Echolocation & Density

Objectives

Students will solve density problems.

Materials

For each student:

- ❑ Bat Foraging worksheet
- ❑ Forest Density worksheet
- ❑ calculator
- ❑ pencil or pen

Background

Bats and dolphins use echolocation to located food, to navigate through obstacles, and to learn more about their environment. Bats send pulses, similar to a series of clicks out into the environment. If the clicks bounce off of an object and back to the bat, it can then identify whether it's food or a big tree to dodge while flying. For example, if you threw a tennis ball at a wall, the ball would bounce back to you very quickly so you would know that the wall was made of something very hard. But, if you threw the tennis ball at a pillow, it would come back to you very slowly, so you would know that the ball had hit something soft. Now, if you bounced the ball off of something round, the ball would come back at a different angle, and it might come back fast or it might come back slowly. From this, you would know that whatever you hit with the ball was not a flat surface, and you would maybe know if it was hard or soft. While these examples are basic, they are the same concepts used to understand echolocation. In this experiment, groups of students will compete as bats flying through a forest eating a specific mass of insects.

Mass—The measure of the amount of matter in a body.

Density—The ratio of mass to volume for an object. Objects that are lightweight for their size have low densities.

Action

1. Distribute the Forest Density and Bat Foraging worksheets to each student. Divide students into groups of four.
2. Explain that each group of students represents a bat population in a forest. The students may opt to name their team of bats. The forest density worksheet represents the forest that the bat teams or populations will be a part of.
3. Ask students to notice the forest is divided into several sections and each section or quadrant has a mass and volume numerical unit assigned to it.
4. Explain that the mass and volume unit represents a swarm of insects. The students will have to determine the density of insects in some of these sections based on the given information. Each team of bats needs to consume 3,500 g/cm 3 of insects a day in order to stay healthy. No one quadrant contains this many insects. Therefore the team of bats will have to travel to several sections of the forest to meet their minimum daily requirement of insects.
5. Ask each group to note on the Bat Foraging worksheet the space to write the section (quadrant) numbers that their team visits. The next space over is to calculate the density of insects using the mass and volume numerical units. (Recall D=M/V) The last space is for keeping a running tally of all the insect densities the team of bats has consumed. If students fill one worksheet, continue to another. It may take more than eight visits to reach 3,500 g/cm 3.
6. Once a team of bats has visited enough sections to reach 3,500 g/cm 3, have them call out DONE. That team will present their answers to the class. The team must include: the order the team visited each section, the calculated insect densities of each section, and the addition of all the densities to reach the final figure of 3,500 g/cm 3. (3,500 g/cm 3is a minimum, more is acceptable as well). The team wins if all their information is accurate. Note: Densities are expressed in g/cm 3. Be sure to convert Mass before calculating the Density, if necessary.
7. Ask the other groups what their total density of insects consumed was before the end of the activity.
8. Create a class list for the rest of the sections' insect densities that were not used by the winning team's method. Now that all the quadrants densities are known, was there a shorter method to achieving the 3,500g/cm 3 minimum.

Forest Density Worksheet

$$D = \frac{M}{V}$$

Note: Densities are expressed in g/cm^3. Be sure to convert Mass before calculating the Density, if necessary.

Section 1 M= 1026g V= $15cm^3$	**Section 2** M= 1300g V= $3cm^3$	**Section 3** M= 1100g V= $12cm^3$	**Section 4** M= 986g V= $17cm^3$	**Section 5** M= 1789g V= $32cm^3$
Section 6 M= 6589g V= $56cm^3$	**Section 7** M= 3824g V= $25cm^3$	**Section 8** M= 2654g V= $36cm^3$	**Section 9** M= 8461g V= $95cm^3$	**Section 10** M= 986g V= $745cm^3$
Section 11 M= 1kg V= $2cm^3$	**Section 12** M= 1kg V= $1cm^3$	**Section 13** M= .86kg V= $23cm^3$	**Section 14** M= .012g V= $3cm^3$	**Section 15** M= .23kg V= $2cm^3$
Section 16 M= .7g V= $7cm^3$	**Section 17** M= .62g V= $85cm^3$	**Section 18** M= .9g V= $3cm^3$	**Section 19** M= 1.3kg V= $15cm^3$	**Section 20** M= 96kg V= $50{,}000cm^3$
Section 21 M= 1117g V= $73cm^3$	**Section 22** M= 1970g V= $36cm^3$	**Section 23** M= 7532g V= $26cm^3$	**Section 24** M= 9512g V= $77cm^3$	**Section 25** M= 2564g V= $7cm^3$
Section 26 M= 750g V= $750cm^3$	**Section 27** M= .9kg V= $2cm^3$	**Section 28** M= 6.1kg V= $36cm^3$	**Section 29** M= 10kg V= $75cm^3$	**Section 30** M= 1973g V= $2003cm^3$

Bat Foraging Worksheet

$$D = \frac{M}{V}$$

Bat Team Name: _____

Quadrant Number: ____ Mass: _____ Volume: _____ Answer: _____		Running Total Insect Densities:
Quadrant Number: ____ Mass: _____ Volume: _____ Answer: _____		_____
Quadrant Number: ____ Mass: _____ Volume: _____ Answer: _____		_____
Quadrant Number: ____ Mass: _____ Volume: _____ Answer: _____		_____
Quadrant Number: ____ Mass: _____ Volume: _____ Answer: _____		_____
Quadrant Number: ____ Mass: _____ Volume: _____ Answer: _____		_____
Quadrant Number: ____ Mass: _____ Volume: _____ Answer: _____		_____
Quadrant Number: ____ Mass: _____ Volume: _____ Answer: _____		_____