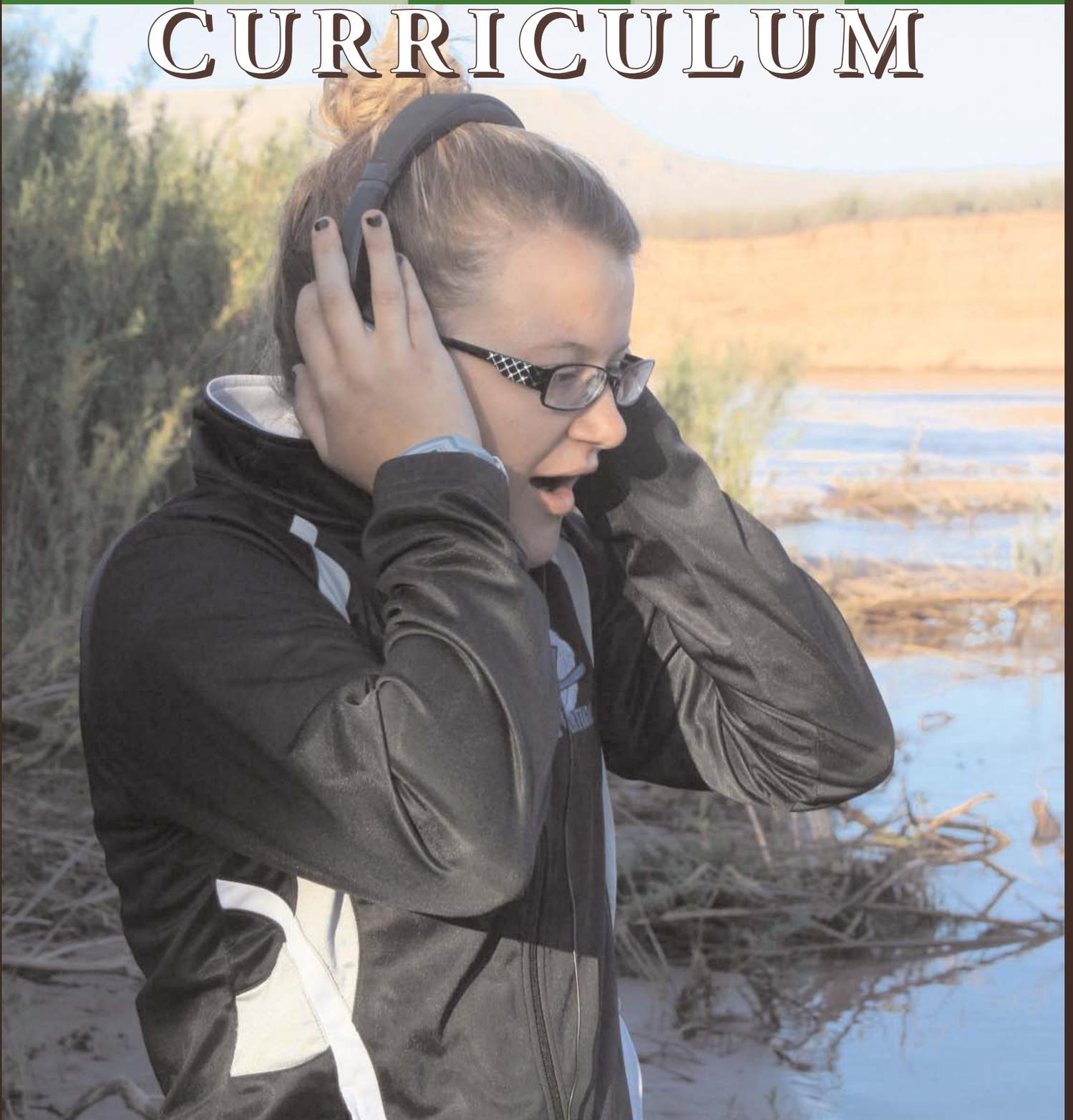
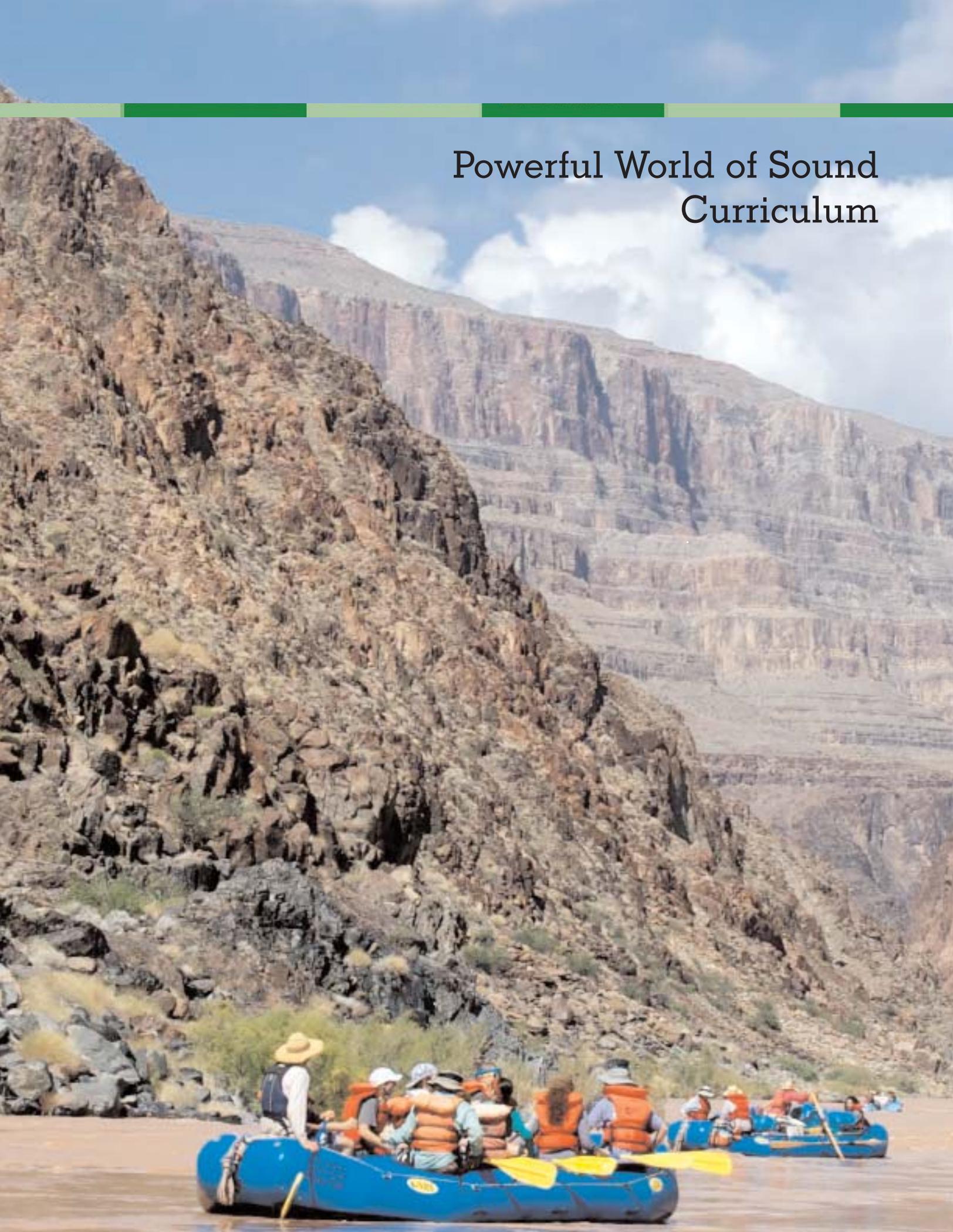


