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Lesson Plan: Sounds of Your Study Site

Center for Urban Resilience

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LESSON 2: SOUNDS OF YOUR STUDY SITE

OVERVIEW:

In this lesson, students will conduct a survey of noise in the study site. They will begin to explore the idea that noise has an impact on the ecosystem and its inhabitants. In small groups, they will use a decibel meter, data sheet and aerial photograph of the study site to collect data on a section of the site. Students will then share this information with classmates to create a map of the noise of your schoolyard. Then students will listen to prerecorded bird songs against urban noise. They will compare the bird songs and the characteristics that make them easier to hear: volume and pitch. This lesson introduces the idea that birds, as well as other animals, are impacted by urban noise.

SUB-QUESTION:

How loud are the sounds around me? How do these sounds impact animal behaviors?

WAYS OF KNOWING URBAN ECOLOGY:



Students will...

Understand

- Understand that cities consist of a variety of sounds that are not found in other settings. (*ecosystem state and structure*)
- Understand that animals, such as birds, are impacted by urban noise. (*human impact*)
- Understand that volume and pitch impact an animal's ability to communicate over urban noise. (*ecosystem change, human impact*)

Talk

No specific goals connected with talking about urban ecology in this lesson.

Do

- Survey their study site with a decibel meter to create a noise map of that area.

Act

No specific goals connected with acting on urban ecology in this lesson.

SAFETY GUIDELINES:

Students will be recording sound levels of local ambient noises. Caution students to gather data safely and not go too close to very loud sounds, such as exhaust vents.

PREPARATION:

Time:

2 class periods

Day 1: Activity 2.1

Activity 2.2

Day 2: Activity 2.3

Activity 2.4

Materials:

Activity 2.1

Blackboard or whiteboard

Projector

Map of study site

Activity 2.2

Decibel meters (1 for every 3-4 students)

Copies of student sheets

Activity 2.3

Map of study site

Projector

Activity 2.4

Computer Files

M7_L2_urban_birds.wav (This can be played in itunes or another music player on a computer).

INSTRUCTIONAL SEQUENCE

Activity 2.1: How are urban sounds related to the presence of animals?

1. Begin the lesson with a short discussion of previous knowledge. Remind students that we have discussed the fast-paced nature of cities and how it has created novel environments and pressures for animals. Different animals respond in different ways to these pressures. In this lesson, we will begin to examine how birds respond to the pressures of city life, specifically urban noise.
2. Ask students to come up with a list of urban sounds. Write these ideas on the board.
3. Ask students to consider the basic biology of birds. What behaviors of theirs might be most impacted by an urban environment?
 - Draw a T chart on the board. On one side write urban sounds, in the next column prompt students to think of bird behaviors that might be impacted by that. Try to have students come up with specific examples. For instance people talking in a park might affect a bird nesting, where transportation sounds might affect a bird flying or migrating.
 - We will explore the ability of birds to communicate in the urban environment in great depth in this module. In this particular lesson, we will begin to examine the effect of urban noise on bird communication.
4. Project an aerial map of the student's study site. This can either be in a power point presentation, or using an overhead projector
 - Have students write down their predictions about where they think the noisiest sections will be. Remind students to think about their field studies in Module 6 and the biodiversity of birds.
5. Pass out the student sheets. Have students read the first 2 pages, the background information.
 - Re-project the aerial map of the student's study site. This time it should have a grid overlaying the area. *If you use Google Earth to retrieve the image you can simply click on "View" and then "Grid". You can assign the grid coordinates, this is only for the classes data collection.
 - Tell students that you are going to be creating a noise map of the study site, by measuring the noise of each grid section with a decibel meter

Activity 2.2: Data Collection

In this activity, students use a grid system to identify and record the locations of sounds in their study areas. They will be instructed to first locate the source of the sound, and then measure it using the decibel meter.

1. Prepare gear for outdoor sampling. Remember to check the battery levels on the decibel meters


Common Student Misconception

Logarithmic scales can be difficult for students to grasp. While it is not critical that students can quantitatively understand the difference between decibel-levels it is important that students understand that the decibel scale is not linear. In other words, an increase in 10 dB is a doubling of how loud a sound is so 70 decibels is 10 times louder than 60 and 80 decibels is 100 times louder than 60 decibels.

2. Introduce the concept of a decibel scale as a logarithmic scale
3. Put students into groups of 2-4 and pass out one decibel meter per group. Use the guide below to walk students through how to use them.

