Student Activity Guide
Grades 9 - 12

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Table of Contents

Planning Your Field Trip to the Aquarium 1

Teacher Background 2

Resources 7

Activity 1 - Dolphin Training Game 8

Activity 2 - Animal Behavior Lab 12
Student Activity Guide
Student activities for a field trip to the National Aquarium in Baltimore

Description
This Activity Guide provides you with:

- Suggestions for pre and post visit activities that meet current Maryland Voluntary Curriculum Standards.
- Activities for your students and chaperones to do during their Aquarium field trip.

Download the companion Teacher's Curriculum Guide to the National Aquarium in Baltimore (www.aqua.org) for detailed descriptions of the major exhibits with links to the Maryland Voluntary State Curriculum.

Planning for the Field Trip
This Activity Guide is designed for 9th through 12th grade students, and fits into a unit on the diversity of life, evolution, and/or ecology.

Day 1
Complete Activity 1 - Dolphin Training Game. Your students will read Animal Training and Behavior and complete the reading questions. Make as many copies of the student reading as you need.

Day 2
During your field trip to the National Aquarium in Baltimore, attend one of the narrated dolphin presentations. Ask your students to pay attention to or record:
- The kinds of reinforcement the dolphins received.
- The number and descriptions of different behaviors the dolphins performed.
- The type of bridging stimulus the dolphin trainers used.
Note: If you don’t want to get wet, be aware that the first few rows of the Amphitheater are in the Splash Zone.

Day 3
As a follow-up, complete Activity 2 - Animal Behavior Lab.

AAAS Benchmarks
5F-9-12#4
Heritable characteristics strongly influence what capabilities an organism will have and how it will react and survive.

MD Core Learning Goals
SKILLS AND PROCESSES:
1.2 The student will pose scientific questions and suggest investigative approaches to provide answers to questions.

CONCEPTS OF BIOLOGY
3.5 The student will investigate the interdependence of diverse living organisms and their interactions with the components of the biosphere.
Teacher Background

Animal behavior
Marine mammals like seals, sea lions, whales, and dolphins have a number of interesting natural behaviors and skills that spark curiosity in people. Dolphins, like all animals, develop behaviors for three main reasons: 1) to find something to eat, 2) to avoid being eaten by predators, and 3) to reproduce. A behavior is defined as any action that is in response to an outside stimulus. For example, some birds migrate in response to the change of seasons and cold weather. Migration is an example of animal behavior.

How does an animal know to behave in a certain way? Instincts are behaviors an animal is born with. When a baby dolphin is born, it instinctively knows to swim to the surface for its first breath of air. Other animal behaviors are learned. Learned behaviors are behaviors the animal acquires through experience. For example, your dog may learn to avoid getting too close to a porcupine after getting a nose full of quills the first time.

One way animals learn new behavior is through mimicry. Young female dolphins, for example, learn parenting behaviors by mimicking or imitating their mothers or other females rearing young.

Play is another important way animals learn new behaviors. Some animals learn hunting or defensive behaviors through playing with siblings. Even in humans, play is an important aspect of learning. Toddlers learn hand-eye coordination by rolling a ball to a parent, for example. Also, teachers often use games to teach children new skills.

One common mistake when talking about animal behavior is to attribute human motivations to animals. Attributing human characteristics to animals is called anthropomorphizing. For example, an animal may show a preference for one food over another. This does not mean the animal "likes" that choice. Liking or disliking something is a human quality. Animals are certainly capable of choosing one item over another. So instead of saying the animal "likes" to do (whatever), we say the animal "frequently does" (whatever).

Animal training
People have been training animals for thousands of years. Humans have trained dogs to herd livestock, to guide and rescue people, and to locate drugs and bombs. Horses are trained to pull wagons. Animals are still trained today to do many different tasks. Training marine mammals, however, is relatively new. There is still much to learn from working
Teacher Background (continued)

with and observing dolphins and other marine mammals.

