

## WELCOME TO THE LIFE IN THE ABYSS OVERNIGHT PROGRAM

We are pleased that you and your students will be joining us for our *Life in the Abyss* Overnight Program! Your students will be embarking on a fun and fascinating examination of living systems and the biotic and abiotic components that define them, as they explore abyssal, benthic, and aquarium ecosystems. In order to better address your needs, we have designed our *Life in the Abyss* Overnight Program to help fourth through sixth-grade teachers meet California Science Content Standards.

We utilize our At Sea Learning Center, the *R/V Sea Explorer*, and have added new activities to explore the deep sea and the organisms that live there. We are proud to be able to offer your students this unique learning experience and are pleased that you will be joining us.

Please take a few moments to familiarize yourself with the materials we have included. It is important to share them with other teachers and chaperones who will be joining you. These materials contain important information to prepare you, your chaperones, and your students for your visit. You will also find important forms that must be returned to the Ocean Institute in order to complete your registration.

If you have any questions about your visit to the Ocean Institute, please do not hesitate to contact our program coordinator, Shanette Grieve at 949-496-2274 extension 339. Again, welcome to the *Life in the Abyss* Overnight Program! We are looking forward to your visit.

Sincerely,  
Rick Baker  
Vice President, Education



## TABLE OF CONTENTS

<b>I. WELCOME TO THE LIFE IN THE ABYSS OVERNIGHT PROGRAM</b>	
<b>A. ADMINISTRATIVE CHECKLIST FOR THE LIFE IN THE ABYSS OVERNIGHT</b>	<b>3</b>
<b>B. DESCRIPTIONS OF THE OVERNIGHT PROGRAM</b>	<b>4</b>
<b>C. LINKS TO CALIFORNIA CONTENT STANDARDS</b>	<b>7</b>
<b>D. ADMINISTRATIVE PREPARATION FOR PROGRAMS</b>	<b>8</b>
Administrative Contact / Introduction / Teacher Information: Before the Program	8
Teacher Information: During the Program	9
No Late Arrival/No Early Departure	9
Chaperone Introduction and Information	9
Payment / Final Count / Student Aid / Transportation	9
Information Packets / Forms / Medical Issues / Student Preparation	10
Behavioral Expectations / Safety Rules / Avoiding Seasickness	11
<i>Laurena G. Chambers</i> Gallery Book and Gift Store	11
Directions to the Ocean Institute	12
<b>E. BACKGROUND INFORMATION</b>	<b>12</b>
<b>F. PRE-TRIP ACTIVITIES</b>	<b>14</b>
ACTIVITY #1: <i>Science Processes</i>	14
ACTIVITY #2: <i>Pit—The Food Chain Game</i>	15
ACTIVITY #3: <i>Bending Light</i>	18
ACTIVITY #4: <i>Pressure</i>	19
Glossary	21



## A. ADMINISTRATIVE CHECKLIST FOR THE OVERNIGHT PROGRAM

### ***Immediately upon receiving this package...***

- Carefully review the Teacher Preparation Package
- Arrange your transportation
- Mail information letter to parents, and make sure to ask for parent chaperones

### ***Two months prior to your trip...***

- Confirm student and adult numbers with the Ocean Institute
- Arrange for parent chaperones—please limit the number to two adults for every 12 students.
- Copy and distribute the Chaperone and Parent Information Packets. **KEEP THE MEDICAL FORMS AND THE ACKNOWLEDGEMENT OF RISK FORMS SEPARATE.**

### ***One month prior to your trip...***

- Begin student preparation
- Collect signed Acknowledgement of Risk and Waiver and medical forms.
- Mail or fax the Program Information Form to the OEC Overnight Coordinator**

### ***Two weeks prior to your trip...***

- Mail program payment to the Ocean Institute—**full payment must be received a minimum of 10 days before your program.**
- Ensure all signed Acknowledgement of Risk and Waiver and medical forms have been received from each student and adult.
- Divide the students into activity groups.

**Note:** We cannot guarantee that changes in numbers of students or adults can be accommodated if requested within two weeks of your program date.

### ***One week prior to your trip...***

- Review behavioral expectations with students
- Review Student Clothing and Supply List
- Contact the Ocean Institute with any last minute questions or changes

### ***24 hours to go!!!...***

- If inclement weather is expected, contact the Ocean Institute for status of the program
- Make nametags for students and adults
- Complete ***R/V Sea Explorer*** manifest listing ALL students and adults

### ***When you arrive for the Life in the Abyss Overnight Program...***

- Unload the bus in front of the Ocean Institute
- Check in at Visitor Services building to give final count of students and adults as well as Acknowledgement of Risk and Waiver forms.
- If necessary, students may use the restroom facilities—please limit use to 7 girls and 7 boys at a time.
- Pass nametags out to students and adults.
- Seasickness remedies should be taken at least 30 minutes before departure (only if you have an afternoon boat trip).

## B. DESCRIPTION OF THE *LIFE IN THE ABYSS* OVERNIGHT PROGRAM

Imagine a world of complete darkness. Imagine a world where the pressure and temperature make exploration almost beyond our physical reach. What is down there? How do animals see in the abyss? How do scientists explore the deep?

In this overnight program, we've combined our popular Living Systems Laboratory and Cruise programs and have added activities that explore the fascinating world of nocturnal and deep-sea animal adaptations. In the evening, students investigate shark adaptations, explore the "deep" with our remotely operated vehicles, dissect an eye to look at low light adaptations, visit the dock where our squid light attracts nocturnal animals, and discover extreme deep-sea hydrothermal vent communities. After spending the night in our surf-themed tent cabin, students venture out to sea on the *R/V Sea Explorer* to conduct the Living Systems Cruise investigations with the added excitement of lowering student-decorated Styrofoam cups down 1000 feet to explore the dramatic effects of pressure!

