

# Behind the Scenes

Pre- and Post- Visit Activities

Grades 9-12





This booklet was prepared by the Conservation Education Department at The National Aquarium in Baltimore.

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September, 2004

# Behind the Scenes Tour

An hour and a half program for grades 9-12 at The National Aquarium in Baltimore

## Program Description

In this program your students have an opportunity to glimpse a side of the Aquarium that few visitors experience. Trek "Behind the Scenes" and discover how we make and filter 2.3 million gallons of saltwater, feed and care for over 12,000 animals, and provide conservation education to over 1.6 million visitors annually. Students will learn about the history of the Aquarium and discover what it is like to work at The National Aquarium in Baltimore.

## Planning for the Program

This Behind the Scenes program is a great opportunity to excite students about the field of marine biology, engage them in learning about the intricacies of aquariums, and discuss societal perspectives on the role of aquaria and zoos in conservation education.

## Pre-trip Activity

Read over the Teacher Background information and share this information with your students. Then research and setup a freshwater aquarium in your classroom. Have students follow procedures for set-up and keep a log of your progress. Follow the basic guidelines in Activity 1 - Setting up a Freshwater Aquarium. These are general recommendations; have students conduct further research into aquarium set up to learn more.

## Day of Field Trip

At the Aquarium attend the Behind the Scenes program, beginning in a classroom lab then touring the behind the scenes areas. Then as you tour the aquarium on your own, have your students focus on the exhibits; how they are designed, the décor of the exhibits, and what kinds of animals there are.

## Post-trip Activity

After having the opportunity to learn about the particulars of how the Aquarium works, students will delve deeper into aquarium care. By keeping detailed records, students will be able to graph the water chemistry levels and look for

## AAAS Benchmarks

12D-9-12#6

Participate in group discussions on scientific topics by restating or summarizing accurately what others have said, asking for clarification or elaboration, and expressing alternative positions.

12D-9-12#7

Use tables, charts, and graphs in making arguments and claims in oral and written presentations.

12E-9-12#4

Insist that the critical assumptions behind any line of reasoning be made explicit so that the validity of the position being taken--whether one's own or that of others--can be judged.

## Maryland Core Learning Goal 1 Skills And Processes For Biology Assessment

Indicator 1.4.2

The student will analyze data to make predictions, decisions, or draw conclusions.

Indicator 1.3.1

The student will develop and demonstrate skills in using lab and field equipment to perform investigative techniques.

Indicator 1.7.1

The student will apply the skills, processes, and concepts of biology, chemistry, physics, and earth science to societal issues.

trends. They will also be providing the classroom fish tank with optimal long term care. Finally, students will research the issues of keeping animals in zoos and aquariums. Have students complete Activity 2: Step A - Become an Aquarist. Then Step B: Views on Zoos and Aquaria.

## Teacher Background

The National Aquarium in Baltimore (NAIB) opened to the public on August 8, 1981. With the opening of the Marine Mammal Pavilion on December 26, 1991 the Aquarium contains over 2.3 million gallons of water to support its collection of over 12,000 animals. The Aquarium provides visitors with the access to view animals and to learn about their habitats and behaviors. Over 1.5 million visitors come to the Aquarium each year.

## Filtration Systems: Closed vs. Open

The National Aquarium in Baltimore has closed filtration systems. These are systems in which exhibit water is recirculated through filters and reused. Because Baltimore Harbor has low salinity (less than 1/4-1/5 that of regular sea water) and pollutants which make it unsuitable for aquarium use, the Aquarium makes its own sea water using Baltimore City fresh water mixed with our own special blend of salts. Examples of other closed systems are Sea World of Ohio and the Shedd Aquarium in Chicago. In open systems, water is "put into one end of the tank and dumped out the other." The exhibit water is pumped from a natural body of water like the ocean, flows through the system, and is released back into that body. The Monterey Bay Aquarium and the Miami Seaquarium use primarily open systems.

## Maintaining the Physical Environment in the Aquarium

In all zoos and aquariums it is of primary importance to provide each organism with environmental conditions that replicate, as closely as possible, those in its natural environment. To optimize an organism's survival at the Aquarium, the husbandry staff is concerned with factors such as water treatment, salts, dissolved oxygen, temperature and light.

