ANCHORAGE MUSEUM

SOUND ANALYSIS

BACKGROUND INFORMATION

Since 2018, the Anchorage Museum has partnered with schools and organizations to record and collect the dynamic soundscapes of Alaska. This lesson introduces students to the concept of sound analysis by exploring tools and techniques which help break down the information in recorded sound data.

STUDENTS WILL:

- Discover how to utilize the sense of hearing to make observations of the natural world
- Practice close listening
- Understand basic properties of sound
- Use spectrograms to analyze sound data
- Use sampling methods to analyze large quantities of data
- Graph findings from analysis
- Think critically and support answers with evidence

MATERIALS

Step 1,2&3 : Computer or tablet with access to internet and ability to listen to audio (headphones recommended). Provided audio and image files.

Online Resources

- **Audacity**
- **Chrome Music Lab**

RECOMMENDED GRADE LEVEL

Eighth through twelfth

Adapt for K-12 and adult learners

KEY TERMS

Sound: vibration which moves through mediums such as air as sound waves

Frequency: the number of wave cycles that pass in a given amount of time; typically measured in Hertz (cycles per second); for sound - the number of vibrations per second; high frequency or high pitch means faster vibration; low frequency or low pitch means slower vibration

Amplitude: the volume or energy of a sound wave; high amplitude means loud sounds and low amplitude means quiet sounds

Data: factual information (such as measurements or statistics) used as a basis for reasoning, discussion, or calculation

Analysis: the process of breaking a complex topic or data set into smaller parts in order to gain a better understanding of it

Spectrogram: a tool used to visualize sounds by looking at the frequency and amplitude of sounds over time

Soundscape: all the sounds in a particular place

Biophony: sounds made by living things, but not people

Geophony: sounds made by the earth

Anthrophony: sounds made by people and machines

Soundscape ecology: the science of studying soundscapes to better understand a place and the relationships between organisms and that place

STEPS

This lesson plan provides three steps and explains them in detail on the next page.

Step 1: Introduction to Sound and Sound Analysis
Step 2: Spectrograms
Step 3: Sampling Methods

This lesson plan was created with support from:

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STEP 1

Introduction to Sound and Sound Analysis - [20 minutes]

In this step, students will learn about the properties of sound and how to categorize different types of sounds to better understand soundscapes. Use **Appendix A** to guide learning.

Additional material required:

- Audio files: sound one
- Image files: sound one

STEP 2

Spectrograms -[20 minutes]

In this step students will learn to use a tool soundscape ecologists use to visualize sound data. Print out **Appendix B** for this activity.

Additional material required:

- Audio files: sound two, sound three
- Image files: sound two, sound three

STEP 3

Sampling methods - [20 minutes]

In this step, students will examine a sampling method used to break down a day's worth of sound data and create their own sampling method. Complete **Appendix C** to guide learning.

Additional material required:

- Audio Files: data set folder

EXTENSION ACTIVITIES

Introduction to Sound and Sound Analysis -[10 minutes]

To extend this step students may find three different listening spots within a given place and complete the category chart for each spot and compare and contrast the differences in soundscapes within that given place.

Spectrograms -[10 minutes]

To extend this step students may listen to clips and create their own spectrogram based on the sounds they heard in the clip. This helps students consider properties of the sounds to which they listen.

Sampling methods- [15 minutes]

To extend this step students may create a graph using the information collected in the chart in **Appendix C**. Students may also create different sampling methods based on various research questions and examine how a research questions helps focuses the data sets to analyze.

ADDITIONAL SOUNDSCAPE ACTIVITIES

To continue learning about soundscape ecology looks at these Anchorage Museum lessons:

- Introduction to Sound and Soundscapes
- Art and Sound
- Sense of Place
- Summer Soundscapes

All Anchorage Museum lessons can be found on the Educator Resource webpage, including more soundscape ecology activities.

INTRODUCTION TO SOUND AND SOUND ANALYSIS

Sound is vibration which moves through mediums such as air as sound waves. A sound wave is a pressure wave that is created by a vibrating object.

1. Experiment with sound waves here. Describe what you observe.

The vibrations set particles in the surrounding medium, usually air, in motion. The now moving particles transports energy through the medium. Since the particles are moving in parallel direction to the wave movement, the sound wave is a longitudinal wave.

2. Go back here and hold down the piano key on the far left side and then try holding the key on the far right side, what do you observe?

Sound has two key characteristics: frequency and amplitude. Frequency is the number of wave cycles that pass in a given amount of time; typically measured in Hertz (cycles per second); for sound - the number of vibrations per second; high frequency or high pitch means faster vibration; low frequency or low pitch means slower vibration.

3. List eight sounds you hear every day. Label which sounds you think have a high frequency and which have a low frequency.

4. Consider your list of sounds, which do you think have a high amplitude? Which sounds have a low amplitude? Does the amplitude for the those sounds remain the same, or does it change?

Amplitude is the volume or energy of a sound wave; high amplitude means loud sounds and low amplitude means quiet sounds. As a sound wave moves over distance the energy spreads out, lowering the amplitude of the sound. A person's position to the sound source will affect the perceived amplitude of the sounds. If you are further away from the sound source, a lower amplitude is perceived compared to being closer to the sound source. .

INTRODUCTION TO SOUND AND SOUND ANALYSIS

5. Take one minute and listen to the provided audio clip labeled, 'sound one.' List all the the sounds you hear in that clip.

