

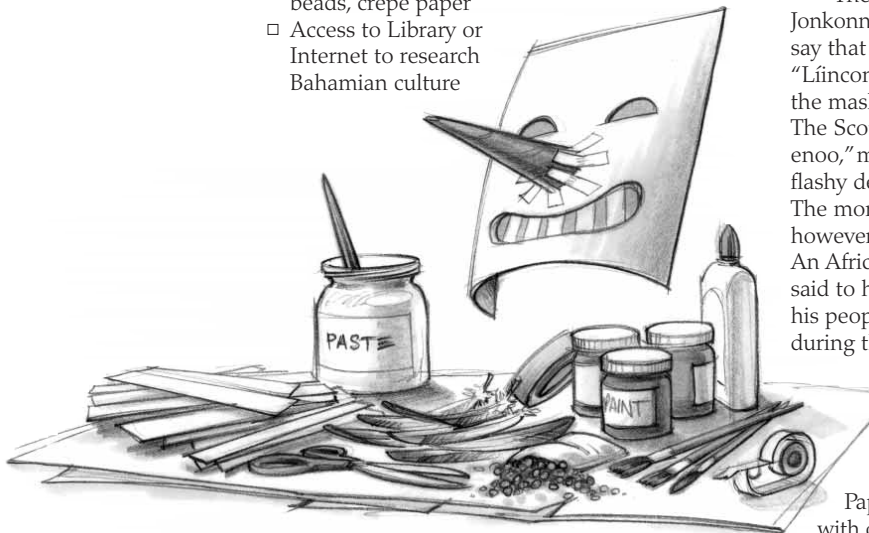


**Objective:** Students will research the traditional Bahamian festival called Junkanoo, compare this festival to one of Mainland USA, and construct masks used to celebrate the Junkanoo festival.

**In The Film:** The colorful sights and the festive sounds of the Bahamian culture provide a backdrop to the blue-hued underwater world of the film's mammalian stars. The smiling faces of the Bahamian children and the light-hearted music add to the whimsy of the film as we share a few of our cultural differences.

**Materials:**

- Cardboard cut into approximately 8x12 inch (20 x 30 cm) rectangles
- Tagboard pieces of assorted sizes (to make raised facial features)
- Papier Maché paste
- Newspaper strips
- Newspapers to cover work area
- Ribbon cut into 8 inch (20 cm) lengths
- Scissors
- Pencils
- Masking tape
- Glue
- Assorted feathers, sequins, beads, crepe paper
- Access to Library or Internet to research Bahamian culture



sessions. Follow package directions for Papier Maché, including prescribed clean-up procedures. Papier Maché can be purchased at most hobby stores. Cover all workspace with newspapers and allow all Junkanoo masks to dry completely before applying paint. Check out an audio cassette tape from the local library with Bahamian music. Play the tape for the class as they create their masks.

**Background:** One of the most notable cultural celebrations of the Bahamian people is their Junkanoo festival. This festival, for many, is synonymous with the Bahamas and provides historic insight to the Bahamian culture. The Junkanoo festival is thought to have begun in the 16th or 17th century, at a time when the slave trade was in full swing. At that time, slaves employed on Bahamian plantations were given two special days off for African (and later Caribbean) dance, music and costumed celebrations with family and friends. Over the years the celebration has continued and today resembles the Mardi Gras (in New Orleans or Rio de Janeiro) combined with the Mummer's Parade. The Mummer's Parade is a cultural festival which takes place annually in Philadelphia, Pennsylvania.

The word for the festival itself (Junkanoo or Jonkonnu) also has obscure roots. Some historians say that the word comes from the French term "L'inconnu" (meaning unknown), in reference to the masks worn by partygoers to disguise them. The Scottish settlers called the festival "junk enoo," meaning "junk enough" referring to the flashy decorated masks and elaborate costumes. The more accepted story naming the festival, however, is found in Bahamian-African folklore. An African tribal chief named "John Canoe" was said to have demanded the right to celebrate with his people after being brought to the West Indies during the slave trade. Whatever the origin, the

Junkanoo Festival is a cultural highlight for the people of the Bahamas.

In Junkanoo celebrations, elaborate masks are constructed with Papier Maché. The masks are then painted with colorful patterns and adorned with feathers and crepe paper. Elaborate costumes that match the masks are designed by clan leaders and are worn during the festival. People wearing the colorful outfits short-step or merengue along the street,

**Teacher Prep Notes:** Adult supervision is required during all portions of this activity! The activity is designed to be done in several class

beating goat-skinned drums, cowbells, or blowing conch shells in a very flashy parade.

African rhythms and Caribbean Calypso beats, combined with English folk songs are blended to create a unique "Goombay" sound. "Goom-bahhh" refers to the sound of the fast paced drumbeat indicative of the Junkanoo Festival.

**To Do:**

- 1** Have each student place a cardboard rectangle to their face. Teachers and adults will mark eye, nose and mouth holes with a pencil. Students will carefully cut out the holes and make sure that the eyeholes match their vision. NOTE: Older students can pair up to mark holes in the cardboard, but careful supervision is needed!
- 2** Once the holes are cut, task students with designing their masks. They may use masking tape to secure bunches of paper to create raised eyebrows, pointy noses or chins.
- 3** Once the facial features are secured, begin applying the Papier Maché. Follow manufacturer directions for the type of Papier Maché used. Make sure students cover the entire mask surface with Papier Maché and create even layers over all the facial features attached. The final layer of Papier Maché should be made as smooth as possible, as this will be the surface upon which students paint.
- 4** Place masks onto newspapers to dry completely.

- 5** Students may then paint their masks with Tempura paints. Encourage students to use elaborate designs and colorful paint combinations. Once the paint is dry, have students glue on feathers, sequins and other colorful objects as decoration. Use glue or tape to secure ribbon to mask, one on either side.
- 6** When masks and decorations are dry, have each student tie the ribbon around their head to put on the mask. Ask students to move their bodies according to how the mask makes them feel.