Powerful World of Sound

# CURRICULUM



A group of people are rafting on a river in a canyon. The rafters are wearing orange life jackets and hats. The canyon walls are steep and rocky, with a mix of brown and grey tones. The sky is blue with some white clouds. The text "Powerful World of Sound Curriculum" is overlaid on the top right of the image.

# Powerful World of Sound Curriculum

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Through a partnership with Global Explorers, the National Park Service Natural Sounds and Night Skies Division is educating a diverse group of youth and educators nationwide in the management and understanding of soundscapes. Through educational activities conducted in classrooms and on expeditions around the world, they inspire an appreciation of natural and cultural resources, a connection to the natural world, and a commitment to environmental stewardship.



## Academic Standards

### ARIZONA SCIENCE STANDARDS

Kindergarten: S4 C4 PO3

Grade 3: S4 C4 PO1, S5 C3 PO3, PO4

Grade 4: S4 C4 PO2

Grade 8: S4 C4 PO1, PO2, PO3, PO4, PO5, PO6

HS: S4 C4 PO2

### NATIONAL SCIENCE EDUCATION STANDARDS

CONTENT STANDARDS, GRADES K-4

LIFE SCIENCE: Characteristics of organisms, Organisms and environments

CONTENT STANDARDS, GRADES 5-8

LIFE SCIENCE: Diversity and adaptations of organisms, Regulation and behavior

CONTENT STANDARDS, GRADES 9-12

LIFE SCIENCE: Behavior of organisms, Interdependence of organisms

SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES: Science and technology in local, national, and global challenges

### STANDARD ABBREVIATION FORMAT USED:

S1 = Strand 1

C1 = Concept 1

PO 1 = Performance Objective 1

### SPECIFICS ABOUT SCIENCE STANDARDS:

See the Arizona Department of Education Web site for details on Academic Standards: <http://www.azed.gov/standards-practices/common-core-state-standards/>. Trunk lessons and activities address these standards. However, it is the teacher's responsibility to integrate the activities into an appropriate framework of long- and short-term goals, and to adapt them to appropriate curricula.

# Introduction & Background Information



## ..... Lesson Objective

Learn about the powerful world of sound and how it affects our environment and the way we experience our environment.

## ..... Lesson Goals

-  Become more aware of the sounds around you and how they affect your everyday life.
-  Become familiar with the Natural Sounds Program and why the work they do matters.
-  Learn about reasons for protecting acoustical environments and soundscapes.
-  Identify potential threats to natural and cultural soundscapes and ways to minimize noise pollution.