### Afternoon Laboratory

Students participating in the Living Systems Lab study the interactions among biotic and abiotic components that define our many aquaria as living systems. Students explore the requirements of a marine aquarium and its inhabitants, examine internal and external anatomy of a squid through a detailed dissection, and determine the water quality of the lab aquaria through a variety of chemical tests.

- **Squid Dissection**

Students will observe and identify the external and internal anatomy of a squid. They will use their observations to discuss how the adaptations in the squid's physical structure and behavior improve its chance for survival in its habitat.

- **Water Chemistry in the Ocean Institute Aquaria**

Students test the abiotic factors, including dissolved oxygen, pH, temperature, and salinity, of the water in a holding tank to determine if local coastal organisms will survive in this tank as part of the Ocean Institute's living collection. If needed, students suggest ways to improve the water quality in the holding tank.

- **Creating an Aquarium Assemblage**

Students get a list of animals and must determine which of the animals can live together in an aquarium. Students examine the animals on their species list and complete data cards. They identify the animals and describe the predator/prey relationships between the animals. They explore the interaction between the abiotic characteristics and biotic components found in an aquarium.

- **Jellies, Biotic Interactions, and the Food Chain**

Students follow the transfer of energy from its abiotic energy source (the sun) through a food chain that begins with phytoplankton and ends with adult jellyfish. Using microscopes, students examine each successive member of the food chain, how it interacts with its food source, and how it serves as food for the next level.

### Evening Program

- **Cow Eye Dissection**

The eye is a highly specialized organ. Students investigate and dissect a cow eye and identify the major external and internal features. They use the cow eye to exhibit adaptations that allow nocturnal hunters and deep-sea animals to thrive in low-light conditions.

- **Remotely Operated Vehicles (ROVs)**

The average depth of the ocean is beyond our physical reach. How we get there depends on the technology we possess. Today, ROVs play a very important role in bringing back information about the deep ocean. A number of different fields in ocean exploration use these vehicles. Students learn about ROVs and the difficulties in getting to the deepest parts of our oceans. Students drive an ROV in our test tank with the challenge of retrieving or locating an object.

- **Sharks**

During this station, students will observe elasmobranchs (sharks, skates, and rays) to determine how teeth and mouth structure play a role in the habitat and diet of an elasmobranch. The students will also analyze a set of “mystery jaws” from an unknown ray or shark, use a dichotomous key to identify the species, and determine the zone of the ocean in which it can survive. Based on both these investigations, the students will be able to associate some key adaptations to elasmobranchs of the abyss.

- **Food Chains of the Deep**

During this segment, students will explore the differences between a phototaxis driven food chain and the food chain of hydrothermal vents. They will witness phototaxis under the squid light and discover, through experimentation, what powers a food chain deprived of oxygen and sunlight.

- **Bioluminescence**

A multitude of deep dwelling organisms produce light, which means they are bioluminescent. At this station, students investigate the differences in the processes and applications of light: phosphorescence, fluorescence and chemiluminescence. Through observation and manipulation of fluorescent rocks, a demonstration of a “glowing” chemical reaction, and a look at our fluorescent and bioluminescent animals, students gain an understanding of how these phenomena are expressed in the wild and why they are considered adaptations for surviving in the deep sea.

## Morning Cruise

Students participating in the cruise aboard the *R/V Sea Explorer* examine local coastal marine populations using a variety of scientific equipment used in the collection and study of marine species. The students begin with an observation of marine birds. Once upon the open ocean, the vessel scouts out sea lions and students discuss their adaptations as nocturnal predators. The students watch as the staff deploys the ship's scientific equipment. The students' Styrofoam cups are lowered down to 1000 feet to learn about the dramatic effects of pressure before returning to the harbor for the final three teaching stations. These teaching stations give the students the opportunity to examine the organisms collected during the cruise. In the wet lab, they use video-microscopes to observe a plankton sample. The students sort through the Benthic Grab sample and examine the invertebrates that live in the seafloor sediment. They learn about the bottom-dwelling fish caught in the Otter Trawl Net at the fish ecology station. The teacher can decide to observe dolphins or whales, (if they are close by) instead of deploying the Otter Trawl Net, in which case the students will rotate through a marine mammal station.

- **The Benthic Grab**

Students help set the Benthic Grab to collect a sediment sample from the sea floor. Later students will sort through the sample to identify organisms that make up a benthic community.

- **The Plankton Net**

Students help set the Plankton Net to collect a sample of the organisms that drift close to the sea surface. Once retrieved, students will observe a sample under a microscope and identify phytoplankton and zooplankton and determine how they are connected in a food web.

- **The Otter Trawl Net\***

Students help set the Otter Trawl Net to collect a sample of the organisms that live on the sea floor. Once retrieved, students will identify organisms and their adaptations for life on the sea floor.

**\*If within a reachable distance the teacher can elect to observe dolphins or whales in lieu of the Otter Trawl. In this case, the cetacean teaching station below is substituted for the Otter Trawl station.**

- **Cetaceans**

Students learn the characteristics that define toothed whales versus baleen whales. By listening to underwater recordings of various species of cetaceans, students discover how toothed whales use echolocation for hunting and how both groups of whales use sound to communicate.