**Key Words:**

**Junkanoo** the name of a festival which takes place on December 26th and January 1st in the Bahamas.

**culture** the skills, arts, music of a given people in a given era or area.

**Taking It Further:** Ask students to create entire costumes that match the masks. Have students model the costumes for the class. Costumes can be displayed for parent nights.

Make drums or play African or Caribbean music while masked students dance around the room.

Organize a Junkanoo Festival at your school where masked students file through classrooms, dancing and moving to the beat of drums and cowbells.

Invite students to make class presentations about festivals that are important to their cultures, comparing them to the Junkanoo festival or other cultural festivals.



# Feeling a Little Off Balance?



## activity SIX

**Objective:** Students will use the scientific method as they introduce chemicals into an aquatic ecosystem and record the changes that occur to that system.

**In The Film:** Dolphins and every other creature under the sea live together in a delicately balanced environment. Each of the dolphin's neighbors, including humans, plays an important role in maintaining the marine life cycle. Whether it is keeping waterways free from chemical spills or free from dead animal carcass debris, each member of the environment plays an important role. The interaction between all creatures in the community makes survival of all species possible.

**Materials:**

- Two large wide-mouthed glass jars (clean mayonnaise jars)
- Pond water (enough to fill each jar at least half full)
- Eight small Elodea or other inexpensive aquatic plants
- Liquid house plant food
- A teaspoon
- Notebooks
- Pencils
- Wax paper
- Rubber bands



**Teacher Prep Notes:** This activity is designed to take several weeks. Pond water can be purchased from a lab supply company. Elodea plants can be purchased at a pet store that sells plants for fresh water aquariums. You may be able to get pond water from the pet store but make sure that the water is relatively clear and does not smell of ammonia. Students can keep track of daily obser-

variations in a journal notebook. Depending on resources available, student teams may be created for each set of two ecosystem jar sets.

**Background:** Generally, members of any ecosystem fall into three basic categories: producers, consumers and decomposers. Green plants and algae are called producers and form the most basic strata of an ecosystem. Producers use water, sunlight, carbon dioxide and environmental nutrients as food.

Consumers are part of the ecosystem that feeds directly upon the producers and does not produce its own food. Animals, birds and insects are members of the consumer strata of an ecosystem. Humans are also consumers, but they, unlike animals, can grow and make their own synthetic food.

The members of an ecosystem who feed on dead organisms are called decomposers. Decomposers break dead organisms down into simpler components, which in turn give nutrients back to the ecosystem's producers. Decomposed organisms provide food for producers. The producers provide food for the consumers. When any organism in the ecosystem dies, it provides food for the decomposers, thus completing the cycle. This complex interaction between community members continues in every healthy ecosystem, be it land-based or aquatic.

**To Do:**

- 1** Students will label their jars "A" and "B."
- 2** Students will then fill each jar equally full with pond water.
- 3** They will then carefully place four Elodea in each jar, making sure not to damage the aquatic plants.
- 4** Under close supervision, students will add 1/2 teaspoon (2.46 ml) of plant food to the jar marked "B." Jar sets will then need to be placed in well-lit areas of the room in locations where they will not be bumped.
- 5** After the first week of the experiment, loosely cover each jar with wax paper. Punch several small holes into the waxed paper with the pencil tip. This will keep the pond water from evaporating from the jars during the experiment.

Students will make observations about each jar's contents over the next four weeks in their notebooks. Ask students to diagram the location of the jars and indicate proximity to light sources in their notebooks. Students should note if and



when the jars are affected by direct sunlight. Ask students to make daily predictions about what will occur in each of the jars. Students can make daily observations about plant size, water and plant quality, and indicate any changes in their notebooks.

At the end of each week, students can share results. After two weeks, supervise students as they add another 1/2 teaspoon (2.46 ml) of plant food to jar "B." Have them predict what will happen with the addition of more plant food. Students should continue to observe their jars and continue to make notes in their journals for the next two weeks.

After four weeks, have students address each of the following questions in their journals, based on their findings.

- What was the control in this experiment?
- Why were the jars placed next to each other in a well-lit area?
- What effect did the plant food have on the Elodea plants? What happens to the plant color? Texture? Shape?
- What effect did adding more plant food have on the Elodea? What does the addition of plant food have on the water quality?
- Plant food contains high levels of nitrogen, phosphorous and potassium. These nutrients are often present in sewage as well. Predict the effects of sewage dumping into the waterways.

**What's Going On & Why?** Each of the jars in this experiment contains living and non-living elements that contribute to an ecosystem. The plants are living, while the water, nutrients and sunlight are not living. The ecosystem produced in each jar produces a healthy cycle if nothing interferes with the system. In this activity, the addition of the plant food interfered with the natural cycle of that ecosystem. When the plant food was added, the amount of nutrients available for the plants increased, but not by members of the ecosystem. Plants in jar "B" received more nutrients than the plants in the other jar not only because of the addition of plant food, but by the nutrients that naturally occur in the ecosystem. Additional nutrients caused the plants in jar "B" to grow faster than the plants in jar "A."

When more plant food is added, we may think that the plants will become more prolific. Depending on the pond water, however, and the plants themselves, the ecosystem may actually begin to pollute itself with bi-products of rapid

growth. While the additional nutrients of the plant food may seem to be beneficial for the plants, their addition can saturate the ecosystem.

The water in jar "B" will soon become cloudy and eventually the plants in this jar will die because the system is no longer functioning in balance.