At the National Aquarium in Baltimore, we train the Atlantic Bottlenose Dolphins and other animals in our care for two important reasons. The first is to assist the trainers in the care and feeding of the animals. For example, the Golden-Lion Tamarins in the Tropical Rainforest exhibit are trained to provide urine samples on cue. Veterinarians test the samples to monitor the animal's health. Also the dolphins are trained to assume specific positions during medical examinations. Because of the training the animals receive, routine medical and animal care procedures are easier and safer for the animal and the trainer.

The second reason we train animals is for education purposes. The goal is to educate people about animal behavior in a way that fosters a closer connection with all animals. We feel this connection leads to a desire to protect and conserve the habitats upon which these animals depend.

Communicating with dolphins
How do you tell an animal what to do when they cannot understand what you are saying? And, how do we let the animal know it has done what we asked it to do? Animal trainers communicate with their animals by using reinforcers.

A reinforcer is anything that increases the frequency, intensity, or duration of a particular behavior. For the dolphins, reinforcers can be fish (a dolphin at the Aquarium can eat up to 25 pounds per day), toys, rubdowns or other touch, swimming with a trainer, or even learning a new behavior. The animal knows it has performed the desired behavior when it receives reinforcement. By carefully observing the frequency of the behavior after we apply a reinforcer, dolphin trainers can identify which types of reinforcers work best for that animal.

How does the trainer provide immediate feedback to the dolphin from far away on the other side of the pool? Trainers use what is called a bridging stimulus (bridge for short). A bridge is a stimulus (either a whistle, a clicker, or a verbal stimulus such as "good") that the trainer uses to communicate the precise moment an animal does something correctly. Remember, a delay of just a few seconds could result in reinforcing the wrong behavior. The shortened word "bridge" is used because it describes the time gap between when the behavior was completed and the reinforcer applied. Trainers usually use a whistle with dolphins because it sounds the same above and below water. Other bridging stimuli that are used include a point at the animal, a pat on the animal, or a tap on the surface of the glass or water.
Teacher Background (continued)

Each of these bridging stimuli tell the dolphin that it is correct, the behavior is over, and it can now receive some kind of reinforcement from the trainer. This is an example of classical conditioning. In classical conditioning, two stimuli are paired together. In this case, the dolphins learn to associate two unrelated stimuli—the sound of the whistle with food. The result is that after numerous trials the animal learns a whistle means it has done something correctly and that it can expect a reinforcer of some sort.

Training new behaviors
How do we train a dolphin to do a new behavior? The dolphin trainer uses a training tool, or a target, to teach a dolphin a new behavior. The target is usually either a trainer’s hand or a small ball at the end of a pole. The target pole acts as an extension of the trainer’s hand.

The trainer starts by gently touching the target to the dolphin’s rostrum or beak. The trainer sounds the bridge and reinforces the animals. This is repeated many times. Next the target is moved several inches from the dolphin. The trainer waits until the dolphin touches the target. The dolphin has learned by now that touching the target will result in reinforcement. The trainer can move the target up, down, left or right, forward, backward, etc. Each time the animal touches the target, the bridging stimulus is given to reinforce the animal’s “correct” behavior.

It may take months or even years to train a new behavior. Training new behaviors takes place through operant conditioning. Operant conditioning is based on the assumption that behaviors are determined by their consequences. Behaviors that receive positive consequences (positive reinforcement) will increase, while behaviors that receive negative consequences will decrease. Also, behaviors that receive no consequences will eventually fade away or stop.
Teacher Background (continued)

Classroom teachers often use operant conditioning as a classroom management tool. Teachers award "gold" stars or other rewards to reinforce a student's positive behavior, while not drawing attention to a student's undesired behavior.

Animals make mistakes from time to time. If an animal refuses a behavior or does it incorrectly, the trainer will simply do nothing to draw attention to the behavior. This 3-4 second neutral pause is called a Least Reinforcing Stimulus, or LRS. By keeping with the philosophy of reinforcing correct behavior and ignoring incorrect behavior, trainers are able to work with the animals in a positive manner. At the National Aquarium in Baltimore, we use only positive reinforcement with all of our animals.

