INTRODUCTION

(Background and acoustical monitoring information was taken from the National Park Service website http://www.nature.nps.gov/sound/assets/docs/InterpHandbook.pdf)

You are the park superintendent and your students are the employees of the Night Skies and Natural Sounds Division of the National Park Service. Have students either group into teams or pairs. You will be asking them to evaluate your park and give recommendations on how best to protect the park’s resources and visitor enjoyment. The goal is to protect, maintain, or restore acoustical environments while increasing scientific understanding and inspiring public appreciation for soundscapes of National Parks. Read to the students the National Parks Mission found in the purple box below.

Noise in parks comes from a variety of sources including vehicles, energy development, watercraft, park operations, off road vehicles, military and commercial overflights, and snowmobiles.

According to the National Park Service website referenced above, these are a few noise issues parks are facing:

- At Zion National Park between 1982 and 1997, as many as 5,000 cars a day entered the park on holidays.
- In the Grand Canyon, no single location is totally free of aircraft noise which can be heard up to 43 times in a 20-minute period. 185,000 air tours fly over parks every year.
- In the recent past, Yellowstone had 1,500 snowmobiles traveling through the park in a single day. The machines could be heard 90 percent of the time at eight popular sites, impacting wildlife, air and water quality, and the park’s wildness.
- In Rocky Mountain National Park, motorcycle noise can be heard 4.6 miles from the source, for a total area of 75 square miles. At the highest point on Trail Ridge Road, a motorcycle’s area of audibility will encompass 240 square miles.
- Park infrastructure, such as heating and ventilation units, also adds to the noise. Generators in Alaska caused a considerable amount of noise.
- Energy development poses a new threat with potential oil and gas drilling near park borders, as do geothermal, hydro-power, wind, and even solar projects.

Students will be viewing topo maps. If topo maps need to be explained, see the background sheet on topo maps in the appendix. You can also do a hands-on tutorial where students make a mountain landscape with containers or paper towel rolls for different level of topography. Cover in foil or fabric or clay for a solid surface to act as the ground. Using a ruler, measure every inch of height gain and use string or yarn to outline/ wrap around the formation to show a contour line.

Here is the National Parks Mission your employees need to uphold:

"Protect natural and cultural resources and provide enjoyment to visitors in parks. (Balance protecting resources while making sure visitors are having a good experience). The Organic Act stipulates that protection must take priority over public use.”
TERRESTRIAL SOUND
Night Skies & Natural Sounds
Activity Part A

ACTIVITY INSTRUCTIONS - Page 1

Location
Outside or Inside

Materials
Nights Skies & Natural Sounds Worksheets
video clips from thumbdrive
park topo maps
pencils

Preparation
cue up video clips

Instructions Part A
You need your Night Skies and Natural Sounds Employees (NSNSE) to evaluate the sound/noise level in the National Park you manage and give recommendations for the best course of action to protect the park’s resources and for visitors’ enjoyment of the park.

First, NSNSE will need more information to have a better understanding of the natural sounds and the needs of wildlife and visitors. Sound monitoring will identify desirable and appropriate sound sources and inappropriate or non-natural sounds. Following along on their worksheets, discuss the following:

- **Where will you set up monitoring stations?**
  Is there an endangered species needing more protection? One part of the park may have very different sound levels - how do you know? Review the map to see the park resources and popular destinations for visitors. Have them draw the locations of their monitoring stations on the map provided. The map will have information on park resources and locations. Topo lines may need to be explained to understand the landscape. See the appendix for an explanation of topo lines.

- **When and how often will you take samples?**
  Weekend and holiday operations may differ from weekdays. Summer may be different than winter. Remind students that sound is affected by weather. The park surveys an area for a minimum of 25 days. Have them write their answers on the worksheet provided.