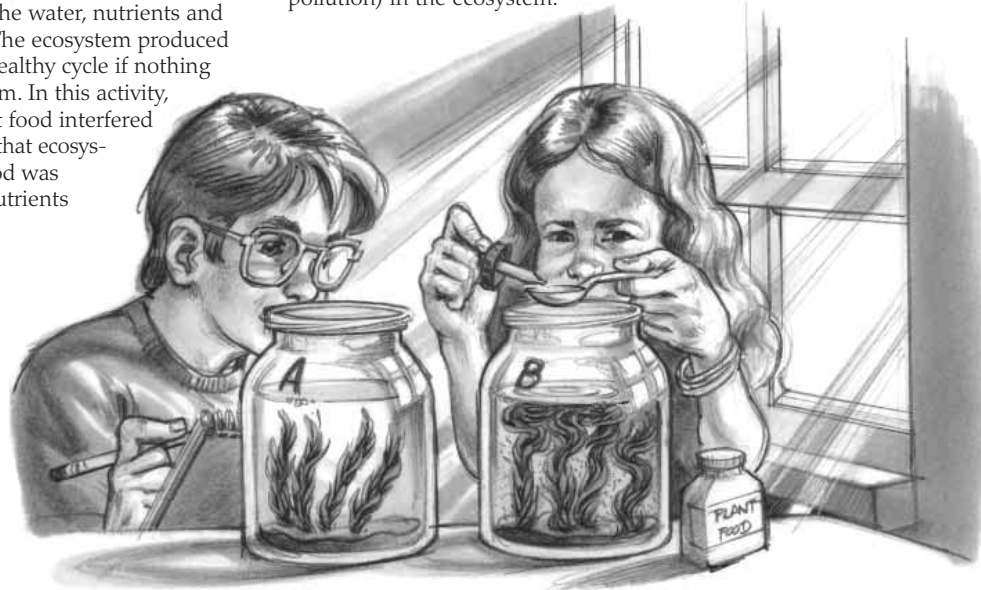
A real-life example of this can be seen in areas where untreated sewage is dumped into local waterways. The addition of the sewage causes an increased growth of algae and other plants which increases plant growth in the area. The increased plant growth will provide more food for fish or other consumers. More consumers eating the plants will increase the levels of waste products and dead organisms found in that ecosystem. This will increase the number of decomposers and the amount of material the decomposers will act upon, again increasing the levels of nutrients into the water, upsetting the natural balance of the system. When an ecosystem becomes saturated with nutrients, it is called eutrophication. Eutrophication does occur naturally, but the effects are often accelerated by human presence (untreated sewage or other pollution) in the ecosystem.

#### Key Words:

**ecosystem** a system of organisms in a natural community that act together in their environment.

**control** a procedure carried out to give a standard of comparison in a scientific experiment.

**eutrophication** the process a body of water takes as it becomes better nourished either naturally or by the addition of fertilization.



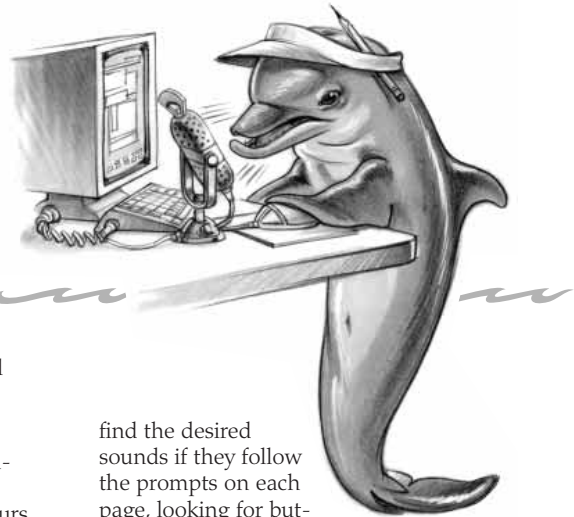
**Taking It Further:** Repeat the experiment but change some of the variables:

- Add measured amounts of plant food each week. Use different types of aquatic plants.
- Put jars in a shady location. Use different types of plant foods.



**activity  
SEVEN**

# Listen & Learn



**Objective:** Students will access dolphin and cetacean sounds from the World Wide Web and discuss the similarities and differences in the sounds.

**In The Film:** Dr. Kathleen Dudzinski has committed her life to cracking the code for dolphin communication. She has taken hundreds of hours to become familiar with the variety of sounds made by the dolphins she studies. The squeaks and squawks are meaningless to most of us and Dr. Dudzinski is working to change that.

**Materials:** Access to a computer with the following capabilities:

- IBM computer with Internet Explorer 4.0 or better.
- Macintosh computer with Netscape Navigator 4.0 or better.
- Multimedia compatible with speakers needed for either Mac or PC.

**Teacher Prep Notes:** The Internet addresses that are included in this activity illustrate some of the sounds made by dolphins and whales. The information about dolphins, whales, other marine animals or links to other web sites does not necessarily reflect the ideas and opinion of the organization(s) developing this guide, the producers of the film, or the scientific community. If access to the Internet is not possible, CDs of dolphin sounds can be purchased from Cornell Laboratory of Ornithology's Bioacoustics Program. Contact: Connie Gordon (607) 254-2408.

Depending on the types of computer resources available, downloading time may require some consideration. This activity can be done as an activity center. Have students fill out a survey form generated from the questions listed below.

**Background:** Through use of the World Wide Web, students are able to see and hear things they normally would not, due to their geographic location. The subject of dolphins and the sounds they make is an example of this. By using the web, students can listen to a variety of dolphin (and whale) sounds to gain an appreciation for the way these animals communicate using vocal sounds.

**To Do:** Arrange students into groups of two or three around each available computer.

**1** Have students take turns logging onto each of the Internet sites listed below. Students will

find the desired sounds if they follow the prompts on each page, looking for buttons indicating dolphin or whale sounds.