1. Turn dial to 60 to turn on the dB meter (this will allow it to read from 50-70 db)

2. Set the weighting factor to "A"



3. Adjust the range if necessary:

- If the display starts blinking, turn the dial **up** until it stops
- If it display shows "Low" turn the dial down until it a number appears

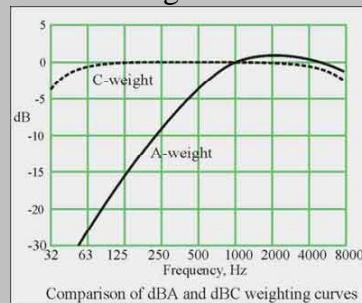
4. Then lead the students out to the field site and using the grid maps assign each group a few of the sections of the grid. They should write the coordinates on the student sheet, and measure each section at a time. It is important that students stay in their grid sections to create the noise map later.
 - Each group should gather data from the study area. Have students rotate who is using the decibel meter at each station so every student gets an opportunity to use it.

Teacher Background Information

A decibel (dB) is a relative measure of sound intensity or loudness. The scale is logarithmic meaning every 10dB is a doubling of how loud the sound is.

What is the difference between the A and C weighting factors?

These weighing factors are a frequency-response function or weighting characteristic (meaning that some frequencies are given more weight or importance than others). As a weighting factor implies, they emphasize or de-emphasize sounds of certain pitches relative to others. A-weighting (dBA) is thought to most closely resemble human hearing and is used by OSHA for measuring noise compliance. C-weighting (dBC) is less often used and is actually almost an unweighted scale.



Above is a scale comparing the two weighting factors. Notice the A-weighting factor weights more heavily the frequencies within the human hearing range. (this scale is taken from <http://www.grozier.com/MetricdbAdbC.shtml>)

For more information about decibels, check out these websites:

“What is a decibel? By How Stuff Works

<http://science.howstuffworks.com/question124.htm>

“What is a decibel?” at Music Acoustics Group at UNSW

<http://www.phys.unsw.edu.au/jw/dB.html>

Concluding the Lesson

1. Bring students back into the classroom. Have them reflect (in writing or orally) if the data they collected agreed or conflicted with their predictions

Activity 2.3: Mapping the noise data

1. Have students think back to their reading yesterday. What does a noise map look like?
 - Students should recall that a noise map is like a mosaic patching together the different sound levels
2. Hand out the student sheets for 2.3. Tell students that you will be creating the sound map as a class based on every group's data.
 - There is a decibel level associated with a specific color on the student worksheets.
 - Project the same grid map from the day before. To create the sound map you can project the map onto a white board and color in the sections according to the data OR you can project the image from a computer and use the drawing tool in PowerPoint or paint to fill in the sections
3. Have each group of student's share the data from their section. Have the groups tell you what color their grid section should be filled in with.
4. When the noise map is completed have students answer the reflection questions on their student sheets
 - Discuss the answers as a class.

Activity 2.4: Impact of Urban Noise

1. Tell students that in this activity they are going to be listening specifically to bird songs against urban noise, like the noise that they measured
2. In this activity students will be comparing two bird songs (A mourning dove and chickadee) against the backdrop of some urban noise. The urban noise was recorded outside of Madison Park High School in Roxbury Massachusetts.
3. Play the sound file (M7_L2_urban_birds.wav) for the students. Have students write down what types of noises they hear.
 - Which bird was easier to hear? Why?
 - Did one sound louder? Did one sound more shrill (pitch)?
 - Play the sound file again so students can listen closer and refine their answers.
4. Discuss student's responses as a class

Common Student Conception

Bird communication and the science of sound are very complex. Often students have a rather limited understanding of why birds sing. Students will often think that if birds only sing louder, then it will be easier to hear the bird. However, that is only part of the story. The bird with the higher pitch is also easier to hear. So the best thing a bird can do if it wants to be heard over significant background noise is to increase its loudness and its pitch. The analogy of an ambulance could be helpful for students because an ambulance produces both a loud sound and high pitched sound.

You will revisit the idea of pitch and loudness throughout the unit so do not worry if the students do not understand these concepts right away.

Concluding the Lesson

1. Ask students: What is the potential impact of urban noise on birds/animals?
 - (This is a very complex question and the one that you will revisit throughout the module). Elicit student ideas and let them know that they will be investigating the impact of urbanization on animal behaviors and that how animals change their behavior in response to the noise in urban environments is just one example.