## Water Treatment

The exhibits at the National Aquarium in Baltimore display animals that live in fresh, brackish, and salt water. The Aquarium is not located close to a suitable source of any one of these types of water and therefore uses Baltimore City tap water. Tap water is filtered to remove chlorine and other substances that are harmful to aquatic organisms. This water is then used directly in freshwater

exhibits such as the Allegheny Stream exhibit and the Shocking exhibit, or in the production of synthetic sea water.

All the Aquarium's marine animals are maintained in synthetic sea water. Synthetic sea salt mixes combined with filtered fresh water provide a medium in which marine life can live by combining over thirty different elements in various amounts. There are many different formulas of synthetic sea salts, and research in refining and improving them is ongoing. From 1981 to 1991 the Aquarium used the commercial sea salt mix called Instant Ocean. In 1992 the Aquarium developed its own formula that is better suited to our collections' needs. The new "recipe," which is made on-site, is currently being used throughout the Aquarium. Some of the back-up tanks and the seahorse lab, however, still utilize commercial mixes.

## Filtration

Whether it is fresh or salt, the water in the exhibits must be cleaned of animal wastes. This is done largely by filtration. Three types are used throughout the Aquarium: biological, mechanical, and chemical. Ozonation is also used in the water treatment process.

**Biological Filtration** is the conversion of nitrogenous wastes to less toxic nitrogenous compounds by the action of bacteria living on a suitable substrate such as a gravel bed or plastic structures called bioballs. The bacteria can also be found on the surface of the tank walls and in the plumbing.

**Mechanical Filtration** is the removal of suspended particles from the water by some type of filter medium such as sand or floss. A rapid sand filter is an example of mechanical filtration which uses layers of gravel, sand and fine coal to trap particles.

**Chemical Filtration** is the removal of dissolved organic compounds. Dissolved organic material can cause the water to have a yellow appearance. This is remedied using a carbon filter or a foam fractionator. Some harmful compounds and medications can also be removed through chemical filtration.

These types of filtration are best illustrated by following the path of water as it circulates through the Atlantic Coral Reef or the Open Ocean tanks keeping in mind that the two systems do not intermingle. Water leaves these exhibits by means of a surface skimmer that keeps specimens in the exhibit while it takes off waste products, trash, and the oils and fats present on the surface as a result of feeding. This water falls to the filtration room by

gravity where several processes take place.

First, the water is divided and pumped through rapid sand filters. These filters are packed with fine layers of sand and gravel. The water travels through the filters at a rate of approximately 600 to 800 gallons per minute, and waste particles are trapped in mineral layers (mechanical filtration). Reversing the water flow, which forces particles up and out into a catch basin, frequently cleans the filters. This cleaning process is called "backwashing." The backwash water is then filtered by a separate filter, and the particles are sent to the sewage treatment plant via the sewer. The cleaned backwash water is returned to the original tank, thereby conserving water.

After the water from the Open Ocean exhibit leaves the sand filters approximately 90% is routed to the bio-filter for biological filtration and 10% is routed to the ozone contactor. The bio-filter consists of a series of distribution troughs through which the water flows spilling over the sides onto the bio-filter plates below. The bio-filter plates provide lots of surface area for beneficial bacteria to colonize. As the water trickles over the plates it is exposed to two types of bacteria living on the plates.

The first bacterium, genus *Nitrosomonas*, oxidizes ammonia ( $\text{NH}_3$  and  $\text{NH}_4^+$ ), a toxic waste product excreted by most aquatic organisms, leaving nitrite ( $\text{NO}_2^-$ ). A second bacterium, genus *Nitrobacter*, oxidizes the still toxic nitrite and converts it to nitrate ( $\text{NO}_3^-$ ), which is relatively non-toxic. A small portion of the ammonia is also lost as a gas to the atmosphere surrounding the plates. The trickling action oxygenates the water and off-gases  $\text{CO}_2$  as it passes over the plates much like a waterfall oxygenates water in a stream. The water leaving the bio-filter and the ozone contactor is then collected in a large tank called the sump. Pumps draw the water up from the sump compartment and back to the respective tanks.