- 2** When the sound sites are found, ask students to watch as the sound files download onto their computers. They will see a small dialogue box indicating the time and size of the Internet file that is being downloaded. A small sliding bar will inform students when the download is complete.
- 3** When ready, ask students to click on the start button within the dialogue box and watch as the sound indicator bar moves across the box. Students will need to listen carefully as the bar begins to move across the box; when it begins to move, the recorded sounds will begin to play. Some of the listed sounds are faint and some recordings are very brief. Have them practice the process until they are familiar with how to access the sounds.
- 6** When students feel they are ready to do a detailed listening observation of each of the sites, have them make notes about each sound. Then discuss the questions listed below.
  - How are the sounds different between whales and dolphins?
  - How are the sounds similar?
  - How many different types of sounds can you hear in each selection? Does one particular animal make the sound, or could another have made it?
  - How did each sound make you feel as you listened?
  - What is the difference between the long sounds and the short ones?
  - If the sounds had human meaning, what would each sound mean to you?
  - Did the sounds remind you of any other types of sounds? Which ones?

**Dolphin Sound Web Sites**

[http://www.seaworld.org/bottlenose\\_dolphin/echo\\_dol.html](http://www.seaworld.org/bottlenose_dolphin/echo_dol.html)

<http://www.human-dolphin.org/sounds/index.html>

<http://neptune.atlantis-intl.com/dolphins/>

### Whale Sound Web Sites

<http://www.cs.sfu.ca/research/Whales/>  
<http://asa.aip.org/sound.html>  
<http://www.cetaceanresearch.com/sounds.html>

**What's Going On & Why?** The World Wide Web has become a popular avenue for conducting research because of its availability for many segments of the population. Schools, homes, science centers and museums have designated computers for Internet access. It is through this seemingly simple technological advancement that we are able to educate ourselves about a myriad of subjects. The web sites that are included in this activity illustrate this. Any person who has access to the Internet, via a computer, can pull up and listen to the sounds of animals with which they may not be familiar. The ability to listen to these animals will provide us with an appreciation for them, and hopefully a new level of respect, while they are prompted to learn more. Educating ourselves, via the Internet, can provide us with valuable

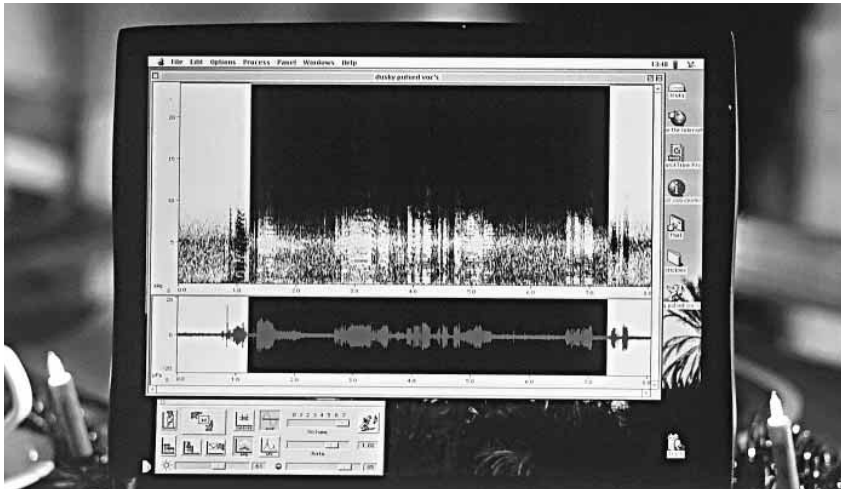
experiences that will assist us in making appropriate decisions and taking appropriate actions. In this case, the conservation of dolphins, whales and other marine animals. Students who hear the sound of a dolphin may become as interested as Dr. Kathleen Dudzinski did in the communication patterns of the dolphin, and find themselves aiming for a career in marine biology.

While the Internet offers what seems to be extensive information on virtually every subject imaginable, we must still verify the results of any research activity with professionals. At the present time, there are no guidelines or proofreaders for the mass of material available to Internet users. People can publish web pages and documents that may not contain valid or reliable information and we would

#### Key Words:

**cetacean** any animal in the order of marine mammals which includes whales, dolphins, and porpoises.

**sound byte** small amounts of sounds which are digitally computerized and made available for use by Internet users.



*The sight of sound on your computer! Access internet sites to listen to a variety of dolphin sounds and gain an appreciation for the way these animals communicate.*

not know it. It is important to note that information taken from the Internet, at least from ones that may not be familiar to you, must be confirmed with professionals. Do not take all that you see on the Internet as fact until you have researched it further!



# The Eyes Have It!

## activity EIGHT

**Objective:** Students will identify parts of the human eye and learn their function.

**In The Film:** By creative filming, we “see” through the eyes of a dolphin and learn that their eyes are quite different from our own. Dolphins can focus each eye on a separate image and have specially adapted eyeballs to allow them to see in both water and air. With these eye adaptations, dolphins can search for food and the companionship of others.

**Materials:**

- 3-inch (8 cm) squares of black construction paper (one per student)
- Masking tape
- Wads of paper
- Hand mirrors (one per student)

**Teacher Prep Notes:** Supervision is required for this activity! Students need to be careful when they place any object near their eyes. Students should wash their hands prior to touching their eyes. Students who are wearing contact lenses should use extreme caution when touching the eye. Students who wear glasses can remove them when they are

**FACT BOX:** Some members of the river dolphin family are blind or nearly blind! Some river dolphins have such small eyes that vision is difficult; others do not even have the required parts of the eye to allow for vision. Because their environment is so murky these animals must rely more on echolocation than on vision.

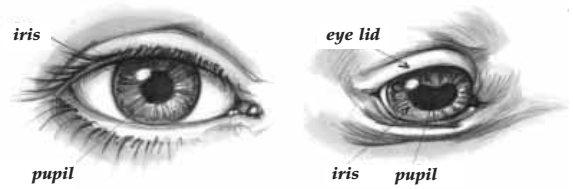
instructed to touch the eyelids.

This activity is designed to be done in two parts. Each part of the activity examines vision and how the human eyeball

works. Extend or combine it with activities that cover optics, genetics (eye color) or perception.