Putting it all together
Let's see how we might train a dolphin to do a high jump: first we reinforce it for touching a target (a bright red ball held in the trainer’s hand. By now the dolphin knows that it will receive reinforcement each time it touches the target. Next, a red ball is lowered from the ceiling to the surface of the water. The dolphin is reinforced for touching it. Then we raise the target a few inches above the water and reinforce the dolphin for touching it again. The training continues in small steps called approximations. With each small step, the target is raised higher and higher. We continue to raise the target until it is at high jump level - as much as 24 feet above the surface of the water!

Finally, the animal needs to learn a specific signal to do the high jump. The signal is conditioned through a combination of classical and operant procedures. A dolphin may be asked to perform many different behaviors. The trainer uses a specific signal for each behavior. The dolphin learns to distinguish between signals to determine which behavior the trainer expects.

While viewing a training session in the amphitheater, ask your students to look for:
1. How the dolphin trainers reinforce the animals.
2. The types of signals the trainers use.
3. How the dolphins respond to those signals.
Glossary

*Anthropomorphizing* - Attributing human characteristics or qualities to animals.

*Approximations* - The small steps an animal learns as part of training complex behaviors.

*Behavior* - Any action that is in response to some stimulus.

*Bridging stimulus* - A whistle, clicker or a verbal stimulus such as "good" that the trainer uses to communicate the precise moment an animal does something correctly. The shortened word "bridge" is used because it describes the time gap between when the behavior is completed and the reinforcer is applied.

*Classical conditioning* - When two stimuli - like a whistle and food - are paired together to provide reinforcement.

*Least Reinforcing Stimulus (LRS)* - A 3 to 4 second pause where the trainer does not acknowledge the animal in response to the animal not doing a behavior or doing a behavior incorrectly.

*Operant conditioning* - A method of training based on the assumption that behaviors are determined by their consequences. The frequency of behaviors that receive positive consequences (positive reinforcement) will increase, while behaviors that receive negative consequences (negative reinforcement) will decrease.

*Reinforcer* - Anything that increases the frequency, intensity, or duration of a particular behavior.

*Target* - A training tool used by a trainer to teach an animal a new behavior. The target is usually either a trainer's hand or a small ball at the end of a pole. The pole acts as an extension of the trainer's hand.
Resources

National Aquarium in Baltimore
Learn more about dolphins and find out how we care for the animals at the Aquarium.

National Aquarium in Baltimore
www.aqua.org

Sniffy the Virtual Rat
Sniffy the Virtual Rat, is a fun, interactive software program that gives students a virtual laboratory experience . . . without all the drawbacks of using a real laboratory rat. Using Sniffy, students can explore operant and classical conditioning by performing experiments that demonstrate most of the major conditioning phenomena discussed in textbooks on the psychology of learning.

Sniffy the Virtual Rat
www.wadsworth.com/psychology_d/special_features/sniffy.html

Careers in Animal Behavior
The Center for Integrative Animal Behavior at Indiana University provides information about careers in animal behavior including what education and training is needed and career opportunities with government agencies, zoos and aquaria, and other institutions.

Center for Integrative Animal Behavior
http://www.indiana.edu/~animal/help/careers.html
Teacher Page

Activity 1 - Dolphin Training Game

Description
Students take on the roles of "trainer" and "dolphin." Using the tools and steps outlined below, the "dolphin" will be trained to do a simple behavior (for example, stand on one foot).

Procedure
1. Ask students to read Animal Behavior and Training. Review with the students the steps and tools used in training behaviors in animals. Select one student to be the "trainer" and another to be the "dolphin."

2. Determine an appropriate reinforcer (applause, verbal encouragement, etc.). Ask the "dolphin" student volunteer to leave the room.

3. As a group, discuss a simple behavior to train the "dolphin" to do. For example, stand on one foot, turn around, raise a hand, etc. Keep the behavior simple.