The water may be pumped directly into the exhibit at midwater level or into the bottom of each tank through the undergravel filter. This action prevents the buildup of organic particles and debris in the gravel bed. The gravel bed also acts as a substrate for bacteria (a bio-filter). This entire filtration process is termed "Reverse Flow," as it follows a path the opposite of that typical of home aquariums with undergravel filters.

The principals and procedures of filtration are the same for the Aquarium's smaller freshwater and saltwater exhibits. In many tanks at the Aquarium a simple undergravel filter is used to clean the water. A filter plate is placed in the bottom of the tank and covered with a layer of gravel. The gravel provides a place for Nitrosomonas and Nitrobacter to live. Air columns and air stones circulate the water down through the gravel where the bacteria can convert the ammonia to nitrate. Food particles and other debris are also pulled down into the gravel. To remove increasing nitrate levels and particles in the gravel a small percentage of water (usually 10%) is replaced about once a week in smaller tanks. A water change also replaces essential trace elements that organisms have used.

## Ozone

Ozone, also referred to as "super charged oxygen," is a gas that most people have unknowingly come in contact with during and after an electrical storm. The pungent odor that lingers in the air following a lightning discharge is ozone gas. Chemically speaking, ozone is O<sub>3</sub>; three atoms of oxygen bonded together. To form ozone, a considerable amount of energy in the form of electricity or ultra-violet radiation from the sun must come in contact with O<sub>2</sub>. The energy causes O<sub>2</sub> to form a bond with another oxygen atom, forming O<sub>3</sub>. Ozone is very unstable and reacts readily with carbon compounds. Ozone disinfects water through oxidation. As ozone (O<sub>3</sub>) decomposes to O<sub>2</sub> a great deal of energy is released, breaking apart other chemical elements. By breaking the bonds which hold the elements of an organic compound together, ozone has the ability to destroy bacteria, fungi, viruses, and large organic molecules. Ozone has been used in this way for drinking water purification in Europe since 1907. Compared to chlorine, another oxidizing agent, ozone has several benefits. For example, it does not combine with organic compounds in the water to form toxic substances called chloramines. An ozone generator manufactures ozone by passing electricity through dry air. The ozone is pumped to a contact chamber. Because high concentrations of ozone are dangerous to all living things, water is passed through the contact chamber where it reacts with the ozone rather than adding the ozone to exhibits. As the water moves in one direction through a series of baffles the ozone is pumped in the opposite direction, setting up a counter-current exchange system, which allows for maximum concentration differences between organics and ozone. After five minutes, any ozone remaining in the chamber is vented to the outside through an ozone destruction unit where it is converted back to O<sub>2</sub>. Ozone can be dangerous to humans. In the event that a leak occurs in the pump room, a leak detector and

automatic shut-off have been incorporated into the system. The shut-off operates independently of the main computer in the pump room. If for any reason the computer malfunctions, the shut-off system would still be operational. Virtually all aquariums in this country, as well as many European and Japanese facilities, use ozone for water purification.

## Oxygenation

Oxygenation, a process whereby oxygen (O<sub>2</sub>) diffuses into water, occurs wherever water comes into contact with air. Carbon dioxide (CO<sub>2</sub>), a waste product of animal and plant metabolism, is given off at this time. This exchange occurs at many places: the surface of the tank, the bio-filter and the air bubble surfaces around air stones.

## Temperatures

The temperature in the Atlantic Coral Reef, Open Ocean, and Ray Tray are precisely regulated according to season. Chillers on each system keep the water from becoming too warm during the warmer months, while heaters (rarely used) can warm the water in the winter. Solid-state thermostats regulate each tank's temperature to a tenth of a degree while displaying it continuously on a monitor. Aquarists and laboratory technicians control the temperature, adjusting the settings on a monthly basis according to a yearly temperature schedule that closely replicates temperatures in the natural environment. The Rain Forest has both heating and cooling systems. During the summer, vents and air-conditioning are used to keep the temperature from getting too high. In winter, the Rain Forest is heated by an electric heating system, as well as through solar heating. Humidity must be kept high for optimum plant growth. This is accomplished with a mist system that simulates rainforest conditions.

