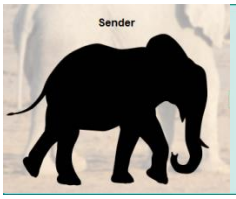

Click and Learn
How Animals Use Sound to Communicate

hhmi | BioInteractive

Student Handout

INTRODUCTION

Use this handout with the Howard Hughes Medical Institute's Click and Learn activity "How Animals Use Sound to Communicate." You will explore three case studies of how animals use sound and hearing to communicate, and how aspects of the trait have been shaped by evolution.

PROCEDURE

Click on the Launch Click & Learn link for "How Animals Use Sound to Communicate" on the BioInteractive website, at http://www.hhmi.org/biointeractive/how-animals-use-sound-communicate. Then follow the instructions, writing down the answers to the worksheet below as you proceed.

PART 1: Introduction to Animal Communication

Page 2: Communication Involves Senses

1. For each sense shown, think of one advantage and one disadvantage, and give an example of a situation when the sense would be important. (For example, the auditory sense has the advantage that it can be used at night. A disadvantage may be that a predator can home in on the sound.)

Sense	Advantage	Disadvantage	Situation
Visual			
Auditory	Can be used at night.	Predator can home in.	Frog chorus
Olfactory			
Tactile			

Page 3: Can You Spot the Signals?

2. Watch the video and write down as many communication behaviors as you can identify and the signals and senses involved.

Page 4: Find Out How You Did

3. Watch the same video again, this time with the researcher's observations. How many were you able to identify? For each of the named behaviors, make a list of both the signal involved and the senses involved in each signal.

Behavior	Signal	Sense

Page 5: Using Sound as a Signal

4. Keeping in mind that signals and senses have evolved by natural selection, write down your ideas about what advantages and disadvantages communicating with sound have over other senses.

PART 2: Elephants: Long-Distance Communication Case Study

Page 3: Advantages of Low-Frequency Sounds

5. Describe the advantages of using low-frequency sounds for communication. What aspect of an elephant's life makes it important to use low-frequency sounds?

Page 5: Can Elephants Also "Hear" Sounds through the Ground?

6. What was the question that the researcher was exploring?

7. Describe how the elephants responded to the alarm call played back in the air.

8. Describe how the elephants reacted to the alarm call played back by the shaker.

9. What could account for the difference?

Pages 6 and 7: Detecting Ground Vibrations through the Bones; Bone Conduction

10. Write down another example of hearing by bone conduction. It could include your personal experience.

Summary

11. Write down your ideas for how the ability to communicate using low-frequency sounds may provide an adaptive advantage for survival and reproduction to elephants.

PART 3: Birds: Species-Specific Courtship Case Study

Page 1: Birds Produce a Variety of Sounds

12. What do you think the cardinal is trying to communicate with its song?

Page 2: Hearing Range of Birds Compared to Other Animals

13. How do the hearing ranges of birds compare to those of bats, elephants, and humans? What does this tell you about the evolution of the communication systems of birds and humans compared to those of bats and elephants?

Page 4: Can You Tell Them Apart? Activity

14. Complete the activity. At the end, how many individuals did you misclassify?

15. How did the sorting difficulty compare when doing it by song alone and by song with a sonogram? What does this tell you about human perception of birdsong?

Summary

16. Write down your ideas for how species-specific songs might provide an adaptive advantage for survival and reproduction.

PART 4: Bats and Moths: Use of Ultrasound Case Study

Page 1: Bats Produce Ultrasounds

17. Play the spectrogram at normal speed and slowed down. How many calls did the bats make?

18. Some bat calls appear fainter in the spectrogram, and others appear brighter. What does this signify?

19. Estimate the frequency range (from low to high) of the most powerful portion of the bat call.

Page 4: What Is Echolocation?

20. What is the advantage of higher frequencies compared to normal frequencies for echolocation?

Page 6: Bats and Moths Are in an Evolutionary Arms Race

21. Watch the video. What are the two ways described in the video that moths use to avoid predation?

22. Answer the following questions about the tethered moth experiments:
    a. What did the scientist conclude from tethering a moth that does not make sound and one that does make sound and letting bats hunt them?

    b. By observing the bats' hunting behavior, what did the scientist conclude about the strategy the sound-making moth was using? Why?

Summary

23. Write down your ideas on how ultrasound provides an advantage to bats and moths in their particular habitat.

PART 5: Sound Tutorial

24. Describe how the wavelength of sound and the frequency of sound are related.

25. What is the wavelength of a 1-kilohertz (kHz) sound traveling in water? Show your calculations.

26. Describe two ways by which a higher-frequency sound is attenuated as sound waves travel through forests. What implications do you think this has in the evolution of communication among forest-dwelling elephants?

27. Bearing in mind that a sound reflects off an object if the object is larger than the wavelength of the sound, calculate the wavelength of a sound in the air for a sound in the middle of the human hearing range. Then calculate the wavelength for a sound in the middle of the bat hearing range. If you had to use echolocation to detect an insect, which sound has an advantage? Explain why.