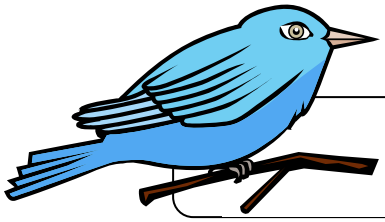

Bats 'N Boas Abound

Summary:
By studying and creatively responding to facts, building a cave habitat and displaying and acting out a "predator/prey" scene, students will learn about Puerto Rican Boas and Bats, and how they survive in their environment.

Background Information:
Deep in the dark caves of Puerto Rico's lush rain forest, in an eerie nocturnal world, hundreds of boa constrictors lay waiting on woody vines for their prey…hundreds of thousands of bats which fly directly into the jaws of the snakes. Even now, researchers are working in these caves to discover the behavioral mysteries of the boas and the bats.

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THE PLAYERS

Bats are the only mammal that can actually fly. Some bats can fly up to forty miles an hour. There are more then nine hundred types of bats. Some bats have a wing span up to six feet. The structure of the open wing is very similar to an outspread human hand, covered in a membrane. Though most bats are insectivorous, many (such as those in the tropics) have developed the ability to feed on fish or fruits and their juices. Bats sleep during the day, and fly, hunt, and feed at night.

Bats are very beneficial to their ecosystem. Some feed on harmful insects. Other species are important pollinators of some tropical flowers. Indeed, many tropical plants are totally dependent on them, not just as pollinators, but also because they eat their fruits and spread their seeds.

Bats will often form nursery roosts, with many females giving birth in the same area. A newborn bat can cling to the fur of the mother and be transported while she hunts. Two mammary glands are situated between the chest and the shoulders. Only the mother cares for the young, and there is no continuous partnership. Bats vary in social structure, with some bats leading a solitary life with others living in caves colonized by more than a million bats.

Grade Level: 3/4 grade

Goal:
Students acquaint themselves with Puerto Rican boas and bats and learn how they interact within their shared habitat.

Key Concepts:
Cave habitat, Survival techniques, Mammal, Reptile, Pollinators, Food Chain, Predator, Prey

Objectives:
Upon completion of this lesson, students will:

1) Describe a Puerto Rican Boa and a Bat and give details about their life and behavior. They will mention how each positively contributes to its environment.

2) Describe a cave environment, which is a bat's habitat.

3) Understand how boas and bats are part of the same food chain in the rainforest.

Teaching Location:
Classroom, large open space (preferable outdoors)

Lesson Time:
Four sessions of 50 mins. each: intro & diorama set-up on Day 1, finish diorama on Day 2, poetry project on Day 3, Conclusion activities on Day 4.

Subject Areas for Infusion:
Environ. Ed, Science, Language Arts, Art, Phy. Ed.

Standards:

Science:
- E.4.1
- F.4.1
- F.4.2
- F.4.3
- F.4.4.

Environ. Ed.
- B.4.4
- B.4.6

Most bats look for dark places to roost. Hollow trees are popular roosting sites. Many rainforest trees become hollow soon after reaching maturity. This may be an ecological strategy to attract bat colonies that will deposit large quantities of guano (bat poop) inside the base of the tree where it will serve as fertilizer. Caves are a very typical roosting site as well.

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The **Puerto Rican Boa** is a slender, terrestrial snake with a dark brown color. It grows up to be over 6 feet long. It feeds on small mammals, birds and lizards. It is currently on the endangered species list. It lives only in Puerto Rico, and is most common on the Karst region, which is at the northwestern tip. The boa feeds by seizing the prey in its jaws, wrapping several coils around the victim, and then constricting (squeezing) until the prey has suffocated. The prey is then swallowed head first. A Boa can't move very fast-- only about 1 mile per hour on open ground. But since they don't have to chase their food, they don't need to travel quickly.
Boas do not lay eggs. Instead, they give birth to live young, about 23-26 at a time. As they develop in their mother's body, they are kept at a fairly constant temperature and are protected from predators. When the young are ready to be born, they are on their own to start protecting themselves (usually by hiding at first) and to find food. Most are smaller versions of adults and instinctively know how to survive on their own.