## Light

A basic problem concerning light is providing a realistic day/night cycle for the animals. To reduce stress, most animals require an orderly alternation of dark and light, which gives them alternate periods of activity and rest. The Aquarium tries to approximate the animal's natural situation, whether the animals are nocturnal (night active) or diurnal (day active).

Also, the length of the light period (photoperiod) directly affects reproduction in many species where seasonal breeding occurs. This is particularly true for birds; the Aquarium cannot keep lights on in the Rain Forest at night during the winter evenings and

expect the birds to breed normally. Continuous long days cause the birds to breed themselves to exhaustion. Several exhibits have very low light intensity. One such exhibit is the octopus, which is usually nocturnal and would hide in brighter light. The light intensity in most exhibits is too low to support much plant growth. This is because the light intensity required to grow plants would be too bright in most instances for people viewing the exhibit as well as many of the animal specimens in the exhibits. Therefore, most of the large seaweeds and grasses on display are plastic replicas. There are diatoms (single-celled algae) which are adapted to low light intensities growing in the Atlantic Coral Reef and several other exhibits. These appear as brown "dust" covering rockwork and windows. These diatoms are not highly regarded dietary items and are scrubbed off of windows and rocks. Small filamentous algae have become established in several tanks. These are more desirable species and are allowed to remain in place. Many serve as natural food for some animals. The Tidal Marsh, Moving, Occupying, Shocking and Pacific Coral Reef exhibits have light levels bright enough to raise plants.

Perhaps the most interesting use of light is in the Pacific Coral Reef and Occupying exhibits (living coral). Here both the quality (wavelength) and quantity of light are sufficient to grow seaweeds and the tiny algae that live in coral cells. The cnidarians in this exhibit depend on these endosymbiotic algae for much of their nutrition. This exhibit is also programmed for a gradual "sunrise" and "sunset." All of these physical characteristics are monitored daily. The husbandry staff takes water samples and temperature readings. The samples are delivered to the water chemistry lab where they are analyzed by the laboratory technicians. The results are then forwarded to the husbandry staff concerned with each exhibit, as well as kept on file for future reference. Animals with health problems are reported immediately to the veterinarian.

### Animals from around the world

Providing clean water and appropriate environmental factors is only one step in establishing a successful aquarium. Designing tank decor, researching the organisms to find compatible tankmates, and determining diets, shelter and space requirements are also important considerations to ensure a successful aquarium exhibit.

The animals that make up the Aquarium's collection are acquired in a variety of ways. While members of the husbandry staff collect many of the animals, others are acquired from institutions or vendors from around the world. Other species are captive bred by NAIB or other aquarium colleagues. Fish for the Maryland: Mountains to the Sea gallery come from the Chesapeake Bay and

coastal waters. Sharks for the Open Ocean exhibit are collected off the coast of Lewes, Delaware, North Carolina, and Florida. They are collected by hook and line or long line (a cable about a quarter mile long with baited lines attached at intervals along the cable). Pacific tropical fish and invertebrates are purchased from wholesale fish vendors which are supplied by collectors in the Philippines, Hawaii, Singapore and other areas. Coldwater Pacific animals such as the giant Pacific octopus and Pacific Tidepool invertebrates are purchased from private collectors on the West Coast. The husbandry staff in Iceland collected the birds exhibited in the Sea Cliffs exhibit. Most of the original rainforest animals were acquired from the wild in Central and South America. Now, many of the frogs and lizards, as well as some of the birds, are captive bred at the Aquarium. To date, the Aquarium has successfully bred 24 species of poison dart frogs. The Aquarium has a fish breeding program. We are currently concentrating on seahorses and pipefish (11 species have bred). To date, NAIB has successfully bred over 20 species of fish for our exhibits and to supply other aquariums. In the future, we are hoping to develop a breeding plan to include other ornamental fish species. Neon gobies, a small blue fish you may see cleaning other fish in the Atlantic Coral Reef, are part of this program, as are high-hats, a small black and white striped fish also seen in the Atlantic Coral Reef.