**Background:** Dolphins live entirely surrounded by water (but breathe air) and humans live in and breathe air. While these major differences between humans and dolphins exist, there are also strong similarities between these types of mammals. A mammal’s eye, for example, provides visual stimulation to the brain and is similar in form and function for both dolphins and humans. The human and dolphin eyes are complex organs which allow each animal to see. The human eye is specially adapted to allow us to see most clearly (unless we wear glasses or contacts) while we are in any aerial environment. The eye of a dolphin is also adapted, allowing it to see under water and in air.

Within the eyes are differences found between



humans and dolphins. Adaptations on the part of the dolphins have allowed for specialized use of their eyes.

**To Do: Part One:**

**1** Hold your hands approximately 4 inches (10 cm) from your face. Look closely at the skin and focus your vision to the texture of the skin. Now focus your vision on an object in the distance. How quickly did your eyes focus from near to far? Did students feel the muscles of their eyes tighten as the eye changes its focus?

**2** Next, focus your vision on a small object at least 6 feet (2 m) away. Then close your left eye. Raise your right thumb so it covers the image of the distant object (see illustration).

**3** Without moving your thumb, open your left eye. What happened to the image of the object? Keep the same position, thumb covering the image of the object, and blink between your left and right eyes. What happens to the image of the object now?

**4** Give each team of paired students a wad of paper, two pieces of black construction paper and some masking tape. Line up each pair so they are facing each other, approximately 6 feet (2 m) apart. Ask students to practice tossing the paper wad back and forth. Then have each student tape a piece of black paper over one eye. It does not matter which eye is covered. Have them toss the wad again. Did students find it easier to toss and catch the paper wad with their eyes covered or uncovered?



**Part Two:**

**1** Now explore your own face by carefully touching the skin and protective bone structure surrounding the eye. You can gently feel your eyeballs by touching the outside of the closed eyelids. By touching carefully, you will be able to feel the shape of your eyeball and the slight bulge of the cornea at the front of the eyeball.

**2** Now look closely at your open eye in a hand mirror, observing your eyelid and eyelashes. Notice the function of both as you wink. Next, hold your eyelids open with your fingers and observe the iris, pupil and sclera of the eye. Look up and down and roll your eyes around while watching them in the mirror. Can you

see the muscles around your eye as your eye moves? Identify as many parts of the eye as possible.

- 3 Locate the pupil of your eye (located in the center of the iris) as you look at it in the mirror. The iris is the colored disc of the eye. By adjusting the amount of light that shines into the eyes, you can control the diameter of the pupil. Turn the lights off, draw curtains or blinds to make the room as dark as possible. Wait approximately two minutes and then observe the pupils of your eyes. Now turn on all available lights, open the blinds or walk out to bright light and observe your pupils again. You can look at your own pupils or the pupils of another student.
- 4 Next close both eyes for two minutes. When you open them, look closely at the diameter of the pupil (either in the mirror or in the eyes of a team member). What is the difference in the diameter of the pupil after darkness vs. bright light?

**What's Going On & Why? Human Eyes:** (see diagram). The human eye is a complex organ that provides more than 80 percent of the information received about the environment. Our eyes contain three basic layers. The tough outer layer, called the sclera, is what we know as the "white" of the eye. The sclera covers roughly  $\frac{2}{3}$  of the surface of the eyeball and protects all inner layers. The part of the sclera located at the front of the eyeball bulges slightly. This bulge is where the transparent cornea is located, and where light enters the inner eye.

The next layer, just inside of the sclera, is called the choroid coat. The choroid coat contains blood vessels, which form the iris or the colored disk of the eye. The iris works like the shutter of a camera. The muscles of the eye (and the body autonomic nervous system) control the diameter of the pupil, depending on the amount of light needed to see an object.

The innermost layer of the eye, behind the iris, is where the lens and retina are located. The lens is a flexible structure about the size of an aspirin and the shape of a hand lens. The lens focuses light that enters the eye, through the cornea, onto the retina at the back of the eyeball. The retina is the innermost layer of the eye. It is as fragile as wet tissue paper, and is attached to the optic nerve. Light-sensitive cells (cones for color and rods for black and white) in the retina absorb light and change them into electrical impulses which are carried by the optic nerve to the brain.

The mass of the eyeball is divided into two cavities. The area between the cornea and the lens is filled with aqueous humor, a clear watery-fluid, which lubricates and provides nutrients for the cornea and lens. The cavity behind the lens is filled with a jelly-like substance called vitreous humor. Vitreous humor gives the eyeball its shape and holds the retina onto the back of the eye.

Part One: The image that was covered by the thumb "jumps" from behind it if you look at it with

the other eye. This is called binocular vision and is helpful for organisms who must hunt for food or must avoid becoming prey. In this activity, having one eye covered with the black paper reduces the accuracy of the paper toss and illustrates how dependent humans are on binocular vision.

Part Two: Students can locate the visible parts of their eye and experiment with the functions of some of these parts.

**Dolphin Eyes:** Dolphins have similar eye functions to humans, but have acute vision both in water and in air. The dolphins' lens and cornea correct the refraction of light between aquatic and aerial environments. Without this adaptation, dolphins would be near-sighted when they tried to see objects while above the surface of the water. A dolphin's eye has

two central areas (retinas) that receive visual images (humans have one retina per eye). Because of this, dolphins have binocular vision in air and may have both binocular and monocular vision underwater.

A dolphin's eyes have a well developed light-reflecting layer (tapetum lucidum), found at the innermost area of the eye, that reflects light through the retina a second time. This gives the animal enhanced vision in dim, light or murky waters.