- **What kind of data will you collect?** (spectrograms are on thumbdrive)
  Acoustical data like spectrograms tell us the “how” - how loud, or how high-pitched a sound is. Audio recordings tell us the “what” - what species made the sound and what the animal was doing. You can do this by listening to the recordings and identifying the sounds. For instance, NSNSE have recorded sounds of elk chewing on the cover of the monitoring equipment. A waterfall can be high in amplitude (loud) but is an appropriate sound for the environment. Students need to determine what is desirable for sound.

- **Tell the students that the data has been collected.**
  Play audio clips from the power point (details in brown box) or use the sound files on the thumbdrive. Have students write down on their worksheets what made the noise and determine which sounds are appropriate for the park. They will circle inappropriate sounds.

If you cannot play sounds, tell them which sounds were recorded. Add your own sounds. Examples of sounds can include: thunder, elk bugling, music from a vehicle, children laughing, diesel engine, airplane, car engine, motorcycle, wind, birds singing, visitors talking, fox barking, crickets, marmots calling, and construction equipment.

MORE INFORMATION

Sound loudness or amplitude of sound is measured in **decibels (db)** while the pitch or frequency is measured in **hertz (Hz)**.

A spectrogram shows sound on a graph. The y axis (vertical) is frequency. The higher pitch or frequency sound will be on upper part of the graph. The lower frequency will be towards the bottom. Time is on the x axis (horizontal) and the amplitude or loudness is the shown in the color. The brighter the color like yellow the louder the sound.

TAKING IT FURTHER

To get a better understanding of identifying sounds or noises in a park, play the PowerPoint **Sounds from the Land**.

There are two versions. One slide show includes photos of the animals and **Sounds from the Land - no photo** will only have the spectrogram and sound to allow the students to guess the sound.
**Instructions Part B**

Data has been collected and one set of collections monitored the main road in the park. Show the NSNSE the recording of a footprint from a car and a motorcycle using the *video on the thumbdrive*. Using this data, have students work as a team to come up with possible solutions. They will consider this question as they make their recommendations for the fictional park.

- How do you have enjoyment of the park by the public while protecting the resources such as wildlife?

The mapping model shows the noise footprint of a motorcycle traveling in the students' park. Red indicates the greatest noise intensity and deep blue shows the lowest. The heavier black line represents the main road through the park. The green lines are trails, and red lines are less developed roads. Note that the sound footprint does not form a complete circle, as various objects (like a rock wall) block the noise and force it into other areas. This shows how and where noise travels. Tell the students that in the summer an average of 100 cars per hour and 10 motorcycles per hour travel on the road. The holidays see higher numbers of 500 cars and 50 motorcycles per hour (excluding winter holidays). Most facilities are closed in the park in the winter and cars drop to an average of 30 per day with no motorcycle traffic. You can change the numbers for cars and motorcycles as you like. Have students work on questions on the worksheet. Discuss it as a group when they are done.

- What do you see?
- What is different from the car and motorcycle?
- Based on your map and its resources, what are the priorities to protect in the park?
- What is important to visitors of the park?
- Are there conflicts between protecting park resources and recreation in the park? If yes, what are they?

**Instructions Part C**

Have students work on Part C of their worksheets. The questions are:

- What are your recommendations?
- How do you have enjoyment of the park by the public and protect the resources, such as wildlife?
- What are your issues to resolve?
- What do you recommend to resolve the issues?
- After listening to classmates’ recommendations, would they change their recommendations? How?
- Are there issues you cannot resolve?

After discussing the worksheet, share with students some things that the National Parks have done to protect the natural soundscapes:

- In Zion National Park, private vehicles were banned during peak visitation times and a mandatory shuttle system was created through the most popular portions of the park. Visitors report that the park is much more serene without cars.

- The military and NPS have meetings and engage in collaborative problem solving. NPS has taken military officers on backcountry trips to encourage cooperation and awareness.

- Denali National Park had a noisy diesel generator and installed batteries to reduce the runtime.

- Many parks schedule activities that may be noisy around times that require a more quiet atmosphere.
Congratulations, you are a new member of the Night Skies and Natural Sounds Division!