## Care and Feeding

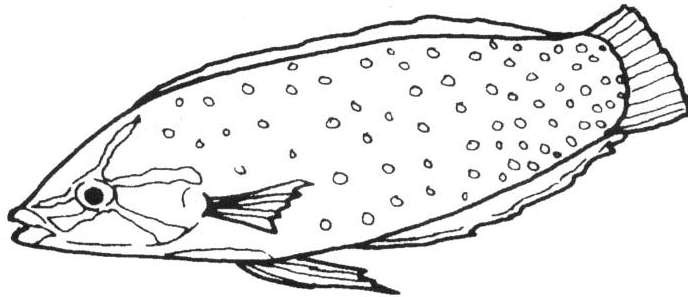
When an animal arrives at the Aquarium, it is the responsibility of the husbandry staff to provide everything it needs to stay alive and healthy. Marine and freshwater fish undergo a quarantine period before they are introduced into an exhibit. This period lasts for at least a month for marine fish and freshwater fish. During this time marine fish are treated with copper sulfate and other drugs to kill any parasites that might infect other exhibit fish. This treatment is not used on sharks and invertebrates because copper sulfate is toxic to these animals. Larger fishes, such as rays and sharks, are usually quarantined in several large tanks in the Aquarium's warehouse facility.

A proper diet is important. A wide variety of foods is prepared and served to the Aquarium animals, along with specialty foods such as flake, gel or plaster food. Most of the animals are fed frozen food (shrimp, squid, smelt, krill or clams) that is thawed before use. A few exceptions are the sharks which eat fresh fish bought at local markets 2-3 times a week and the rainforest animals which are served fresh fruit, live crickets, fruit flies, meal worms and wax worms. Herbivorous coral reef fish are fed by anchoring

clumps of lettuce, broccoli and other greens on the tank bottom. Seahorses and many of our invertebrates eat live brine shrimp. In addition, some animals receive daily vitamins or medication.

Once a week, water samples are taken by the husbandry staff and tested for a number of parameters, including ammonia, nitrite and nitrate levels, pH and salinity. The Open Ocean, Wings in the Water, Atlantic Coral Reef and Marine Mammal exhibits are monitored daily. These tests are extremely important in detecting a potential medical problem before any observable symptoms present themselves.

The medical staff conducts physical examinations on the dolphins at least four times a year. During a physical, animals are weighed, blood samples are taken and their eyes and mouths are checked. All sharks, rays and turtles are given physicals once a year to two-years.



## An Aquarist's Day

Have you ever wondered what it is like to work as an aquarist at the Aquarium? Let's follow the aquarist who is responsible for the Maryland: Mountains to the Sea exhibit, comprised of the Allegheny Stream, Tidal Marsh, Coastal Beach, and Atlantic Shelf, as well as 15 back-up tanks to see what a typical aquarist's day is like.

Arrival time is 7:30 a.m. An automatic timer turns on the lights in his gallery, he checks the tanks to make sure the pumps are working, looks for signs of medical problems and checks water temperatures. The bullfrogs in the Allegheny Stream exhibit are fed live crickets and the fish in the Allegheny Stream, Tidal Marsh, and back-up tanks are fed flake food before he heads for the food prep room. Here he takes food from the freezer to thaw if it was not done the night before. He checks the bulletin board to see if she has to take care of a gallery for an aquarist who is off that day.