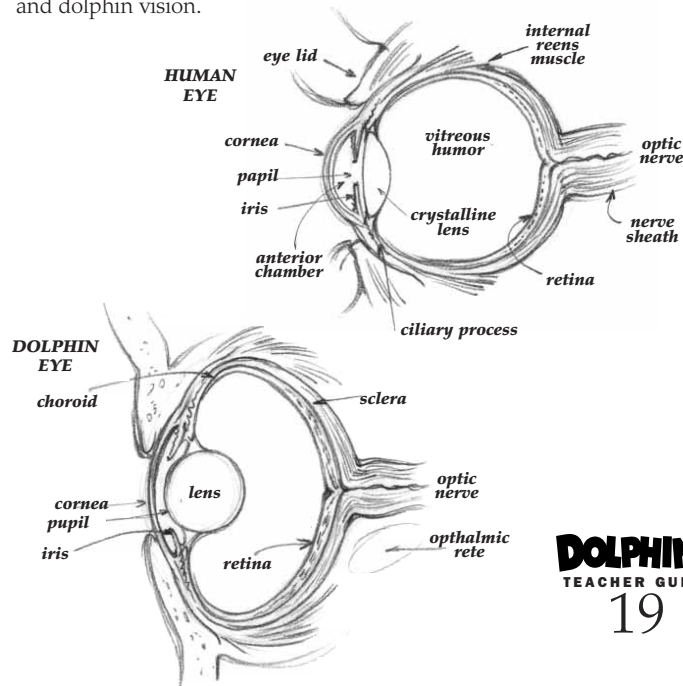
**Taking It Further:** Conduct research about dolphin vision and prepare an oral report discussing the similarities and differences between human and dolphin vision.

#### Key Words:

**optics** the branch of physical science dealing with light and vision as a phenomenon associated with the generation, transmission and detection of electromagnetic radiation (light).

**binocular vision** when both eyes of an organism send visual images to the brain giving them depth perception and allowing them to judge distances. Humans and some other organisms have binocular vision.

**monocular vision** when one eye is used to see visual images.



# Uncommon Sense!



## activity NINE

**Objective:** Students will practice echolocation as a way to identify objects and positions.

**In The Film:** While underwater, Dr. Kathleen Dudzinski observes the behavior of many dolphins. She uses her specially designed video array to detect and, hopefully, decipher the sounds made by the animals she studies. The distinct chirps, squeaks, squawks, whistles and clicks dolphins make seem to represent some sort of communication between them. Are these sounds used only when the animals are communicating, or do they make sounds for other purposes? Scientists tell us that these animals find hidden prey (or even each other) in the vast ocean by using their specially evolved echolocation systems.

**Materials:**

- A large room or a large outdoor area
- A blindfold
- Pencil
- Paper

**Teacher Prep Notes:** This activity is designed to be done in a classroom but can be effectively done

**FACT BOX:** The use of echolocation gives dolphins a very detailed image of their surroundings. Dolphins may actually be able to locate a pea-sized object from a distance of between 16 to 656 feet (5 to 200 m) and they may be able to determine if a female dolphin is pregnant by the types of echoes returned to them.

on the playground or in a large indoor or outdoor space. Caution should be used when students are blindfolded. The activity can be done with obstacles, such as desks and chairs, in place. Continue the activity until all students get the chance to

be “it” or conduct the activity over several days. Students may record their experiences as part of a creative writing exercise.

**Background:** Animals who live in darkness or in murky waters have evolved to be able to hunt in these environments. They use a highly specialized type of sonar to help them detect objects in their surroundings. Dolphins and bats are animals who have adapted to their environments by developing echolocation systems.

**To Do:**

- 1 Gather students in a central location of the room. Ask them to listen to the sounds around them. Ask them to list what sounds they hear and determine if the sounds tell them anything

about the location of the sound-maker. For example, do the sounds from the birds chirping from the window tell students anything about where the birds are located? Do the sounds from the hallway tell them anything about where the hall-walkers are or what they are doing?

- 2 Now ask students to make clicking sounds with their tongues. Make sure that each student is able to make the same sound and that each person is able to make the sound loud enough to be heard by the entire group.
- 3 Select one person to be “it” and ask them to wear the blindfold. This person will stand in the center of the room. To disorient this person, have them turn around in place three times and ask them to search out and tag class members. The person with the blindfold should make clicking sounds whenever he or she needs information (update on student locations) about the others. The person who is “it” must rely upon hearing to find classmates. When another class member is tagged they will sit out and observe the remainder of the activity.

The other class members will not be blindfolded. They will each walk around the room, trying not to be tagged by the person wearing the blindfold. These students are free to go anywhere in the room but they must repeat the clicking sound each time it is made by the person with the blindfold. The clicking sound is the only sound that any class member may make once the activity begins. **NOTE:** Students may not run during this activity!

The person with the blindfold will emit clicks and will receive answer clicks from the other class members, which will tell the locations of the students. Continue the activity until more than half of the class has been tagged.

Once the activity is over, ask the student who wore the blindfold to describe his or her experiences.

- Did they have an easy time finding their classmates? Why or why not?
- Could they easily hear the clicking sounds locating the other students?
- What outside factors affected how well they heard the clicking sounds?
- How effective at avoiding being tagged were the other students?

- Did they find the clicks to be helpful when trying to avoid being tagged?

Discuss how this land-based version of echolocation can be related to how dolphins and bats use this specialized tool.

**What's Going On & Why?** Dolphins transmit high-frequency sound waves (higher than can be detected by the human ear) to get an auditory image of their surroundings. This is called echolocation and is a highly developed adaptation found primarily in bats and dolphins. Dolphins use echolocation to determine size, shape, speed, distance, direction and maybe even internal structures of objects in the water.

During echolocation, dolphins produce ultrasonic clicks from within their nasal passages and emit them through the rounded front of their head. This area contains the melon, a fluid-filled organ that acts as an acoustic lens to focus sound into beams. The fluid in the melon is the same density as the seawater. The sound waves travel through fluids with similar densities without distortion. This gives a clearer signal to the dolphin.

The clicks travel through the water, bounce off an object and send an echo back to the dolphin.