**Sample Schedule: *Life in the Abyss* Overnight****Day 1**

3:00pm - 3:30pm	Arrive at Ocean Institute Check in, snack, teacher/chaperones meet with lead instructor
3:30pm - 4:00pm	Stow gear in Surf Deck Introduction and Rules
4:00pm - 6:00pm	Living Systems Lab (4 rotations)
6:00pm - 6:45pm	Pizza Dinner with Salad & Fruit
6:45pm - 7:00pm	Abyss Introduction (PowerPoint in Samueli conference center)
7:00pm - 7:40pm	Cow Eye Dissection
7:45pm - 9:15pm	Evening Stations <ul style="list-style-type: none"> <li>○ ROV/ Sharks/ Styrofoam cups decorated</li> <li>○ Food Chains of the Deep</li> <li>○ Bioluminescence</li> </ul> (If there are 4 groups, sharks becomes separate rotation)
9:15pm - 10:15pm	Nighttime rules / Prepare for bed / Lights out

**Day 2**

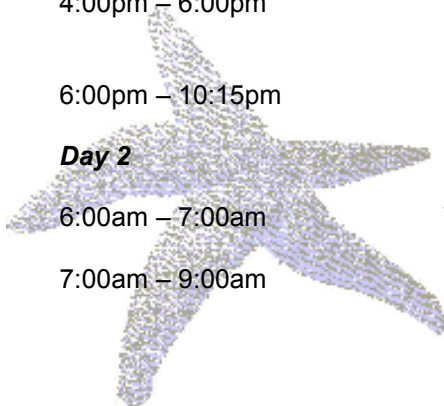
5:45am - 6:00am	WAKE UP!
6:00am - 6:45am	Clean up / Eat breakfast (bagels, muffins, cereal bars, fruit) on Surf Deck
7:00am - 9:00am	Living Systems Cruise
9:15am	Conclusion, Thanks, and Good-byes!

**Alternate Schedule:****Day 1**

4:00pm – 6:00pm	Living Systems Cruise (Styrofoam cups decorated before intro in Surf Deck)
6:00pm – 10:15pm	Dinner and evening rotations remain the same.

**Day 2**

6:00am – 7:00am	Wake up, Clean-up, Breakfast
7:00am – 9:00am	Living Systems Lab



## C. LINKS TO CALIFORNIA SCIENCE STANDARDS

### **Grade Four**

#### Life Sciences

- 2.a. Students know plants are the primary source of matter and energy entering most food chains.
- 2.b. Students know producers and consumers (herbivores, carnivores, omnivores, and decomposers) are related in food chains and food webs and may compete with each other for resources in an ecosystem.
- 2.c. Students know decomposers, including many fungi, insects, and microorganisms, recycle matter from dead plants and animals.
- 3.a. Students know ecosystems can be characterized by their living and nonliving components.
- 3.b. Students know that in any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.
- 3.d. Most microorganisms do not cause disease and many are beneficial.

#### Investigation and Experimentation

- 6.a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.
- 6.c. Formulate and justify predictions based on cause-and-effect relationships.
- 6.f. Construct and interpret graphs from measurements.

### **Grade Five**

#### Physical Sciences

- 1.a. During chemical reactions the atoms in the reactants rearrange to form products with different properties.

#### Life Sciences

- 2.a. Students know many multi-cellular organisms have specialized structures to support the transport of materials.
- 2.c. Students know the sequential steps of digestion and the roles of teeth and the mouth, esophagus, stomach, small intestine, large intestine, and colon in the function of the digestive system.

#### Investigation and Experimentation

- 6.a. Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.
- 6.f. Select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make inferences based on those data.
- 6.g. Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.

### **Grade Six**

#### Ecology (Life Science)

- 5.a. Students know energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis and then from organism to organism through food webs.
- 5.b. Students know matter is transferred over time from one organism to others in the food web and between organisms and the physical environment.
- 5.c. Students know populations of organisms can be categorized by the functions they serve in an ecosystem.
- 5.d. Students know different kinds of organisms may play similar ecological roles in similar biomes.
- 5.e. Students know the number and types of organisms an ecosystem can support depends on the resources available and on abiotic factors, such as quantities of light and water, a range of temperatures, and soil composition.

#### Investigation and Experimentation

- 7.a. Develop a hypothesis
- 7.b. Select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data and display data.

## D. ADMINISTRATIVE PREPARATION

### ADMINISTRATIVE CONTACT

For questions regarding the *Life in the Abyss* Overnight Program, please contact:

Shanette Grieve, Director of Program Development  
Telephone Number: (949) 496-2274, extension 339  
Fax Number: (949) 496-4296  
E-mail: [srillorta@ocean-institute.org](mailto:srillorta@ocean-institute.org)

### INTRODUCTION

Thank you for choosing the Ocean Institute as your field trip destination. We appreciate the time and effort it takes to prepare your students for their program, and we will do everything we can to make their experience as rewarding as possible.

Please make sure that all of the participating teachers have a copy of these teacher materials. The information contained here can help you find answers to your questions, develop your preparation timeline, and prepare both your students and chaperones. This packet also contains directions to the Ocean Institute as well as contact telephone numbers—please call us at any time with questions you may have about your field trip.

### TEACHER INFORMATION: BEFORE YOUR PROGRAM

You can do several things before you arrive to help make your program run as smoothly as possible:

- Review the program goals, station activities, and expected behaviors with the students before you arrive. Complete the classroom activities with your students, and make sure they have a clear understanding of the educational concepts they will explore during the program.
- Spend some time choosing and preparing your parent chaperones. Review the program goals, station activities, and expected student behaviors with them before you arrive. Make sure that they have a clear understanding of their role as a chaperone.
- Complete and return the **Program Information Form**. (We must have the accurate number of students attending the program at least one month before your program in order to ensure proper staffing and equipment.)
- Have signed Acknowledgement of Risk and Waiver and medical forms for each student and chaperone (including the teacher) before boarding the bus.
- Notify the Ocean Institute staff of students with special health, behavioral, or dietary considerations.
- Have a completed Manifest for the *R/V Sea Explorer*.
- Send program payment to the Ocean Institute at least **10 days before the scheduled date of your field trip**.
- Divide your students into activity groups. This program accommodates a minimum of 26 students and a maximum of 45 students. Use the information below to determine the number of groups for your program.