You just listened to a soundscape. A soundscape is all the sounds in a particular place. Soundscapes are unique to a specific place and time.

6. Open up the provided image labeled 'sound one' and re-listen to the sound one audio clip. Did you identify any new sounds?

Soundscapes may contain many different sounds. Scientists who study soundscapes divide sounds into three categories:

Biophony: sounds made by living things, but not people; examples include birds and mosquitoes

Geophony: sounds made by the earth; examples include rain, waves, and landslides

Anthrophony: sounds made by people, and machines; examples include laughter, footsteps, and cars

7. Take the list of sounds you made in question one and two and categorize these sounds into sound categories:

Biophony	Geophony	Anthrophony

SPECTROGRAMS

Data is the factual information, such as measurements or statistics, used as a basis for reasoning, discussion, or calculation.

Data analysis is the process of breaking down the data into smaller parts in order to gain a better understanding of it. Soundscape ecologists need tools and technique to analyze the sound data they collect in order to understand what kind of information the data is showing.

1. Experiment with a spectrogram here. What type of information does it show?

A spectrogram is a tool used to visualize sounds by examining the frequency and amplitude of sounds over time.

When reading a spectrogram, the time of the sound clips appears on the bottom or the x axis and the frequency appears along the Y axis, with higher frequency sounds at the top and lower frequency sounds at the bottom. Amplitude is represented by color; the color may vary depending by spectrogram used.

2. Listen to the provided audio clip labeled 'sound two." List the sounds you hear in this clip.

3. Open up the provided image labeled sound two and re-listen to the sound two audio clip. Try to identify the sounds heard on the spectrogram, and list below.

SPECTROGRAMS

Spectrograms allow scientist to see visual representations of the soundscapes. Spectograms helps identify the frequency, amplitude and recurrence of different sounds within the soundscape. Spectrograms also allow scientist to define which clips they need to listen to by allowing them to visually identify points in recorded data which may be of interest to listen to.

4. Open up the provided image labeled 'sound three' and listen to the sound three audio clip. Identify and list the sounds you heard from sound three.

5. Use the spectrogram to help sort the sounds you heard into the chart below.

Low Frequency	High Frequency	High Amplitude	Low Amplitude

SAMPLING

Soundscape ecologists collect large amounts of sound data in order to learn how soundscapes and the environment where they are recoded change over time. Soundscape ecologists use sampling to analyze large amounts of data without having to examine each individual data point.

Sampling is the act, process, or technique of selecting a representative part of a data set for the purpose of determining parameters or characteristics of the overall data set.

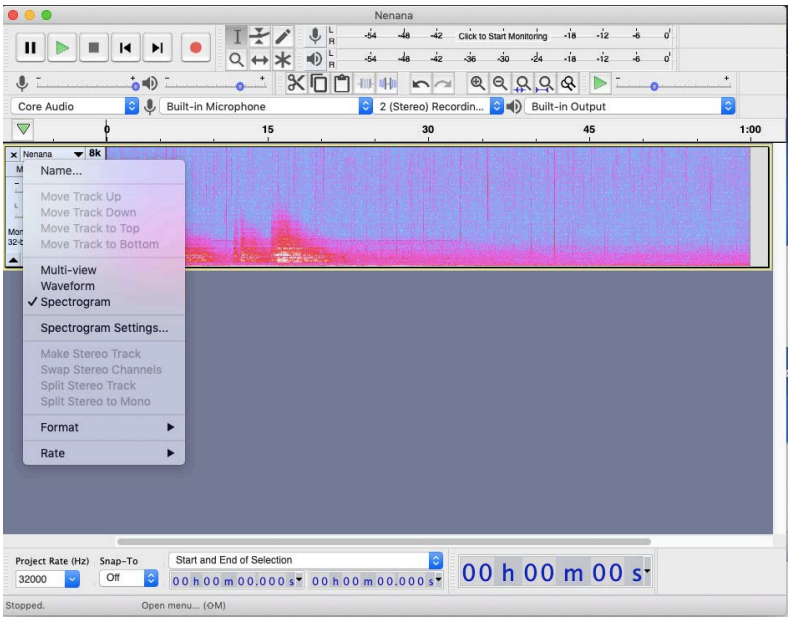
1. Listen to the provided audio clip labeled 'sound four' with the provided image labeled 'sound four.' This is a sound clip that has been condensed an hour of data into one minute by taking a sample of the first ten seconds every ten minutes throughout the hour. List all sounds you are able to identify.

2. How did the soundscape stay the same through out the hour? How did it change?

3. Do you think the sampling method was an appropriate way to listen to an hour's worth of data? Why or why not?

SAMPLING

Download Audacity, a free audio software with a spectrogram setting **here**. Open the clip labeled 'Data Set' in Audacity. Use the drop down menu next to the file name in Audacity to access spectrogram view, shown in the photo below.



4. The 'Data Set' clip is an hour long clip from one of our recording sites. Using Audacity's spectrogram tool, look and listen to the data and create a sampling method to determine which sound category biophony, geophony, or anthrophony is most dominant during the hour period. Explain your method and reasoning behind it.

SAMPLING

5. Using the sampling method you created fill in the chart below with all the sounds you were able to identify from the clips.

Biophony	Geophony	Anthrophony

6. Based on the chart above, which category of sound was most dominant during the hour recording?

7. How successful was your sampling method in answering the above question? Is there anything that you would change about your sampling method? Would you be able to use it to sample a day's worth of data?