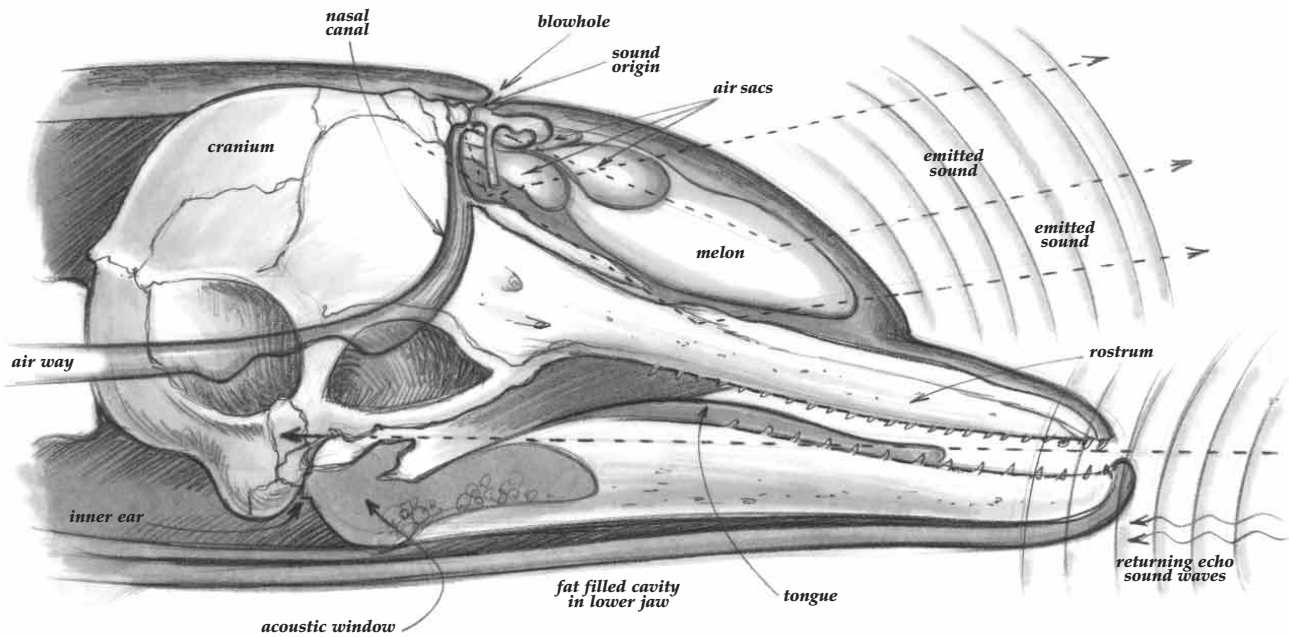
When the echoes return to the dolphin, the animal's lower jaw acts as a receptor for them. The jaw contains a fluid-filled cavity where these echoes are passed along, via the auditory nerve, to the middle then inner ear of the animal, and finally to hearing centers of the brain.

In this activity, the student who wore the blindfold emitted a clicking sound each time he or she required information about their surroundings. They made the clicking sound primarily when they wanted to know if another student was within tagging range and this represents the sounds made by dolphins who use echolocation. The clicking sounds made by the other students in the class represent the echoes that are returned to the dolphin, giving it information about its surroundings.

**Key Words:**

**sonar** an apparatus that transmits and receives sound waves in water. Sonar is used in submarines to locate (and possibly identify) water depth and other objects.

**echolocation** the auditory feedback system used by some animals which allows them to pick up reflected echoes from sounds generated by objects in the water providing the animal with information to determine an object's location.





# Talk the Talk

## activity TEN

**Objective:** Students will identify Greek and Latin root words that are used to classify dolphins.

**In the Film:** Years of observation have given the scientists highlighted in the film the opportunity to recognize specific dolphin species. Of the close to 40 species of dolphins living in our Earth's oceans, only three are highlighted on the huge screen. Through provocative camera angles, we can see their individuality in body colorings, shape or size. After seeing these specific species on film, how successful would you be at identifying them if you saw them in the open ocean? This is an issue that the scientists have had to deal with in order to conduct their research and have resolved it by using ancient terms from the past.

**Materials:**

- Copies of *Talk the Talk* copy page
- Pencils for writing.

**Teacher Prep Notes:** This activity can be done by individual students or in student pairs. In order

**Key Words:**

**taxonomy** the arrangement of animal and plant classification names.

**binomial nomenclature** binomial means consisting of two names while nomenclature designates a system of naming.

**genus** a classification of related plants or animals that is the subdivision of a family.

**species** the classification of closely related plants and animals that follows the genus category.

to stimulate students, display a poster depicting several species of dolphins and whales as they work through the activity. Students may get visual clues that will assist them in the identification. As students memorize the levels of plant and animal classification, assist them with a mnemonic device. A mnemonic device is a system for improving memory by

the use of a formula derived of letters. Example: "King Phillip Came Over For Good Spaghetti". Kingdom, Phylum, Class, Order, Family, Genus, Species.

**Background:** In the fourth century B.C., Greek philosopher Aristotle developed a system to classify all living things. His system divided organisms into two large groups: plants and animals. He then divided these into three sub-groups according to the way the organisms moved. For animals, this classification included those that flew, swam and walked. Plants were classified by growing seasons and plant types. Each group was given

Latin or Greek terms that described the properties of that organism. Some organisms were given up to 12 Greek or Latin names for identification!

By the eighteenth century, Swedish scientist Carolus Linnaeus expanded that system to one that used binomial nomenclature, a more logical way of naming organisms. Binomial nomenclature gives each organism two scientific names indicating both the genus and species. Greek or Latin terms were used in this naming system.

In the 200+ years since, scientists have further adjusted the naming system. We know more about the organisms living on Earth now than ever before. Using what we have learned about organisms and their evolutionary relationships, the classification system has been expanded. All living things are now classified into seven major groups: kingdom, phylum, class, order, family, genus and species.

All dolphins are in the Kingdom Animalia, the Phylum Chordata, the Class Mammalia and the order Cetacea. Most dolphins are grouped together into a family called Delphinidae, which is part of the sub-order Odontoceti, or toothed whales. Delphinids include the well-known bottlenose dolphin, the common dolphin and the killer whale.