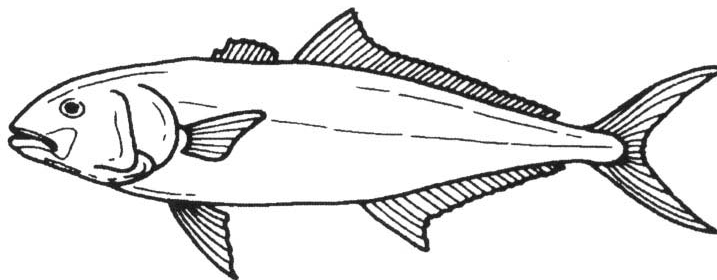
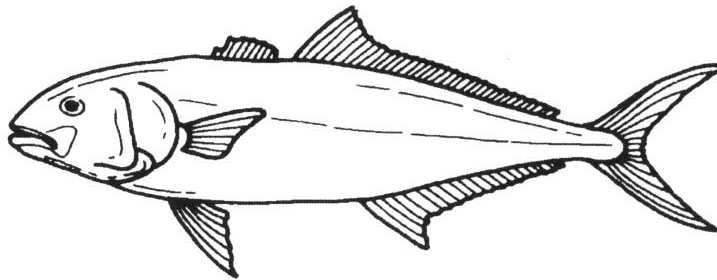
Upon returning to his gallery, the daily routine of tank maintenance begins. This may include: watering plants in the Tidal Marsh and Allegheny Stream and cleaning the glass in all the exhibits. Once a week, water changes and hydrocleaning (each tank is vacuumed with a siphon to remove particles) of the sand or gravel in all exhibits and back-up tanks. Once a week the sand filters on the exhibit tanks are backwashed (this cleans out the filters). Animals that require live food are fed at this time, and any necessary medical procedures are completed.

When the routine maintenance is completed, he returns to the food prep room to prepare the cut-mix of fish and shrimp for the afternoon feeding. If he is covering for another aquarist he goes through a similar routine in another gallery.

The afternoon is spent taking care of remaining husbandry tasks and paperwork: daily logs, correspondence records, and organizing back-up areas. Animal records and inventories are monitored through a specially designed computer program which is updated daily. Any spare time is spent reading research articles to keep up with advances in husbandry science, fixing equipment in need of repair, assisting co-workers with projects, and responding to the needs of other departments. Also, each aquarist needs to review their water quality data to make any necessary adjustments.

One of the last jobs of the day is feeding the prepared cut-mix to the animals in the exhibits and back-up tanks. New animals or animals with special dietary needs, such as the turtles, are fed individually. At 4:00 p.m., if all work has been completed, the scheduled day is over; although animal shipments, medical emergencies, or special events may keep him at the Aquarium after hours.

The Maryland aquarist is also responsible for collecting and stocking all the plants and fishes for the exhibits in his gallery. In a typical year he organizes and participates in seining, plant collecting and a trip to a pound netter.



## A few reminders for your tour:

- Wear comfortable clothes and non-slip shoes; shoes must have a strap on the heel (i.e. flip flops are not acceptable). Behind the scenes work areas can be wet, slippery places.
- Please leave your chewing gum at home. If it should fall into a tank it could be hazardous to the health of our collection.
- Some of our animals are sensitive to bright light. Please refrain from taking flash pictures of the octopus.
- Please notify us ahead of time if you have any special needs so that we can make appropriate arrangements. Back-up areas cannot accommodate wheelchairs or walkers.

## Resources

The National Aquarium in Baltimore website

<http://www.aqua.org>

FishBase is a relational database with information to cater to different professionals such as research scientists, fisheries managers, zoologists, educators and many more. FishBase contains practically all fish species known to science.

<http://www.fishbase.org>

A comprehensive guide to the identification and care of tropical marine animals

Delbeek, J.C. and J. Spring  
*The Reef Aquarium*, vols 1-2  
Coconut Grove, FL: Ricordea  
Publishing. 1994.

## Other Aquatic Facilities:

John G. Shedd Aquarium  
1200 S. Lake Shore Drive  
Chicago, IL 60605  
<http://www.sheddnet.org>

New England Aquarium  
Central Wharf  
Boston, MA 02220-3309  
<http://www.neaq.org>

Monterey Bay Aquarium  
886 Cannery Row  
Monterey, CA 93940  
<http://www.mbay.org>

The Florida Aquarium  
701 Channelside Drive  
Tampa, FL 33602  
<http://www.flaquarium.org>

Mystic Marinelife Aquarium  
55 Coogan Boulevard  
Mystic, CT 06355-1997  
<http://www.mysticaquarium.org>

The Tennessee Aquarium  
One Broad Street  
Chattanooga, TN 37401  
<http://www.tennis.org>

# Activity 1 - Setting up a Freshwater Aquarium

## Description

In this activity, students will set up a freshwater aquarium in your classroom, research procedures for set-up, and keep a log of your progress. Record: what items are required, how long it takes to set-up the system and for the aquarium to become established, how many and what kind of animals are appropriate for your aquarium, expenses, etc. How will you decorate the tank (with live or artificial material)? If you use live plants, what effect do they have on the system?