Your goal is to protect, maintain, or restore acoustical environments while increasing scientific understanding and inspiring public appreciation for soundscapes of National Parks! You have some challenges ahead of you.

Here is the National Parks mission you need to uphold:

“Protect natural and cultural resources and provide enjoyment to visitors in parks. (Balance protecting resources while making sure visitors are having a good experience). The Organic Act stipulates that protection must take priority over public use.”

Noise in parks comes from a variety of sources, including vehicles, energy development, watercraft, park operations, off road vehicles, military overflights, airports and development, and snowmobiles.

According to the National Park Service website, these are a few noise issues parks are facing:

- At Zion National Park between 1982 and 1997, as many as 5,000 cars a day entered the park on holidays.
- In the Grand Canyon, no single location is totally free of aircraft noise which can be heard up to 43 times in a 20-minute period. 185,000 air tours fly over the park every year.
- In Yellowstone, 1,500 snowmobiles traveled through the park in one day. The machines could be heard 90 percent of the time at eight popular sites, impacting wildlife, air and water quality, and the park’s wildness.
- In Rocky Mountain National Park, motorcycle noise can be heard for 4.6 miles from the source for a total area of 75 square miles. At the highest point on Trail Ridge Road, a motorcycle’s area of audibility will encompass 240 square miles.
- Park infrastructure, such as heating and ventilation units, also add to the noise.
- Energy development poses a new threat with potential oil and gas drilling near park borders, as is geothermal, hydro-power, wind, and even solar.

Here is your job:

Your supervisor wants you to evaluate the sound/noise level at a National Park and for you to recommend the best course of action to protect the park’s resources and for visitors to enjoy the park.

To make recommendations, you will need more information to have a better understanding of the natural sounds and the needs of wildlife and visitors. You will be conducting sound monitoring to identify desirable and appropriate sound sources and inappropriate or non-natural sounds.

To plan your investigation, you will need to answer the questions on the next 3 pages labeled Part A, B and C.
Where will you set up monitoring stations? Is there an endangered species needing more protection? One part of the park may have very different sound levels. How do you know? Review the map to see the park resources and popular destinations for visitors. Use the map provided and draw the locations of your monitoring stations.

When and how often will you take samples? Weekends and holiday operations may differ from weekdays. Summer may be different than winter. Remember sound is different depending on the weather. The park surveys an area for a minimum of 25 days.

What kind of data will you collect? Acoustical data like spectrograms tell us the “how”—how loud, or how high-pitched a sound is. Audio recordings tell us the “what”; what species made the sound and what the animal was doing. You can do this by listening to recordings and identifying the sounds.

Listen to the sounds recorded and write down what made the sounds. Are they appropriate sounds in the park? Circle the sounds you deem inappropriate.
PART B

There are many methods that can be used to collect sound data. You will view a recording of a sound footprint from a car and a motorcycle on a major road in the park. Using this data, work as a team to come up with possible solutions. Consider this question as you make your recommendations:

- How do you balance enjoyment of the park by the public while protecting the resources such as wildlife?

The video shows the noise footprint of a motorcycle traveling in your park. Red indicates the greatest noise intensity and deep blue indicates the lowest. The heavier black line represents the main road through the park. Review the legend for red and green lines. Note that the sound footprint does not form a complete circle, as various objects (a rock wall for example) block the noise and force it into other areas. This shows how and where noise travels. The park superintendent will tell you the results of your monitoring.

<table>
<thead>
<tr>
<th>Season</th>
<th>Number of Cars</th>
<th>Number of Motorcycles</th>
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What do you see?
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What is different between the car and motorcycle?
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Based on your map and its resources, what are the priorities to protect in the park?
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What is important to visitors to the park?
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Are there conflicts between protecting park resources and recreation in the park? If yes, what are they?
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PART C

How do you balance enjoyment of the park by the public while protecting resources such as wildlife?

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What are your issues to resolve?

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What do you recommend to resolve the issues?

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