**To Do:** Distribute Talk the Talk pages to each student and ask them to use the key to name the dolphins listed.

**What's Going on & Why?** Like other animals, dolphins can be identified two ways, by the common name and the scientific name. Common names can get confusing, especially when one scientist might call a certain animal "short-snouted dolphin," another may call it a "spinner dolphin" and still others may call it a "clymene dolphin." With all of these different names, how can scientists be sure they are observing and communicating about the same animal? The scientific names, formed by the genus and species names, are used to clarify what type of animal is being observed or discussed. A Clymene or short-snouted spinner dolphin is known as *Stenella clymene* (*Stenella* is the genus name and *clymene* is the species name).

NOTE: This activity was adapted from materials provided by Sea World, Inc. and was used with permission. If you would like more information on marine animals and classroom activities, please contact the Sea World San Diego Education Department: (619) 226-3834.



**To Do:** Use the Greek and Latin word fragments at right to help you decode the dolphin scientific names provided.

**Example**

*Tursiops truncatus*—bottlenose dolphin

**dolphinlike face cut-off**

(Ter•see•ops trun•CAY•tus)

1. *Stenella coeruleoalba*—striped dolphin

(stuh•NELL•uh coh•rue•lee•oh•AL•bah)

2. *Grampus griseus*—Risso’s dolphin

(GRAM•pus GREE•see•us)

3. *Lagenorhynchus obscurus*—dusky dolphin

(la•gen•oh•RING•kus ob•SKYOO•rus)

4. *Lagenorhynchus acutus*—Atlantic white-sided dolphin

(la•gen•oh•RING•kus uh•KYOO•tus)

5. *Pseudorca crassidens*—false killer whale

(soo•DOR•kuh KRA•suh•denz)

**acutus:** sharp, pointed  
**albus:** white  
**australis:** southern  
**borealis:** northern  
**caeruleus:** sky blue  
**crassus:** thick  
**crucis:** cross  
**dens:** tooth  
**delphis:** dolphin  
**gero:** bear, carry  
**grampus:** a kind of whale (great fish)  
**griseus:** gray

**lagen:** bottle, flask  
**lisso:** smooth  
**obscurus:** dark, indistinct  
**orca:** a kind of whale  
**ops:** face  
**pseudos:** false  
**rostris:** beak, snout  
**rhynchos:** beak, snout  
**stenos:** narrow  
**truncare:** cut off  
**tursio:** dolphinlike

6. *Lagenorhynchus albiristris*—white-beaked dolphin

(la•gen•oh•RING•kus al•buh•ROS•trus)

7. *Lagenorhynchus cruciger*—hourglass dolphin

(la•gen•oh•RING•kus KROO•suh•ger)

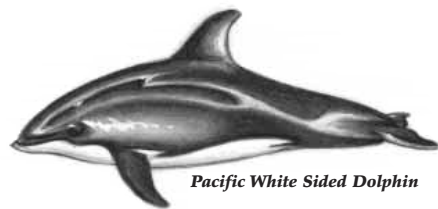
8. *Lissodelphis borealis*—northern right whale dolphin

(lis•so•DEL•fus bor•ree•A•lis)

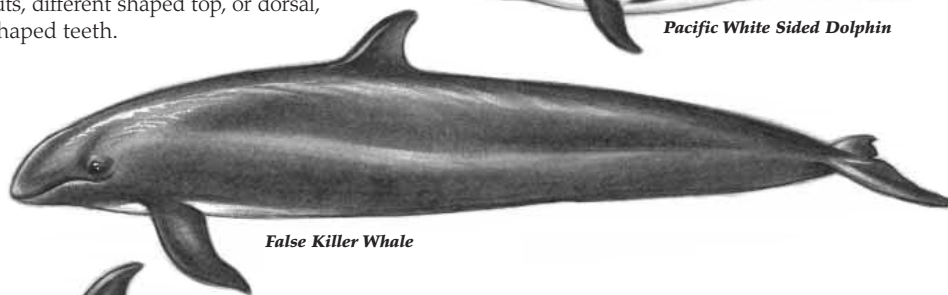
9. *Lagenorhynchus australis*—Peale’s dolphin

(la•gen•oh•RING•kus ah•STRA•lis)

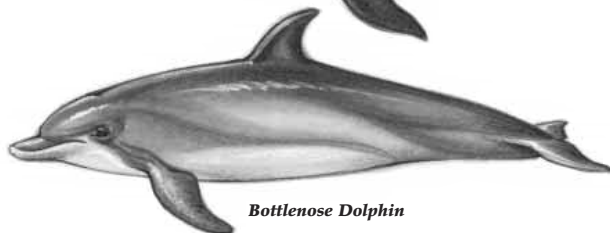
**Did You Know?** Porpoises (and whales) also belong to the order *Cetacea*, but porpoises belong to their own family, *Phocoenidae*. These animals are actually quite different than dolphins for they have shorter snouts, different shaped top, or dorsal fins and spade-shaped teeth.



**Pacific White Sided Dolphin**



**False Killer Whale**



**Bottlenose Dolphin**

**Answer Key**  
*Stenella coeruleoalba* "narrow sky-blue and white"  
*Grampus griseus* "a gray kind of whale"  
*Lagenorhynchus obscurus* "flask-snouted, dark"  
*Lagenorhynchus acutus* "flask-snouted, sharp pointed"  
*Lagenorhynchus albiristris* "flask-snouted, white snout"  
*Lagenorhynchus cruciger* "flask-snouted, cross beak"  
*Lissodelphis borealis* "smooth dolphin, northern"  
*Lagenorhynchus australis* "flask-snouted, southern"

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<http://www.go-abacos.com>

### International Flags

<http://www.flagsunlimitedinc.com>

### Patagonia Information

<http://www.greentravel.com/>

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