## Teacher Preparation

-  Read background info and familiarize yourself with general sound concepts.

## Materials Needed

-  Student journals, writing utensils
-  Handout with sound messages (included with lesson)
-  Sound CD



## Timeline

-  Introduction to National Park Service and Natural Sounds (10 minutes)
-  Powerful World of Sound Lesson (50 minutes)
  - Activity One
  - Activity Two



## Soundscapes 101

Some of the terms we use in talking about sounds may be unfamiliar to students or even teachers. Below are the Natural Sounds and Night Skies Division's definitions of some of these terms as well as few you might have thought you already knew.

Physical sound sources, or **acoustic resources**, include both natural sounds (wind, water, wildlife, vegetation) and cultural and historic sounds (battle reenactments, tribal ceremonies, etc.), and a **soundscape** can be defined as the human, or animal, perception of those acoustic resources. Like beauty, soundscapes are in the mind of the beholder. The rhetorical question about the tree that falls in the forest may help illustrate this. Because no human is there to hear it, the resulting crash is not a part of the human soundscape. It is, however, a pretty significant part of the soundscape of the squirrel standing in the tree's path.

The **acoustical environment** is the combination of all the physical sound resources in a given area. This includes natural sounds and cultural sounds, as mentioned before, and non-natural human-caused sounds. The sound vibrations made by our imaginary falling tree, then, are a part of the acoustical environment. Bat echolocation calls, likewise, while outside of the realm of the human soundscape, are a part of the acoustical environment. One can perhaps understand, then, why it is critical to take the entire acoustical environment into account when working to protect natural sounds.

Still with us? Good! Now hang on for the fun part. Sounds that characterize the acoustical environment of a park can be divided into two main categories: intrinsic and extrinsic. **Intrinsic sounds** belong to a park by its very nature, based on its purposes, values, and establishing legislation. In addition to natural sounds, intrinsic sounds can include cultural and historic sounds that contribute to the acoustical environment of a park. **Extrinsic sound** refers to any sound not forming an essential part of the park unit, or a sound originating from outside the park boundary. These could include the voices of students visiting the park, or jets flying thousands of feet above the park unit.

Speaking of students, now seems a good time to tackle the conundrum of appropriate versus inappropriate sounds. **Inappropriate sounds** are those that do not help meet the mission of a given park or of an area within the park. So, whereas children's laughter during an interactive game outside of an environmental education center would likely be deemed appropriate, the same boisterous interaction may be inappropriate in endangered piping plover habitat. A radio playing at a moderate level could be appropriate in a campground but inappropriate in the backcountry where visitors anticipate natural quiet. Crank that radio volume up several notches at the campground and you are staring squarely into the face of appropriate sound at an unacceptable level (in most situations, in most parks...now you see why it's a conundrum?) What's important to understand is that characterization of a sound as appropriate or inappropriate is heavily dependent on location of the sound and the enabling legislation of the park. It is often referred to (in circles where they talk about this kind of stuff, which admittedly are small) as **extraneous**. Whether a sound is acceptable or unacceptable will depend on how long, how loud, or how often it occurs.

Now you might be asking yourself, "isn't that just a high-priced term for 'noise'?" To which we would have to answer, "almost..." (Did you really expect this to be that easy?) **Noise** is a general term for either unwanted or extraneous sound. Noise, being unwanted, is subjective. The rumbling of a motorcycle going over the Blue Ridge Parkway may be considered noise to someone enjoying the views from a pull off, but not to the person riding the motorcycle.

To learn more about the science of sound, please visit the Natural Sounds and Night Skies website: [www.http://nature.nps.gov/sound/science.cfm](http://nature.nps.gov/sound/science.cfm).

# Powerful World of Sound Curriculum

## Understanding the Impacts of Noise

It is impossible to see, difficult to define, and even harder to regulate. But for all of its esoteric qualities, recent studies are revealing surprising impacts of noise on park resources and visitor experiences. The following summaries on the effects of increasing noise levels in our national parks will provide educators a brief summary of current research results. This is, however, an emerging field of study. Future findings may well influence the way parks are managed in the decades to come. Educators wishing to stay informed can read up on new findings on the Natural Sounds and Night Skies Division websites listed at the end of each summary.

### Effects of Sound and Noise on Wildlife

That old expression, “The early bird gets the worm,” turns out to be truer than ever in urban settings today. In fact, recent studies are finding that some birds in noisy environments have taken to singing at night in order to be heard over the din of the city (Fuller et al. 2007). Birds have also been found to sing more loudly in noisy environments, essentially shouting to communicate (Brumm and Todt 2002, Brumm 2004).

Sound, just like the availability of nesting materials or food sources, plays an important role in the ecosystem. Activities such as finding desirable habitat and mates, avoiding predators, protecting young, and establishing territories are all somewhat dependent on the acoustical environment. So, what does that mean for humans? Beyond needing to have a good pair of earplugs handy for those predawn bursts of birdsong, it is a strong indication that animals are being forced to adapt to increasing noise levels. To illustrate further, imagine that you are at a cocktail party. The room is filled with animated people, all talking loudly. Your mission: to find a mate that will ensure healthy progeny. Your criteria? The male with the deepest voice. There is one problem, however. The party is near a busy highway, and the males are speaking in a higher pitch than normal in order to be heard.