26-36 students – three groups  
37-45 students – four groups

**TEACHER INFORMATION: DURING YOUR PROGRAM**

Ocean Institute instructors are all well trained to instruct students of different ages and abilities. You and your chaperones can help the instructors monitor student behavior and safety. There are several things you can do to facilitate the smooth running of your educational program:

- Work cooperatively with Ocean Institute instructors and parent chaperones to manage students during the program.
- Work cooperatively with Ocean Institute instructors and parent chaperones to solve student and chaperone management problems.
- Report any problems to the Ocean Institute staff as soon as possible.

**NO LATE ARRIVAL/NO EARLY DEPARTURE**

Due to the schedule of the *Life in the Abyss* Overnight program, students and adults will not be permitted to arrive late or depart early.

**CHAPERONE INTRODUCTION AND INFORMATION**

Adult chaperones play a significant role in safety and the educational quality of the program. We request that you bring no more than 2 adults per 12 students. We ask your chaperones to help us in the following ways:

- Work cooperatively with Ocean Institute instructors and classroom teacher to enforce all safety rules.
- Work cooperatively with Ocean Institute instructors and classroom teacher to keep students on task at the stations.
- Guide students to different stations throughout the program.
- Act as a positive role model for the students by exhibiting enthusiasm for learning without answering questions directed at students.

**PAYMENT**

**Payment must be received 10 days before your program date.** Please mail a single check for the total amount of the program minus the deposit you have already paid. Please make the check payable to Ocean Institute.

**FINAL COUNT**

Call the Ocean Institute two days before your program if the number of students or adults changes. When you arrive at the Ocean Institute for your program, you must have an accurate count of total students and adults participating in the program. If the number of participants listed on your Program Agreement is not accurate, call the Ocean Institute immediately. **We cannot guarantee that changes in numbers of students or adults can be accommodated if requested within 2 weeks of your program date.**

**STUDENT AID**

The Ocean Institute maintains a student aid fund for students who are unable to obtain sufficient funding to attend the program. Please call (949) 496-2274, extension 0 for more information and to receive the necessary forms for student aid.

**TRANSPORTATION**

Student transportation should be arranged well in advance. It is important that you arrive on time. Please schedule yourself to arrive 30 minutes before your scheduled program start time. If you arrive late, your program time will be shortened.

Buses can unload in front of the Visitor Services building. After the students have unloaded, the drivers will be notified of where to park the buses.

## INFORMATION PACKETS

We have included separate packets for the teachers, chaperones, and parents. They contain copies of information and forms that must be completed before arriving for your program. **IT IS IMPORTANT THAT YOU ARE FAMILIAR WITH ALL THE INFORMATION AND FORMS FOUND IN EACH PACKET.** These packets are ready to be copied and distributed to the appropriate participants. Information on each of the forms is in the next section.

**Please make sure that you provide chaperones with both the Chaperone Information Packet and the Parent Information Packet.**

## FORMS

The following forms are included in the Information Packets found at the back of this booklet. Please make sure that all of the forms are completed before you arrive for the *Life in the Abyss* Overnight Program. Make sure that you use the forms from this packet—they are the most up to date forms.

### Medical Forms

You will find **medical forms** in the Information Packets. You must have a completed and signed medical form for each student and adult participating in the *Life in the Abyss* Overnight Program. In order for a child to receive any prescription or non-prescription medication during the program, the Administration of Medication form(s) must be completed and signed by the parent or guardian and the child's physician.

### Acknowledgement of Risk and Waiver

Each student must have this form signed by a parent or guardian to participate in the *Life in the Abyss* program. Please make sure that you have one signed form for each student and adult chaperone when you check in with Visitor Services.

### Manifest for the *R/V Sea Explorer*

A manifest for the *R/V Sea Explorer* must be completed for the cruise portion of the *Life in the Abyss* Overnight Program. The Coast Guard requires us to have a completed Manifest in order to account for all passengers before we leave the dock. Please have it completed before you arrive at the Ocean Institute—we will lose valuable instructional time if the Manifest needs to be completed when you arrive. It is important that the Manifest is accurate and includes the first and last names of ALL students, teachers, and chaperones. Your Ocean Institute Floating Laboratory Specialist will take a head count before boarding the vessel and the number of this count must match the number on the Manifest.

### Program Information Form

The Program Information Form should be completed and returned to the Ocean Institute at least one month before your program. This information will help us prepare for your program. Use this form to let us know about any special needs you or your students may have.

## MEDICAL ISSUES

**The medical forms included in this package must be completely filled out and signed for every student and adult participating in the *Life in the Abyss* Overnight Program.** Please carefully review the completed forms to ensure that they have been properly filled out and signed. The teacher-in-charge will keep all medical forms as well as be responsible for storing and distributing student medications (both prescription and non-prescription). **Please notify the Overnight Coordinator in advance of any participant with special dietary or other needs.** We do not have a medical doctor or nurse on site, and we do not have housing for sick students. Parents of ill or injured students will be notified immediately and arrangements made for transportation to the hospital or home.

## STUDENT PREPARATION

The more familiar the students are with program concepts and content before they arrive, the more they will benefit from and enjoy their experience. We have included background information and classroom activities to introduce important concepts to your students before they arrive for their program.