4. Bring the student "dolphin" back into the room. Ask him/her to act naturally by walking around the room. The "dolphin" has to keep moving. The "trainer" will reinforce the "dolphin" anytime s/he comes close to the desired behavior. Constant progress, even if only inch by inch, will get you to your goal faster.

5. After each reinforcement is given, the "dolphin" must go back to where it entered the room and start over. (This helps curb the tendency of some "dolphins" to stop and freeze after the reinforcement is received). After a few reinforcements you can skip this, if you wish. Ignore behaviors that are incorrect. Remember, the "trainer" needs to be consistent.

6. The audience gains much from watching the process, but they cannot talk, give instructions, etc. The "trainer" and the "dolphin" do not speak the same language, so no talking or giving hints.

7. Stop the activity when the "dolphin" has done the correct behavior.

More Training Suggestions
1. Don't try to train two or more complex behaviors at the same time. Keep it simple.

2. The "trainer" needs to stay ahead of the "dolphin." Plan out the sequence of behaviors you want to reinforce.

3. At some point, the "dolphin" may suddenly realize the point of what it's being asked to do, and go and do it. If so, it's common to reinforce the animal's behavior with what is called a jackpot reinforcer. For example, provide a larger than normal reinforcer.
Activity 1 - Dolphin Training Game

Directions to Students
Read the following article about animal behavior and training. Then answer the questions on page 11.

Animal Behavior and Training

Animal behavior

People are naturally curious about dolphins and their behavior. Dolphins, like all animals, develop behaviors for three main reasons: 1) to find something to eat, 2) to avoid being eaten by predators, and 3) to reproduce.

Some animals are born with certain behaviors that help them survive. Other behaviors are learned. Play is an important aspect of learning new behaviors in animals. For example, some young animals learn hunting skills by playing with siblings. Can you think of some animals that learn by playing?

Animal training

From the earliest civilizations to today, people have been training animals to do many things. Dogs are trained to guide and rescue people, for example. You may have even trained a pet at home.

Some of the animals at the National Aquarium in Baltimore receive special training so we can take care of them better. For example, the dolphins are trained to be still when the Aquarium veterinarians examine them. Because of the training the animals receive, routine medical and animal care procedures are easier and safer for both the animal and the trainer.

We also train animals to help people learn more about them. By viewing a training session, the visitor is drawn closer to the dolphins by learning about their natural behaviors.

Communicating with dolphins

How does the trainer tell a dolphin what to do? The trainer communicates with the animal by using reinforcers. A reinforcer is anything that increases the frequency, intensity, or duration of a
Activity 1 - Dolphin Training Game

Animal Training and Behavior (cont.)

particular behavior. For the dolphins, reinforcers can be fish, toys, rubdowns or other kinds of touch. By correctly using reinforcement, dolphins can be trained to do many behaviors.

How does the animal know it has correctly done what you asked? Trainers use what is called a bridging stimulus (bridge for short). A bridge is a stimulus (either a whistle, clicker, or a verbal stimulus such as "good") that the trainer uses to communicate the precise moment an animal does something correctly. When the dolphin hears the whistle, it knows it has done the behavior correctly, the behavior is over, and it will now receive some kind of reinforcement from the trainer.

Animals make mistakes from time to time. If an animal refuses a behavior or does it incorrectly, the trainer will simply do nothing to draw attention to the behavior. This 3-4 second neutral pause is called a Least Reinforcing Stimulus, or LRS.

Putting it all together

How might we train a dolphin to do a high jump?

- First we reinforce the dolphin for touching a target (a bright red ball) held in the trainer’s hand. This is repeated many times.

- A red ball is lowered from the ceiling to the surface of the water. By now the dolphin has learned that touching the target will result in reinforcement.

- We raise the target a few inches above the water and reinforce the dolphin for touching it again. The training continues to take place in small steps called approximations. With each small step, the target is raised a little higher.

- Eventually the dolphin brings its entire body out of the water. We continue to raise the target until it is at high jump level - 24 feet above the surface of the water!
Activity 1 - Reading Questions

Directions to Students
Complete the questions based on the *Animal Training and Behavior* article you just read.