Preposterous? A similar scenario (without, as far as we know, the cocktails) is actually occurring among certain amphibian populations. Research shows that males of at least one frog species is adapting to traffic noise by calling at a higher pitch (Erbe 2002). This could be problematic for the females, because they prefer lower-pitched calls, which indicate larger and more experienced males. Human-caused noise has produced similar results in multiple bird species (Brumm 2004).

In general, a growing number of studies indicates that wildlife, like humans, is stressed by a noisy environment. The endangered Sonoran pronghorn avoids noisy areas created by military jets, female frogs exposed to traffic noise have more difficulty locating the male’s signal, and gleaning bats avoid hunting in areas with road noise (Brumm 2004). When these effects are combined with other stressors such as winter weather, disease, and food shortages, sound impacts can have important implications for the health and vitality of wildlife populations within a park.

These findings are especially significant because national parks are under increasing noise pressure. Noise levels in park transportation corridors today are at 1000 times the natural level. Additionally, the sounds of vehicular traffic have a much larger “footprint” than the concrete surface. Road noise impacts on wildlife have been shown to extend over a mile into the forest (Brumm 2004). Air transportation, as well, can affect life on the ground. Sound levels during peak periods in a high air traffic corridor in the Yellowstone backcountry, for example, were elevated by up to 5 decibels. The result is as much as a 70% reduction in the size of area in which predators can hear their prey (Brumm 2004). Thus, if a predator can typically hear its prey 100 feet away in any direction, the noise from air transportation shrinks that range to 30 feet. Increasingly, careful consideration of the impacts of human-generated noise on wildlife is a critical component of management for healthy ecosystems in our parks.

To view an Annotated Bibliography on Impacts of Noise on Wildlife, please visit:  
[http://nature.nps.gov/sound/assets/docs/Wildlife\\_AnnotatedBiblio\\_Aug2011.pdf](http://nature.nps.gov/sound/assets/docs/Wildlife_AnnotatedBiblio_Aug2011.pdf)

# Powerful World of Sound Curriculum

## ..... **Effects of Sound and Noise on Visitors**

Our world is getting noisier. With dramatic increases in traffic, the explosion of digital gadgets (think of your buddy's constantly chirping Smartphone), and our increasing capacity to reach once-remote areas, quiet solitude is a diminishing commodity. Not surprisingly then, the American public comes to parks with natural quiet in mind. They come for the soothing effect of a gurgling stream, a delicate bird song, or the rustle of leaves on a fall day. From the awe-inspiring thunder of a waterfall to the gentle rustle of leaves in the breeze, natural sounds have a subtle but profound impact on visitors. In fact, 95% of Americans say one of the most important reasons for preserving national parks is to provide opportunities to experience natural peace and the sounds of nature (Fuller et al. 2007).

However, natural quiet in parks is increasingly at risk. To study the effects of human-caused noise on visitors, volunteers at Muir Woods National Monument cataloged all sounds they heard, day and night, for a year. What they found was surprising. It was rarely quiet (Habib et al. 2007). Parks are experiencing an on-going acoustic assault by everything from air tours to maintenance equipment. Such noise affects visitors' perceptions of solitude and tranquility. In a related study at Muir Woods, visitors found increasing levels of human-caused sounds to be unacceptable and even annoying (Habib et al. 2007). Noisy visitors, loud talking, and other related sounds were found to substantially detract from the quality of the visitor experience. In other studies, noise has been shown to be more disturbing to visitors if it is loud, occurs in bursts, is unpredictable, or if it interferes with quiet activities such as bird watching. Isolated areas are not exempt. In Grand Canyon, no single location is totally free of aircraft noise, and in some areas it can be heard up to 43 times in a 20-minute period. Backcountry hikers, after September 11, 2001, reported knowing that something was very wrong because there were no sounds from commercial aircraft (Brumm and Todt 2002). Tranquility, it turns out, even in the most remote areas of our national parks, is at risk.

"As the din of modern society continues to grow, the need for refuge from noise and clamor are becoming increasingly important." National parks must strive to "help meet that need by providing places of calm and quiet where people can still hear the wind in the trees, the rhythm of nature, and the beat of their own heart..." (Habib et al. 2007).

To view an Annotated Bibliography of Visitor Experience and Soundscapes, please visit:  
[http://nature.nps.gov/sound/assets/docs/VisitorExperience\\_Soundscapes\\_AnnotatedBiblio\\_17Aug10.pdf](http://nature.nps.gov/sound/assets/docs/VisitorExperience_Soundscapes_AnnotatedBiblio_17Aug10.pdf)

## ..... **Effects of Sound and Noise on Cultural and Historic Resources**

"And the rockets' red glare, the bombs bursting in air..." These words tell a story about our country's fight for freedom and have a powerful effect on millions of Americans. The specific sounds associated with our history or cultural heritage not only teach us about the past, they connect us to distant times and places in a way that few other things can.