## STUDENT BEHAVIORAL EXPECTATIONS

Please take time to discuss the academic nature of their field experience with your students before arriving at the Ocean Institute. When at the Ocean Institute, we expect your students to follow the same behavioral rules you have in your classroom.

## STUDENT SAFETY RULES

The students will use tools and equipment during the *Life in the Abyss* Overnight Program. They must wear closed-toed shoes and follow the instructor's safety guidelines.

A portion of the *Life in the Abyss* Overnight program takes place on the *R/V Sea Explorer*. Before the cruise departs you will be met by an Ocean Institute Floating Laboratory Specialist who will review the following safety rules with you and your students:

- Walk at all times while onboard the *R/V Sea Explorer*—running and horseplay are not permitted.
- Keep both feet on the deck at all times, and remember to stay off the rails.
- Keep off the upper deck and access ladder unless permitted by Ocean Institute instructors.
- Keep hands off the equipment until instructed to do otherwise.

## AVOIDING SEASICKNESS

There are several things that you and your students can do to avoid seasickness during the cruise:

- Eat a good breakfast before the cruise—make sure that you avoid sweets and greasy foods.
- Take anti-motion sickness medication at least 30 minutes before boarding the vessel.

## LAURENA G. CHAMBERS GALLERY BOOK AND GIFT STORE

*Chambers Gallery* Book and Gift Store is a fun and unique non-profit museum store open daily from 9:00 AM to 5:00 PM and definitely worth the visit. The revenue is directed toward lowering tuition for schools that participate in Ocean Institute programs.

To help accommodate all of the schools that would like to shop each day, please have one teacher from your school check-in with a store staff member before your students begin shopping.

There will be a limit on the number of students allowed to shop at one time and we encourage you to organize them so that they all have time to enjoy the shop. Please have one or two adults in the store to help supervise your students. We ask that all food, drink, and backpacks be left outside while they are shopping. Teachers receive a 15% discount in the shop if members of the Teachers Club and 10% normally.

Please remind your students that sales tax will be added to their items.

In order to ensure a positive experience, we recommend the following:

1. Plan sufficient time before or after your program to shop.
2. All purchases should be stowed safely away and out of sight for the program.
3. Please allow only 10-12 students in *Chambers Gallery* Book and Gift Store at a time. Remaining students should remain outside in a manner that does not interfere with traffic in and out of the building.



## DIRECTIONS TO THE OCEAN INSTITUTE

The address of Ocean Institute:  
24200 Dana Point Harbor Drive  
Dana Point, CA 92629  
(949) 496-2274

**Directions from Los Angeles:**

- Travel south on Interstate 5.
- Exit on the Pacific Coast Highway Exit.
- Stay in the right lane of the exit ramp and go north on P.C.H.
- Turn left onto Dana Point Harbor Drive. The road ends in the Ocean Institute parking lot.

**Directions from San Diego:**

- Travel north on Interstate 5.
- Exit on the Beach Cities Exit
- Stay in the left lane of the ramp and go north on P.C.H.
- Turn left onto Dana Point Harbor Drive. The road ends in the Ocean Institute parking lot.

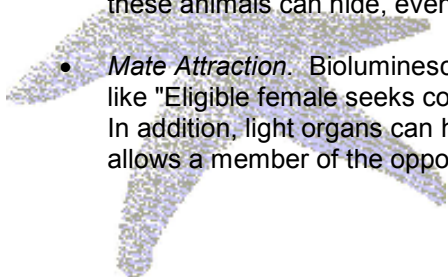
**E. BACKGROUND INFORMATION****Bioluminescence**

There are living lights in the ocean. They are beautiful, fascinating, and critical to the very existence of most marine life. Visible light made by living creatures is known as bioluminescence. Many deep-sea animals make their own light to find food, to find each other, and to confuse or attract other animals.

- *Finding Food.* If you are trying to find something in the dark, a flashlight can be very handy. Many animals have light organs under their eyes that they can use just like a flashlight to help them search for their prey. Anglerfish attract their prey to them with a glowing lure that dangles from the end of its fishing pole. When the unsuspecting prey tries to nibble at the tempting bait, it finds itself instantly engulfed in that mouthful of needle sharp teeth.
- *Defense (Camouflage & Predator Avoidance).* One way bioluminescence is used to fend off attackers is with a blinding distraction. Like the ink cloud used by a squid to distract a predator, many animals in the ocean can squirt out a glowing cloud.

A very common use of bioluminescence in the ocean is as *camouflage*. In the open ocean there are no trees or bushes to hide behind, there is only dim blue light filtering down from above and darkness below. Many animals like these produce a very distinctive silhouette, easily seen by a predator swimming below. Many animals in the ocean have bioluminescent light organs on their bellies that they use to disguise their silhouettes. Because seawater scatters light, these point patterns tend to blur at a distance and the bioluminescence exactly matches the color and intensity of the dim blue light filtering down from above, so these animals can hide, even in the open ocean.

- *Mate Attraction.* Bioluminescence can also be used to advertise for a mate. Signals that send messages like "Eligible female seeks compatible male" can be sent using a special flash code, as fireflies do on land. In addition, light organs can have a very special shape or pattern that is specific to a particular species and allows a member of the opposite sex to recognize a potential mate.



Animals can make the light in one of two ways. Some animals grow luminescent bacteria in special body pockets, while others produce their own light in body organs called *photophores*. The three types of luminescence are:

- *Fluorescence* can be demonstrated with glowing rocks and an ultraviolet light—molecules are only excited in the presence of UV light.
- *Phosphorescence* can be demonstrated with ceiling stars—molecules stay excited after the light source has been removed.
- *Chemiluminescence* can be demonstrated with glow sticks—light is emitted as a result of mixing chemicals. Bioluminescence is a form of chemiluminescence.