In general, boas are found in a variety of habitats. The ones that live in forests blend into the leaf litter on the ground to stay hidden. Since the Karst region in which the Puerto Rican Boa lives usually has many caves, the Boa has the opportunity to feed on bats. The boas hang at the opening of the cave and waited until the bats flew out of it. Then they capture it with its jaws and take the victim to the ground to kill it by constriction. The Puerto Rican Boa is the only known boa that captures bats in mid-flight.

Historic records, some dating back to the 1700s, indicate that during the first few centuries of Spanish colonization, the boa was relatively abundant, and oil produced from the snake's fat was widely exported. Soon after came a reduction of its habitat due to deforestation of the island. This certainly seems to be the trend with many Puerto Rican native animal species.

Materials:
- Images of Puerto Rican bats and boas, to pass around
- One large shoebox per student pair
- Black and green construction paper
- Glue
- Pointed-tip scissors
- One plastic cup per student pair
- 3 6-inch pieces of yarn per student pair

- Metal pan
- Epsom salts
- Colored dye (black, brown color—can mix all colors together)
- Spoon
- Paper towel or toilet paper tubes, thick straws
- Note cards
- Hot glue gun (optional)
- Gummy worms (optional)

Vocabulary

Mammal: any kind of vertebrate that nourishes their young with milk from mammary glands and has skin with some hair

Reptile: any kind of cold-blooded air-breathing vertebrate that usually lays eggs and has scaly skin

Pollinate: to place pollen on the stigma of a flower so the plant can reproduce

Guano: bodily waste matter of bats

Stalagmite: a column of calcium carbonate in a cave formed on the floor

Stalactite: an "icicle" of calcium carbonate hanging from the ceiling of a cave

Set-Up:

1. Prepare fact strips about the bats and boas, separately. If there are 24 students in a class, prepare 12 strips for each animal (they can be differentiated by color). These should have one interesting factual sentence on each piece. They should be numbered at the bottom, so they can be read in order.
2. Prepare following cave solution for use in the diorama activity:
   Combine five cups Epsom salts with four cups boiling water.
   Cook in a metal pan until solution is dense and Epsom salts are thoroughly combined with water.
   Add colored dye. It should have a brownish, grayish tint.
   Stir with a spoon and cool. Remind students not to taste or touch the mixture.
3. Prepare a teacher model of the diorama and trees ahead of time to guide students.

Procedure:

Introduction

1. Tell the students that today they are going to learn about a dramatic struggle for survival on the island of Puerto Rico. In fact, it takes place by many caves all over the world. A cave may seem like a nice dark, cool, quiet, safe place…perfect, in fact, for a bat. Come time to hunt insects or find fruit at dusk, however, and the snakes, the boas, are waiting for a bat dinner at the entrance. They know just when to gather and wait for the bats to fly out in swarms.
2. Snakes and bats are important contributors to their habitat, but they are also important links in the food chain. There is no bad guy here—just a hungry mammal and reptile, fulfilling their role in the cycle of life.
3. Pass around pictures of bats found in Puerto Rico and pictures of boas, particularly the Puerto Rican Boa.

4. Ask the students what they already know about bats and what they know about boa constrictors. Write this information on the board
5. Next, pass around fact strips about each animal. Each student takes one. The Bats come to the front of the room first and read their strips aloud. The Boas do the same. The teacher should take brief notes on the board to summarize their characteristics and behavior.