The acoustical environment of national park cultural and historic sites, therefore, is an important part of the ambiance and helps create meaningful connections. The silence of an empty cell on Alcatraz Island hints at the sense of isolation of a former inmate. Cannon fire or Taps at a Civil War battlefield conjures images of both pride and sadness. Every unit within the national park system has its own cultural soundscape that is both unique and appropriate to that particular place. From the brassy horns of New Orleans Jazz to hypnotic native drumming at Bandelier, no two are the same. Unwanted or inappropriate sounds, such as aircraft, vehicles, and construction equipment, can detract from the experience. With this in mind, the National Park Service manages park units to protect those cultural and historic sounds considered fundamental to the park's purposes and mitigate extraneous noise.

To listen to some cultural and historic sounds recorded in parks, please visit:  
<http://www.nature.nps.gov/sound/gallery.cfm#cultural>

# Powerful World of Sound Curriculum

## Where is All That Noise Coming From?

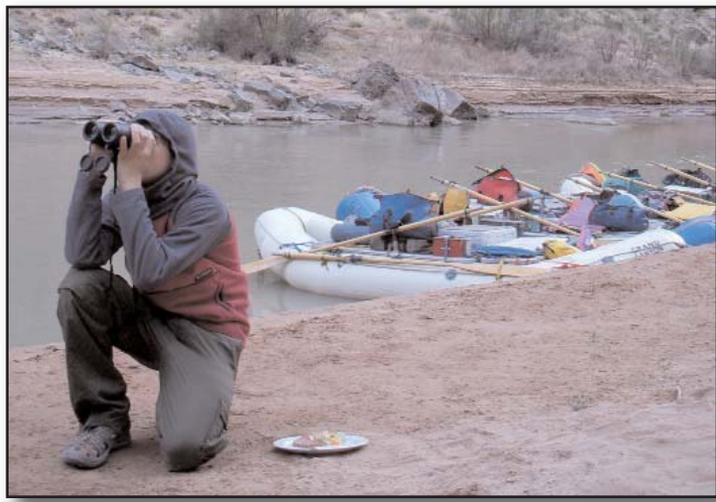
Let's face it, people can be noisy. This fact is no different when we visit parks. And, since parks were created in part for people's enjoyment, a certain degree of noise is appropriate. Some means of exploring our protected areas, however, are noisier than others. When visitors view the park via an air or bus tour, for example, intrusive sounds are created that can impact wildlife and other visitor experiences. The increasing popularity of such activities demands that managers understand and work to mitigate their effects on park resources.

Noise sources come from outside park boundaries as well. The distant hum of overhead air traffic or whirring of wind turbines can take a toll on park resources. Determining the levels and types of sound that are appropriate for different areas within a park is key to effective management. The Natural Sounds and Night Skies Division provides critical data to help parks in making the complex decisions that will preserve vulnerable soundscapes.

Some of the common noise source concerns in National Parks are:

- Park Operations
- Aircraft
- Watercraft
- Vehicles
- Energy Development
- Snowmobiles
- Off-Road Vehicles
- Military Overflights
- Airports & Development

**For more information on how the National Park Service manages these issues, visit:**  
<http://nature.nps.gov/sound/sources.cfm>



"If you have ever sat on a mountain top and surveyed the country below, you must realize that what you saw was even more beautiful because of the awesome silence which surrounded you. Art galleries maintain quiet because curators realize that a painting viewed in the midst of noise is less beautiful than when it is contemplated in the midst of silence." —Karl Pruter

## How Can You Help?

### Minimize your Noise Footprint

- Speak softly when having conversations, especially on hiking trails and at campsites.
- Be aware that the noise you make could affect other visitors, and encourage friends and family to do the same.
- Be considerate of campground quiet hours.
- Look for mute options on electronic equipment such as cell phones, watches, or cameras.
- Turn off cell phones / avoid using speakerphones.
- Consider leaving iPods and/or personal radios in the car or at home.
- Avoid using external speakers that others can hear.
- Participate in non-motorized recreational activities (i.e., hiking, birdwatching, snowshoeing, canoeing).

### Enjoy a Quieter Ride

- Turn off car alarms and disable sounds on electronic door locks (check your vehicle owner's manual on how to do this).
- Use alternative transportation such as shuttles.
- Turn off vehicle engines when stopped at wildlife traffic jams, overlooks, or roadside pullouts. Idling vehicles create unnecessary noise.
- Keep car radio volume at a low level to avoid disturbing other visitors.
- Turn off radios and open windows to hear interesting park sounds.
- Drive at posted speed limits (driving faster creates more noise).
- Don't rev it up! Ride motorcycles respectfully in parks.

### What you can do at home

- In addition to the strategies listed above, the following steps can be used to improve your soundscape at home.
- Consider noise when purchasing home appliances and yard equipment (manufacturers typically provide sound level information in product manuals).
  - Be considerate of neighbors when operating motorized equipment.
  - Use mass transportation.
  - Join a carpool or ride your bike to school or work.