## Equipment



### Remotely Operated Vehicle (ROV)

A remotely operated vehicle is an underwater robot that allows the vehicle's operator to stay in a safe environment topside while the ROV works in the hazardous environment below. The ROV system includes the vehicle, an umbilical cable to connect the vehicle to the operators, a handling system to control the cable dynamics, a launch system, and power supplies. The umbilical carries the power and the command and control signals to the vehicle and the status and sensory data back to the operators.

The equipment that ROVs carry depends on the purpose of the expedition. They can carry video cameras and lights; instruments to detect and record depth, heading, and position; instruments to measure water clarity and temperature; manipulators or cutting arms; sampling devices, and much more.



### Squid Light

The squid light is a 1000-watt light that is suspended over the side of the boat to attract marine organisms at night. Many species are drawn to the light, and other species come closer to feed on distracted prey.

Some nocturnal animals are attracted to sources of light, like moths and mosquitoes. This is known as **phototaxis**. Marine organisms, like squid, are attracted to the light, and some animals, like sea lions, come close to the light because they are searching for prey. It is easy to see a marine food chain in action by spending twenty minutes watching the squid light!



### Microscope

A microscope is used to magnify small items for closer examination. Scientists can use a microscope to take a closer look at samples of sand, sediments, or even living organisms.

## F. CLASSROOM ACTIVITIES

### ACTIVITY #1: Science Processes

#### Introduction

Students locate and describe in their field notes an object in the classroom. They exchange field notes to identify the unknown objects. This will help them practice the science processes of observing, comparing, and communicating.

#### Materials

- Paper and pencils

#### Background

*Observing:* The scientific thinking process from which fundamental patterns of the world are constructed.

*Communicating:* The scientific thinking process that conveys ideas through social interchanges.

*Comparing:* The scientific thinking process that deals with concepts of similarities and differences.

#### Student Challenge

*You are scientists who have observed an unidentified organism during your field research. If you carefully describe it, other scientists will be able to identify the organism based on your field notes.*

#### Procedure

1. Choose an object in your classroom and describe it in your field notes. Be as descriptive as you can without actually identifying it. You may also wish to sketch it.
2. When you have completed your field notes, swap descriptions with another scientist. Try to identify the unknown object based on their observations!
3. Were you able to identify the object that was described by another scientist? Were you surprised at the details you noticed about the object? Have you ever used these skills before in your science classes?



## ACTIVITY #2: *Pit—The Food Chain Game*

### Introduction

Students play a game that illustrates the food chain

### Station Link

Afternoon Lab: *Jellies, Biotic Interactions, and the Food Chain*

Evening Rotation: *Squid Light: Phototaxis / Food Chains of the Deep*

Morning Cruise: *The Plankton Net*

### Materials

- Pit Cards
- Rope to mark the **Pit**

### Background

We are all part of a large food web. Food chains are the sequence of organisms in which each is food for the next organism in the sequence (i.e., grass -> mouse -> snake -> hawk). The simple links of a food chain create a food web. At the beginning of the food chain is the ultimate source of energy, the sun. Plants take sunlight and convert it to edible energy. Then the hunt is on, beginning with the herbivores munching on plants only to satisfy the appetites of carnivores. The important link that ties life and death together is the community of decomposers. They break down the nutrients so that plants may use them to grow.

### Overview of the Game

Divide the students into eight equal teams. Each team has a home base on the playing field. In the center of the playing field is the “Pit,” a marked off trading area. Each team gets a set of eight cards of the same animal. When the trading pit opens, one student from each team runs into the pit with one card held upside down yelling, “Trade!” The students exchange cards and run back to home base without looking at the card. When they get to their home base, they can decide to keep it or trade again. Students can only trade one card at a time. The goal is to collect eight cards that form a complete food chain.

### Student Challenge

*Collect eight cards that form a complete food chain.*

### Procedure

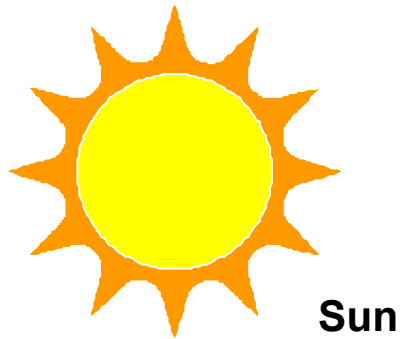
1. Introduction: Have your students form a large circle. Set out the eight cards of one food chain in the middle of the circle. They should be out of order. Ask one student to find the first card in the chain. Ask another volunteer to find the second card in the chain. Go until the cards are put in order. Repeat step two with the other food chain. This is a great way to help kids familiarize themselves with the cards and the food chain concept.
2. Explain the **Pit** Rules before going outside, giving a demonstration helps alleviate any confusion.

#### *Pit* Rules

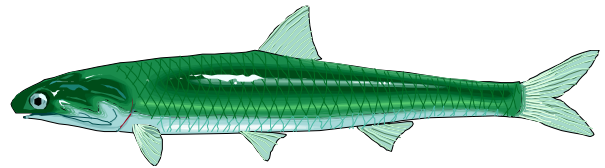
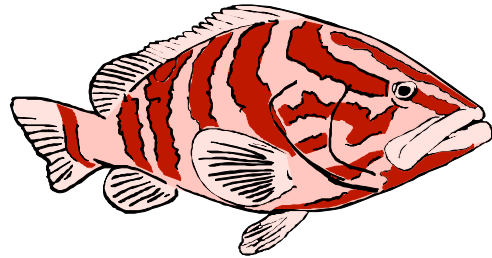
1. Only one student can bring a card to the trading pit.
2. The card must be held upside down in the trading pit. If it is not, the student must stay in the pit for 10 seconds before going back. This cuts their trading time.
3. A student can only trade once in the pit before heading to home base.
4. The team that collects all the cards first yells, “food chain!” and trading stops.
5. All the other teams must create a food chain with the cards they have. Ten points will be given for each card correctly placed.
6. The game continues with the second set of cards.