## Procedure

1. Several weeks before your Aquarium trip, brainstorm with your students about what you will need to set up a freshwater aquarium. Research which species would do best in a freshwater tank. Consider the size of the tank. How many fish can your tank support? Almost any size tank up to 55 gallons is fairly basic to care for.
  - \* Generally, a 20 gallon would be sufficient for a classroom setting. The overall recommendation is to have 1 inch of fish per gallon of water. This means 1 inch when the fish is full grown, not when you first put them in. (ex. If the fish reach a full grown length of 2 in., 10 would be the capacity for a 20 gallon tank).
2. Have students research the fish, filtration, décor, and food needs of the tank.
  - \* One way to set up the filtration would be to get an undergravel filter with either an air pump or a powerhead to run it. This would sit on the top of the uplift tube to draw the water through the gravel so the bacteria can clean it. You can also get a small mechanical filter; this could hang on the back of the tank to remove large debris and you can also put carbon in them which improves water quality. The tank should have a top and light on it. Pet stores sell glass or plastic tank covers and either will do. The light cycle should only be about 8-10 hours a day; a timer would assist in regulating this. It is a good idea to make sure that the tank is not set up in direct sunlight; this would cause tremendous amounts of algae to grow.
3. Once the tank is set up with water and filtration, the nitrogen cycle must occur before fish are added (Activity 2: Step A). This ensures that the "good" bacteria are in place to break down the ammonia excreted by the fish.
4. Make sure the students monitor the aquarium daily for: water temperature, pH, nitrates, and ammonia.

Test kits may be purchased at a local pet store or ordered from:

Carolina Biological Supply Co.

2700 York Road

Burlington, NC 27215

<http://www.carolina.com>

5. Using the log sheet that is attached; have students keep daily records of the tank.
6. Once your students visit the Aquarium they will have a better understanding of the husbandry and details of aquarium care. They will be able to return to the classroom and put the fish into the tank, perform routine maintenance, feeding and keep a long term log book.

## Activity 2: Step A - Becoming an Aquarist

### Description

Having had an opportunity to experience first hand all of the "ins and outs" of what goes on at the Aquarium, students put their knowledge to the test. With your classroom tank set up and established, it is time for your students to become aquarists. First, have your students read over the attached paragraph about a NAIB's aquarist's day. They will now be able to make educated decisions about which fish they are going to put into the tank, what to feed the fish, and how to maintain a healthy aquarium.

### Procedure

1. Photocopy and distribute "An Aquarist's Day" to your students to read.
2. Once the fish are purchased, make sure to slowly acclimate them to their new home.
  - \* As a general recommendation, basic tropical freshwater fish can be purchased from a pet store. Fish such as Oscars and Cichlids get too large and usually eat live food, so these would not work as well. So, basic fish would include, but are not limited to, mollies, swordtails, platys, tetras, algae eaters, and a few small catfish. With these types of fish you would probably want about 13-15 fish total for a twenty gallon tank.
3. Using the tank label that is included, fill in all the necessary information and attach the label to the tank. This label will ensure that all the students know what the temperature range should be, what to feed, etc.
4. Continue to feed daily and check the water chemistry weekly. Perform water changes every 2-4 weeks and scrub algae weekly. Have your students record data on the Fish Tank log.
5. Research and be aware of several common fish diseases. Some include ich, fungus, and bacterial infections. Easy to use medications are sold in pet stores to treat the diseases. Most likely, however, fish diseases stem from a poor water quality issue. Most parasites and fungus are in the water normally. It just takes the fish being stressed out to allow the "bad bug" to infest the fish and make it sick.
6. After one month have the students graph the daily water chemistry levels with the dates they were taken.
7. If mortalities occurred, does your data offer any explanation; for example if a fish died around the time that ammonia levels were high. Explain these trends.