### Plan for the Future

- Reduce unwanted exhaust noise by replacing faulty mufflers or installing quieter models.
- Check for Environmental Protection Agency noise certifications especially for motorcycle exhaust systems.
- To achieve a more pleasant ride and a quiet environment, install quiet tire models. Check tire noise ratings at Consumer Reports.
- Rent a hybrid vehicle while on vacation.
- Reduce and repair vehicle rattles and other problems that cause excessive noise.

From <http://nature.nps.gov/sound/difference.cfm>

## Notes to self:

.....

“How often we speak of the great silences of the wilderness and of the importance of preserving them and the wonder and peace to be found there. When I think of them, I see the lakes and rivers of the North, the muskegs and expanses of tundra, the barren lands beyond all roads. I see the mountain ranges of the West and the high, rolling ridges of the Appalachians. I picture the deserts of the Southwest and their brilliant panoramas of color, the impenetrable swamplands of the South. They will always be there and their beauty may not change, but should their silences be broken, they will never be the same.” —Sigurd F. Olsen



## ..... **The Lesson:**

### **Step 1. Begin by introducing the topic of sound and how it applies to students**

Suggested talking points:

-  “Why do you think a Natural Sounds Program exists?”
-  Introduce what the Natural Sounds Program is and what they do. Explain that the government thinks protecting natural sounds is so important that they have a whole division dedicated to this cause!

### **Step 2. Introduce sound concepts**

Suggested talking points:

-  Brainstorming about what we already know about sound (What types of sound are there? How are they categorized? What are some of the sounds you hear in your everyday life? What sounds do you like/ not like?)
-  What can sounds tell us about a place? What could someone learn about you just by the sounds you make? (i.e., language, music taste, habits, etc.)
-  Natural Sounds, Human-Caused Sounds and Cultural Sounds (students give examples)
-  Soundscape and Acoustical Environment (Soundscape is the human perception of sounds, acoustical environment includes all the sounds present in a place.)
-  Natural Sound is a resource that is threatened and needs protecting.
-  Two activities to help us better understand sound concepts

### **Step 3. Conduct Activities 1 and 2 (see description on following pages)**

## ..... **Activity 1: Layering Sounds** // 25 minutes; Steps A-D

**Theme:** There is a layered world of sound around you.

**General Concept:** (Onion Metaphor) Students will imagine that the sounds occurring around them are layered just like the layers of an onion. Students will be able to peel away layers of sound, similar to peeling away layers of an onion. Once one layer is removed, another layer can be revealed. Sometimes human-caused sounds can mask the sounds of nature, so intentionally peeling away an outer layer of human-made sounds may allow students to hear other sounds that were hidden (or “masked”), resulting in a better awareness of the acoustical world that surrounds them. Give it a try...

**Logistics:** Find a place outdoors where your students will be able to hear both natural and human-made sounds.

**Materials Needed:** Student Journals

### **Learning Objectives:**

-  Students will tune into both the natural and human-made sound “layers” around them, and will be able to differentiate between the two.
-  Students will express the role of sound in their everyday lives.
-  Students will consider why it may be important to have an awareness of the sounds around them.
-  Students will learn about the NPS Natural Sounds Program and why they need to pull apart different sound “layers” to manage and protect soundscapes in park.

“By such a river it is impossible to believe that one will ever be tired or old. Every sense applauds it. Taste it, feel its chill on the teeth: it is purity absolute. Watch its racing current, its steady renewal of force: it is transient and eternal. And listen again to its sounds get far enough away so that noise of falling tons of water does not stun the ears, and hear how much is going on underneath—a whole symphony of smaller sounds, hiss and splash and gurgle, the small talk of side channels, the whisper of blown and scattered spray gathering itself and beginning to flow again, secret and irresistible, among the wet rocks.” —Wallace Stegner

## ..... **Activity 1: Layering Sounds // cont...**

### **Step A. 6 minutes**

#### **Part 1) 30 Second Listening Exercise (All Sounds)**

Students spread out and find a comfortable spot to sit where they can still hear with journal near by. Minimize sounds (clothing, phones, ipods, etc.) Students close eyes and simply listen to all the sounds around for 30 seconds. After 30 seconds, instruct students to open eyes and make a list of all the sounds they heard.

#### **Part 2) 3-5 minute Discussion**

##### Suggested Discussion Questions:

-  What did you hear?
-  Of those sounds, which ones were human-made?
-  Which sounds were natural?
-  What sounds did you like/ not like?
-  Do you think there's a difference between sound and noise?

Note: Be sure to emphasize the difference between the use of "sound" and "noise." Noise is sometimes incorrectly used as a synonym for sound, but "noise" is a sound that is undesired or extraneous.

### **Step B. 6 minutes**

#### **Part 1) 30 Second Listening Exercise (Natural Sounds)**

Repeat activity peeling away human-made sounds listening just for NATURAL SOUNDS. Introduce concept of onion, imagining you can peel away layers of sound, similar to peeling away layers of an onion. Once one layer is removed, another layer can be revealed. Give start/ stop cues and instruct students to make list of sounds heard in journal.