**Pit—The Food Chain Game: Marine Food Chain #1**

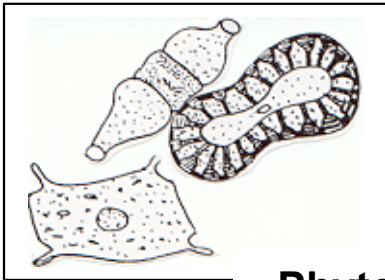
**Answer:** Sun→Phytoplankton→Zooplankton→Featherduster Worms→Anchovy→Sea Bass→Dolphin→Shark



**Sea Bass**



**Anchovy**



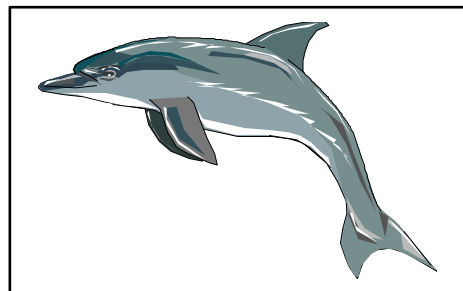
**Featherduster Worms**



**Phytoplankton**



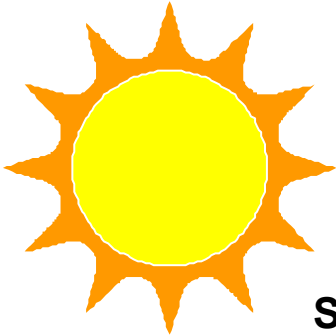
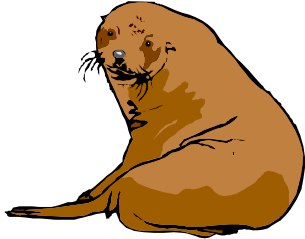

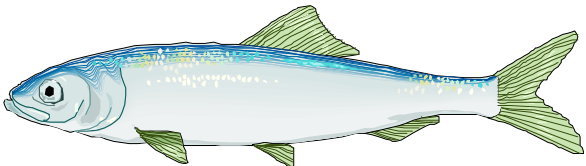
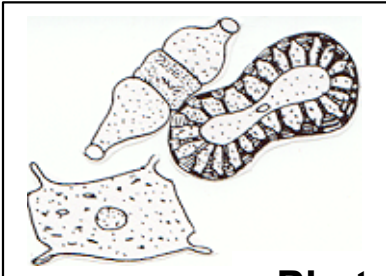


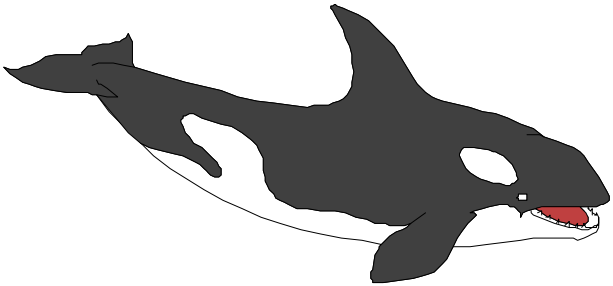
**Bottlenose Dolphin**



**Zooplankton**

**Pit—The Food Chain Game: Marine Food Chain #2**

**Answer:** Sun→Phytoplankton→Zooplankton→Featherduster Worms→Squid→Mackerel→Sea Lion→Orca

 <p><b>Sun</b></p>	 <p><b>Sea Lion</b></p>
 <p><b>Squid</b></p>	 <p><b>Mackerel</b></p>
 <p><b>Phytoplankton</b></p>	 <p><b>Featherduster Worms</b></p>
 <p><b>Zooplankton</b></p>	 <p><b>Orca</b></p>

**ACTIVITY #3: *Bending Light*****Introduction**

Students learn several aspects of the properties of light, especially that of light in water.

**Station Link**

Evening Program: *Cow Eye Dissection*

**Materials**

- Dishpan
- Penny
- Water
- Glass
- Pencil

**Background**

*Refraction* is the bending of light where two substances meet, like between air and water or air and glass. Light travels at different speeds through different substances. It travels more slowly through water or glass than it does through air. As the light slows down, it also changes direction, either bending or refracting.

**Procedure***Bending light*

1. Fill the glass with water and place a pencil in it.
2. Look at the pencil through the side of the glass

What do you notice?

*Magic Money*

1. Place the coin in the dishpan.
2. Have one person stand and look at the coin while you move it slowly backwards toward the near side until the person cannot see it.
3. Have the students stand in the same place and fill the pan carefully with water while making sure the coin does not move.

What happens?



**ACTIVITY #4: Pressure****Introduction**

Students learn basic principles of pressure and calculate how much pressure their Styrofoam cups will face when lowered down 1000 feet during the cruise.