## Activity 2: Step B - Views on Zoos and Aquaria

### Description

Zoos and aquaria are among the most popular attractions for visitors around the world. The National Aquarium in Baltimore has over 1.5 million visitors a year. Many people would argue that zoos and aquaria are important to bringing people closer to animals and ultimately changing people's attitudes and behavior towards the environment. Others would argue that displaying wild animals is a form of confinement and that the animals would be better off left in their natural environment.

The purpose of this activity to have students research and discuss the range of opinion on the issue of the role of zoos and aquaria in society, and to analyze that opinion against scientific data.

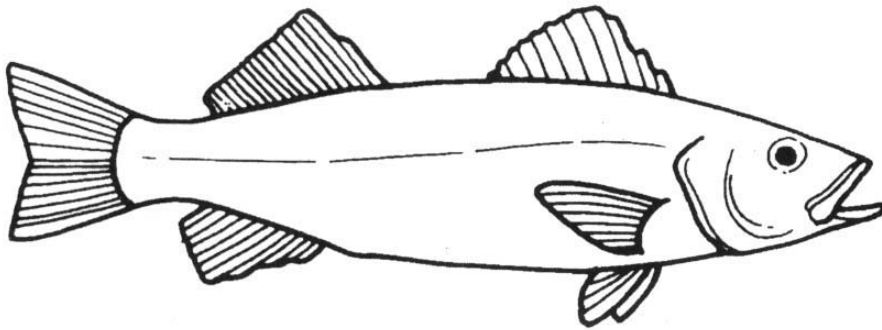
### Procedure

1. Discuss with your class their opinions about animals in captivity, particularly their experiences at the National Aquarium in Baltimore.
2. Research environmental and conservation organizations that have published views on this topic. The following organization's web sites might be useful. These are just a few examples, many others exist.

American Zoo and Aquarium Association  
People for the Ethical Treatment of Animals  
American Humane Society  
Human Society of the United States  
National Wildlife Federation  
National Marine Fisheries Service

3. Write a brief summary statement of four to five organization's views toward the role of zoos and aquaria.
4. On the board, draw a horizontal line. Discuss with your students which two organizations represent the most opposing views. Write the organizations' names on either end of the line.
5. Discuss the placement of the other organizations along the continuum. Place those organizations on the line.
6. Discuss:
  - a. Are there any points of view that some or all the organizations agree on? Describe them.
  - b. Are there any points of view that some or all the organizations differ on? Describe them.

- c . Describe why it might be good for the environment to have widely divergent opinion.
  - d. Describe why it might not be good for the environment to have widely divergent opinion.
7. Review each organization's summary statements the student wrote earlier. Compare those statements with information you research from a neutral source (government agency or academic institution) and analyze that statement based on:
- \* most of the scientific community would accept it as factual
  - \* some of the scientific community would accept it as factual
  - \* none of the scientific community would accept it as factual
8. Return to the continuum above. How are the views of the opposing organizations similar or different when compared to the scientific community? Is their room for compromise? Why or why not?







|  |  |                 |
|--|--|-----------------|
| <b>TANK #:</b>                           |  | <b>Class:</b>   |
|  |  |                 |
| <b>Common Name(s):</b>                   |  |                 |
|  |  |                 |
| <b>Scientific Name(s):</b>               |  |                 |
|  |  |                 |
| <b>Water Quality</b>                     |  |                 |
| <b>Target Temp (°F):</b>                 |  | <b>Feeding:</b> |
| <b>Temp. Range:</b>                      |  |                 |
| <b>Salinity Range:</b>                   |  |                 |
| <b>pH Range:</b>                         |  |                 |
| <b>NH<sub>3</sub> Tolerance:</b>         |  |                 |
| <b>NO<sub>2</sub> Tolerance:</b>         |  |                 |
| <b>Special Treatments/ Instructions:</b> |  |                 |
|  |  |                 |
| <b>Date started:</b>                     |  |                 |
|  |  |                 |