#### **Part 2) 3-5 minute Discussion**

##### Suggested Discussion Questions:

-  What did you hear this time?
-  Did you hear anything new this time?
-  How easy or difficult was it to peel away the layer of human-caused sounds? Were you able to do it?

## Activity 1: Layering Sounds // cont...

### Step C. 6 minutes

#### Part 1) 30 Second Listening Exercise (Human-made Sounds)

Repeat activity peeling away the natural layer of sound and focus only on human-caused sound. Give start/ stop cues and instruct students to make list of sounds heard in journal.

#### Part 2) 3-5 minute Discussion // Suggested Discussion Questions:

-  Was this easier or harder?
-  What did you hear this time?
-  Did anything you heard surprise you?

### Step D. 10-15 minutes

#### Activity One; Final Discussion

- How did this activity affect you? (heightened awareness? surprise? bored? etc.)
- How did your perception of your environment change when you peeled away the human-made layer vs. the natural layer?
- What sounds were pleasing/ annoying? Why?
- What sounds did you think were inappropriate for this location? Why?
- What sounds did you think were appropriate for this location? Why?
- Would the sounds you thought were appropriate for this location be appropriate for a national park?
- How many of you have been to a National Park? Where?
- If you were a Natural Sounds Program researcher helping the park manager at this park, what sources of noise might you suggest managing for?

### Introduce the National Park Service Dual Mission

#### Talking points:

- Protect natural and cultural resources and provide enjoyment to visitors in parks. (Balance protecting resources while making sure visitors are having a good experience. Enjoyment must leave the parks “unimpaired” for the benefit of future visitors as well.)
- Because of this, what challenges do you think they encounter? For example, they need to minimize human-made sound to protect natural resources, but in order to provide a quality experience for their visitors some human-made sounds need to be allowed (i.e., visitors talking, cars, motorcycles, OHV’s, etc.).
- With the help of the Natural Sounds Program, it is up to the park managers to decide what sounds are appropriate or inappropriate for a particular park unit.
- The Natural Sounds Program works to protect, maintain, or restore acoustical environments while increasing scientific understanding and inspiring public appreciation for soundscapes. In order to assist park managers and achieve their mission, researchers at the Natural Sounds Program must be able to effectively peel apart the natural, cultural and human-made sound “layers”. This allows them to focus on each layer of sound separately and provide better guidance to park managers on the best strategies for protecting both the acoustical environment and soundscape and for addressing noise pollution issues.

## ..... **Activity 2: Communicating in the Wild** // 25 minutes; Steps A-D

**Theme:** Animals rely on sound for communication and survival.

**General Concept:** In this activity, students will explore the role sound plays in wildlife communication. This activity will be similar to the game everyone knows as “Telephone”. Students will try to communicate a message to one of their fellow students under various noise conditions.

**Logistics:** Find a place where it would be appropriate to play audio clips at various sound levels.

**Materials Needed:** CD player or computer with speakers to play audio clips from provided CD. Speakers should be placed in the middle of the room between the listeners and the reader. The audio clip can also be downloaded from: <http://nature.nps.gov/sound/clips.cfm#wild>.

### Learning Objectives:

-  Students will understand the concept of masking.
-  Students will be able to explain the importance of sound for wildlife communication.
-  Students will be able to give examples of how masking impacts wildlife communication, courtship and mating, predation and predator avoidance, and effective use of habitat.

**Message:** One student will try to communicate a message to the rest of the class under different noise conditions (an audio clip will be played at various volumes). Ask the group to imagine they are in a natural environment such as a park or a forest. Ask everyone to stand up. Begin with an introductory question such as: “Why do you think sound is important in the wild?” The purpose of this activity is to allow students to understand what wildlife may experience under unnatural noise conditions.

“If you love it enough, anything will talk with you.”—George Washington Carver

## Activity 2: Communicating in the Wild // cont...

### Step A. 2-3 minutes

#### Part 1) Reading Statement with NO interference

Ask for a volunteer to read the first statement and have the volunteer stand about 20 feet away from the rest of the group.

Ask student to read statement 1 at a normal speed and normal tone (important!). Do not play an audio clip. This represents a situation when there are no noise intrusions in the wild.

**Message 1: Did you know that wildlife depend on sounds to communicate, navigate, avoid danger and find food?**

#### Part 2) 1 minute Discussion

-  What was the message? (Their response does not have to be word for word, we just want them to get the main point of the message.)
-  Did anyone have difficulty hearing him/her? Why?

### Step B. 2-3 minutes

#### Part 1) Reading Statement with MEDIUM interference

Ask for second volunteer to come up and stand 20 feet from the rest of the group. Remind him/her to read the 2nd message at a normal speed and tone when you give the OK. Prepare to play audio clip at medium volume. Notify the group the clip you're about to play represents a situation when human-made noise intrudes into the wild. Begin playing the clip, and cue student to begin reading the statement.

**Message 2: Did you know that noise can be harmful to wildlife health and reproduction, habitat use, ability to find prey, and avoid predators?**

#### Part 2) 1 minute Discussion

-  What was the message? (Their response doesn't need to be word for word, we just want them to get the main point of the message). Could you make out any part of the message?
-  How difficult was it to hear him/her?
-  Could you identify any of the sounds in the audio clip?