**Station Link**

Evening Program: *ROVs*

Cruise Program: *Pressure Drop*

**Materials**

- Gallon milk jug or clear 2 liter soda bottle
- Scissors
- Duct tape
- Water to fill the jug or bottle

**Background**

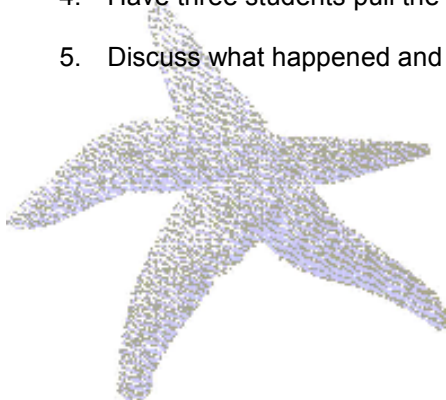
In the ocean, pressure increases by one atmosphere for every 33 feet (10 meters) you descend. This means that at a depth of 33 feet, the pressure is double what we experience on land. By the time we reach 660 feet (201 meters), the pressure is more than 20 times greater than the surface. On the deep sea floor, the pressure is 320 times greater.

We experience one atmosphere of pressure at sea level, or 14.7 pounds per square inch (psi). Every 33 feet (about 10 meters) adds one atmosphere (ATM) of pressure. At 12,000 feet (3658 meters) below the ocean surface, the pressure is 364 atmospheres (5274 psi). In many parts of the ocean, the depth is greater than 13200 feet (4000 meters), making ocean exploration very limited without deep-sea technology.

Animals in the very deepest parts of the ocean are living at pressures of more than 1000 atmospheres. Many deep-sea animals lack any gas filled spaces in their bodies, like lungs or swim bladders, and since the liquid that their bodies are composed of compresses very little under pressure, they experience very little effect from pressure changes. Some deep-sea fish have swim bladders that involve remarkable gas exchange systems that allow them to pump out gas against the very high pressures at which they live.

**Procedure**

1. Puncture three holes in the jug or bottle. Make sure that they are spaced evenly from top to bottom. Leave at least 5 cm from the bottom.
2. Cover the holes tightly with duct tape.
3. Fill the bottle with water to a level approximately 5 centimeters above the top hole.
4. Have three students pull the tape off at the same time.
5. Discuss what happened and why.

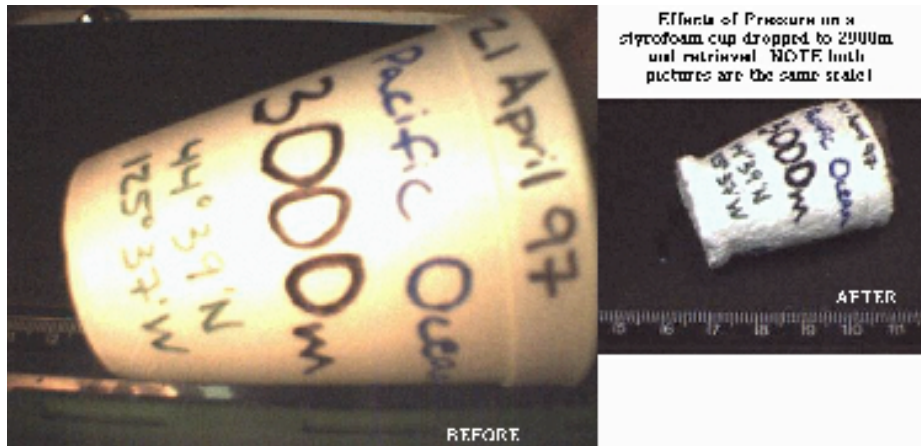


**Extension Calculation: Styrofoam Cups**

When you are on the *R/V Sea Explorer*, you will be lowering a small Styrofoam cup down to a depth of approximately 1000 feet (304.8 meters).

We experience one atmosphere of pressure at sea level, or 14.7 pounds per square inch (PSI). Every 33 feet (about 10 meters) adds one atmosphere (ATM) of pressure. At 12,000 feet (3658 meters) below the ocean surface, the pressure is 364 atmospheres (5274 PSI). The average depth is close to 13200 feet (4000 meters), making ocean exploration very limited without deep-sea technology.

1. How many atmospheres are at 1000 feet?
2. How many pounds per square inch (psi) would be exerted on an object at 1000 feet?
3. Come up with a fun example of what it would feel like if you had that many pounds per square inch exerted on you!



## Glossary

*Abyss* – depths in the ocean greater than approximately 14,000 feet.

*Ampullae of Lorenzini* – a special network of jelly-filled canals in the head of a shark that detect electric fields.

*Benthic* – of the sea floor, or pertaining to organisms living on or in the sea floor.

*Bioluminescence* – the release of energy as light during a specific chemical reaction within living organisms.

*Buoyancy* – how well an object floats or sinks determined by the amount of water it displaces.

*Chemiluminescence* – the release of energy as light during a specific chemical reaction.

*Chemosynthesis*- the process in which a living organism converts an inorganic compound or substance into an organic or usable compound to use for energy.

*Fluorescence*- light emitted from an object during exposure to radiation from an external source. Light enters the object at one wavelength and is released at a longer wavelength.

*PSI* – pounds per square inch.

*Pelagic* – pertaining to the open sea.

*Phosphorescence* – process in which energy absorbed by a substance is released slowly over time in the form of light.

*Phototaxis* – movement of an organism in which the directional stimulus is light.

*Phytoplankton* – microscopic plants that drift with ocean currents.

*Refraction* – a change in direction or bending of a wave.

*ROV*- remotely operated vehicle.

*Tapetum lucidum* – the membrane that lines the back of the lens of certain animal eyes. This reflective structure acts like a mirror and reflects light back through the retina, giving the retina a second chance to absorb the light. Most animals that are active at night have tapetums to improve their night vision.

*Zooplankton* – microscopic animals that drift with ocean currents.