1. What is a reinforcer?

2. Why is a whistle referred to as a bridge?

3. Why are targets used?

4. What does the trainer do if the dolphin performs an incorrect behavior? Why?
Activity 2 - Animal Behavior Lab

Description
Students perform a simple animal behavior experiment to determine how flatworms (planaria) respond to light and dark stimuli.

Procedure
1. Cut out a circle of white paper the same diameter as a petri dish. On each circle, color one half with black magic marker or black pen like the example to the right. Tape the circle to the bottom of the petri dish.

2. Carefully add enough spring water or aged tap water to fill the petri dish about halfway.

3. Use an eyedropper to put 10 planaria into the dish (5 on light side and 5 on dark side).

4. After 30 seconds count the number of planaria on each side. Students record the number on a data sheet they design.

5. Continue counting every 30 seconds until the planaria are not demonstrating any significant change in location, or it is time to stop.

Preparation
Planaria
Planaria can be collected from a local pond, or can be purchased from biological supply companies, like Carolina Biological. Keep planaria in spring water or aged tap water. Feed them every couple of days - a small amount of canned cat food is good - but change the water immediately after feeding. You will need 10 planaria/team of students.

Materials
- Stopwatch or wristwatch
- Scissors
- Masking tape
- White paper
- Black magic marker or pen
- 50-mm petri dishes (1 per team)
- Eye dropper or pipette
Activity 2 - Animal Behavior Lab

Description
Students work in small groups to perform a simple animal behavior experiment. Students investigate how flatworms (planaria) respond to light and dark. Students record and graph their data. At the end, students discuss their results with the class.

Introduction
Scientists have investigated why and how animals move from place to place for many years. How are birds able to find their way when they migrate hundreds or thousands of miles? How are honeybees able to communicate to the other workers in the hive how to find a particular flower full of nectar? These are just some of the questions scientists are trying to understand about animal behavior.

Ethology
Some animal behaviors are learned over time, and others are innate from birth. Ethology is the study of innate behaviors, or instincts, in animals. For example, ethologists have discovered that honeybees "dance" in a particular way to communicate to the other worker bees the location, distance, and abundance of nectar-producing flowers. If the feeding place is directly away from the sun, they will dance down the hive. If it is towards the sun, they will dance up. To communicate the distance to the flower the bees wiggle their bodies – few wiggles and the flowers are close by. The more wiggles the further away the flowers are. If the flowers are nectar-rich, the wiggling becomes really frantic.

The Experiment
In this laboratory exercise you will work in teams to investigate orientation behavior in flatworms (called planaria). This lab will also help you understand the scientific method by giving you first-hand experience with conducting and interpreting a study involving animal behavior.

Planaria are common freshwater flatworms usually found under rocks in streams and ponds. They glide about using cilia located on the underside of their body. The two "eye" spots near the front end are groups of pigmented photosensitive cells that allow the planaria to sense light levels in its environment.
Activity 2 - Animal Behavior Lab

Procedure
1. Cut out a circle from white paper the same diameter as a petri dish. On each circle, color ½ of it with black magic marker or black pen like the example to the right. Tape one circle to the bottom of each petri dish.

2. Carefully add enough spring water or aged tap water to fill the petri dish about halfway.

3. Use an eyedropper to put 10 planaria into the dish (5 on the light-colored side and 5 on the dark-colored side).

4. After 30 seconds, count the number of planaria on each side. Record the numbers on a data sheet that you design.

5. Repeat the count every 30 seconds until the planaria are not demonstrating any significant change in location, or your instructor tells you it is time to stop.

Data Analysis
1. Determine the best way to graph the data on your chart.

2. Create a graph of your data. Be sure to label the x and y axis, provide a title and a key. Draw your graph in the space below.
Activity 2 - Animal Behavior Lab

Conclusions

1. Based on your data, what behavior did you observe the planaria doing?

2. What was the stimulus the planaria were responding to?

3. How might the observed response help planaria survive?