## Activity 2: Communicating in the Wild // cont...

### Step C. 2-3 minutes

#### Part 1) Reading Statement with LOUD interference

Ask for a third volunteer to come up and stand 20 feet from the rest of the group. Remind him/her to read the third message at a normal speed and tone when you give the OK.

Prepare to play audio clip at loud volume (students should not be able to hear speaker). Notify the group the clip you're about to play represents a situation when a very loud human-made noise intrudes into the wild. Begin playing the clip and cue student to begin reading the third statement.

**Message 3: Masking has the greatest impact on predator avoidance because detecting predators can be a life or death situation for an animal.**

#### Part 2) 1 minute Discussion

- 🔊 What was the message? (The class does not need to respond word for word, we just want them to get the main point of the message). Could you make out any part of the message?
- 🔊 How difficult was it to hear him/her?
- 🔊 Could you identify any of the sounds in the audio clip? (Sounds include train, helicopter, propeller airplane, and motorcycle).

### Step D. 10-15 minutes

#### Activity Two; Final Discussion

- What are some examples of messages that an animal might try to communicate to another animal?  
Some answers: A male trying to court a female; Bird using an alarm call to notify other birds that a predator is nearby; Animal notifying another animal that prey is nearby; Young bird using a begging call to get food from parent.
- I set specific parameters that our volunteers had to follow (speak in normal tone, at normal speed, 20 ft distance from listeners), but what could the reader have done differently to get the message across? In other words, what might an animal have to do to get a message across when it is noisy?  
Some answers: Call louder; Use visual signals; Move closer to message receiver.
- If an animal had to call louder to get its message across, how would that affect the animal?  
Some answers: make the animal more obvious to predators/prey; make the animal tired or stressed or hoarse from shouting.
- If animals were grazing in a noisy area where they couldn't hear as well, what else could they do to make sure they are safe from predators while grazing?  
Possible answer: They might graze less – they would have to rely more on their sight to see predators, thus foraging less and expending more energy to keep safe.
- If your class will be traveling to the Grand Canyon, make predictions about the sounds you might hear on your visit. What sounds do you hope to hear (or not hear)?
- Close lesson by reading real-life examples of how wildlife have been affected by noise.

## Wildlife and Noise: Additional Examples

(Optional: Read or pass around and have students take turns reading statements out loud)

1. Titmouse (bird) – responds to human noise by altering the frequency structure of their song. In order for their songs to be heard, they must sing at higher frequencies. (Katti and Warren 2004).
2. Killer Whales - The noise from fast whale-watching boats was found to be audible to killer whales over 16 km, to mask killer whale calls over 14 km, and to elicit a behavioral response at over 200 m (Erbe 2002).
3. Nightingales, Zebra Finches, Blue-throated hummingbirds - All birds increased the sound level of their songs in response to an increase in white noise broadcast to them. Birds that are forced to sing at higher levels have to exert more energy and must bear the increased costs of singing (Brumm and Todt 2002, Lohr et al. 2003, Pytte et al. 2003).
4. Common Marmosets (monkey)– Marmosets were found to increase both the sound level and length of their spontaneous calls in response to increased levels of white noise broadcast to them. Again, this forced them to exert more energy that would normally be used for other tasks (Brumm et al. 2004).
5. Tree Swallows – One study examined how nestlings' response to calls by their parents is affected by ambient noise. Researchers found that the nestlings' begging call length, sound level and frequency range all increased with increasing noise levels at nests. This might explain why nestlings have to rely on other methods such as visual signals to get parents attention (i.e., more body movement) (Leonard and Horn 2005).
6. Mountain Sheep - Significantly more animals abandoned sampling areas and moved away from helicopter noise. Likewise, mountain sheep changed the vegetation type they occurred in more often with presence of helicopter noise (Bleich et al. 1994).
7. Ovenbirds – One study found a significant reduction in ovenbird pairing success at compressor sites (77%) compared with noiseless wellpads (92%). We hypothesize that noise interferes with a male's song, such that females may not hear the male's song at greater distances and/or females may perceive males to be of lower quality because of distortion of song characteristics (Habib et al. 2007).
8. Chaffinches – Increased vigilance of surroundings as a result of louder background noise led to significantly fewer pecks and an overall reduction in intake rate. This suggests that compensating for the increased predation risk could indirectly lead to a fitness cost (Quinn et al. 2006).
9. Giant Pandas - preliminary findings indicate that ambient noise can have long-lasting effects on stress indices. Days characterized by louder levels of noise were associated with increased movement, restless handling of the exit door of the enclosure, increased scratching and vocalizations indicative of agitation, and/or increased glucocorticoids (classic endocrine response to stress) excreted in urine (Owen et al. 2004).
10. Bottlenose Dolphin - Significant heart rate accelerations were observed in response to sound playback stimuli (Miksis et al. 2001).

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“Only in the oasis of silence can we drink deeply from our inner cup of wisdom.” —Sue Patton Thoele



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