Activity 1: Setting the Stage: A Diorama of the Encounter

1. Give students an overview of this project, and show them a previously-made teacher model. They will be creating a representation of a cave, and the "tag" game between the bats and boas that takes place in that habitat.
2. Divide students into groups of two. Two teams will work at a table. Each team gets a large shoebox, black construction paper, and three 6-inch pieces of yarn. Have students cover the inside of the box with the paper using glue and scissors.
3. Give each group a plastic cup. Trace around the diameter of the cup on top of the box, wherever they'd like to place it.
4. With adult supervision (or performed by an adult), punch holes in three places around the circle you have drawn to drop yarn into.
5. Glue the bottom of the cup to the top of the box, inside the places where holes for the yarn have been made.
6. Depending on the size of their box, students may wish to repeat this process with more cups and holes on top of their box.
7. The teacher will come around and pour the cave solution into their cup about ¾ full. Instruct the students to soak the three pieces of yarn in their cave solution. Then put one end of the yarn in the hole on top of the box and the other end remains in the cup.
8. The solution should be absorbed by the yarn. The excess will drip from the yarn strands hanging into the box. Over a few days, this will form stalactites. (Those are formed from the ceiling down from water that contains carbonate of lime. It flows down to form a column.) Stalagmites may form from the floor of a cave or mine to the stalactite column.
9. When the cups need to be refilled, solution must again be heated in a metal pan and stirred with a metal spoon.
10. Although it may take a few days for the cave stalagmites to form, students may still add paper bats to their scene. Provide realistic clip art of bats to decorate authentically and cut out. They can attach them to string and tape them to the inside of the cave (around the stalagmites) and especially to the entrance.
11. Using thick straws (flanged on the bottom to stand up on a table) and paper towel tubes, create trees to place near the entrance of the cave. These "trees" can be embellished with green construction paper leaves, or dried leaves from outside glued to the top.

12. The students may create small paper snakes, or the teacher can rotate between groups and help hot glue gummy worms to the "branches" (or sides) of the paper towel tree. This should resemble the Puerto Rican boas that wait at the entrance of the cave for the bats to fly out.
13. Students should write a few sentences on a note card to explain what is going on in this scene. This should accompany the diorama in its display location.

Activity 2: Dangling Snakes and Fly-By Bats

1. Students decorate Boa and Bat cut-outs from tagboard. They may choose either a bat or a boa (assuming the distribution will be fairly even). For the boa, create a large spiral on a square paper and cut it out so it hangs like a snake. For the bats, provide a large, sturdy bat outline to pass around and trace. The students should consider the photographs as they design their bat or boa as authentically as possible. They might even notice such things as texture and coloration (camouflage) which will be studied in a subsequent lesson.
2. On the back of the bat, or along the twisty body of the snake, the students write a short poem about their animal. It may be a cinquain, a limerick, an acrostic, or a rhyming couplet. It should convey some sort of accurate information about that particular animal.
3. Punch holes in the tops of the animals to hang from the ceiling. Half of the room could be filled with snakes, and the other half filled with boas, to represent the "battle scene."

Conclusion

1. Discuss as a class why the Puerto Rican Boa and bats are important to their habitat. Why is their predator/prey relationship important as well?
2. What other animals have a similar relationship? Make a short list on the board.
3. Students could write in their journals their feelings about the bat and boa and their relationship around the rainforest cave, or they may write a short action story.
4. Play a quick game of Bats and Boas tag. The game begins with two or three "boas" in the middle of the field and the rest of the students as "bats" lined up on one side of the field, spread out, facing the boas. Upon signal (a whistle, perhaps), the bats must leave the cave (i.e. run across the field) to the other side without getting eaten by the snake. If a person is eaten, or tagged, they must join hands with the bat and become part of their bat-catching effort. (After four bats are attached to a boa, the split into teams of two—perhaps because they've had plenty of food and were able to reproduce). See how many rounds it takes before all the bats are captured! An interesting twist to add to the game is to have little flags or token for the bats to collect, representing the insects and other food they are searching for out of the cave. A bat must have at least one insect token to continue onto the "next night's" hunt (the next round).

Assessment:

- Note each student's level of participation during all discussions and during the team diorama project. Assess for completeness and level of detail. Consider accuracy of fact cards.
- If desired, assess bat/boa poem based on creativity (and any other skills that is currently being worked on in Language Arts).

Adaptations:

This activity could be adapted for older grade levels by increasing the sophistication of vocabulary terms. There could be an increased emphasis on animal taxonomy, classification, and niches in the food chain. Gifted and Talented students may have an interest in further internet investigations about other kinds of snakes and bats. They might also like to create math problems based on population fluctuation as well. Students with special needs should be paired up with a strong student and helpful peer.

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