Masking Mayhem Educational Activity

Objective

This activity introduces masking, or sounds interfering with each other. The group will experience the challenges of picking out a single sound in a noisy environment.

Ages	10+
Group Size	10–20 students
Setting	Indoors or outdoors
Duration	40 minutes
Subject(s)	Science, Life Sciences

Overview

How quiet or loud is that sound? There are several overlapping terms for this property of sound. Many people say volume. Technical writings might use loudness or amplitude. Musicians talk about dynamics with borrowed Italian words (piano, forte, etc). We prefer the term "intensity" over these alternatives. We try to use it consistently throughout the following activity.

Intensity contributes directly to objective measurements like sound level, typically measured in decibels. This unit of measurement allows sounds to have an objective, quantifiable measurement. The scale used for decibels is often calibrated to human hearing. 0 dB is literally the threshold of the quietest sounds humans can possibly hear. Measuring decibels is optional in this activity, but it gives a hands-on way to learn about this unit.

This activity shows how a noisy location can make it difficult to hear specific sounds. It poses the question, "Can we hear one person clearly in a crowded soundscape?" Members of the group will need to take on different roles. Some people will create sounds, while others carefully listen. At the end, everyone can share thoughts on how sounds balance or compete based on their intensity. These observations help the group understand noise management in other contexts.

Logistics

This activity works best with the group in a semicircle formation. They could be sitting on the floor, seated at tables, or standing up.

The following materials are recommended:

- watch, or another device to monitor time
- an approved sound level app, website or device

Important Vocabulary

Decibels	The standard unit of measurement for the sound level (also known as "dB SPL"). Whether a sound is too loud or too quiet can often be subjective. Decibels provide a consistent, objective measurement.
Intensity	An acoustic property that affects the perceived sound level. Increases in intensity will make a sound louder, while decreases will make it sound softer.
Masking	When the presence of one sound affects or interferes with the perception of a second sound.
Sound Level Meter	These devices enable quantitative measurements of sound level in decibels (dB). There are many smartphone apps that perform this function, including the free NIOSH SLM app.

Procedures

Introduce the term "intensity" and explain that this property or trait describes how loud or quiet a specific sound seems to our ears. Explain that this activity will explore the role of intensity in hearing sounds clearly.

The activity requires three roles that are explained in greater detail below:

- solo volunteer
- listeners
- maskers

Step 1. Prepare a Volunteer

The first step in this activity is selecting a volunteer who will help with your demonstration.

Say

I need a volunteer for a special role. Before anyone offers, let me explain that this person needs to be capable of speaking at different intensity levels.

If no one volunteers, then ask "Who's 75% confident they could do this? What can I clarify to make you more confident?"

Have the volunteer join you in front of the group.

Say

[to the volunteer]: Pick a two-syllable word or phrase that you can confidently repeat over and over. It could be nonsense like "bah-bah", or an actual phrase like "hey-you-hey-you". Choose something that will be easy to repeat continuously. Avoid anything like a tongue twister, because you do not want to get tired quickly.

Ask them to start by repeating the phrase at the intensity level of a normal conversation. See if they can repeat it for 10 seconds while you monitor the time with a watch.

Procedures (continued)

Work with the volunteer to adjust the level or phrase so that they are confident. Then, check in with the rest of the group to make sure that everyone can hear your volunteer. After agreeing that the phrase is appropriate, and they have a sense of the normal conversation level.

Say
[to the volunteer]: Now you are going to repeat your phrase at two other levels of intensity: soft but audible and loud but controlled. First, make your sound as quiet as possible, but still audible to everyone in the space. You want your voice to get softer, but the level needs to remain louder than the background noise here. Next, make your voice louder than normal, but still controlled. You want your voice to get louder, but you don't need to scream or strain your voice.

As they practice these softer and louder intensity levels, offer constructive feedback. Ensure that they are producing three easily distinguished intensity levels.

Say
[to the volunteer]: Now that you have your phrase and three intensity levels, I want to practice directing you. I will use four directions: "soft", "norm", "loud" and "stop". Your job is to react with your chosen phrase at the corresponding intensity level. Let's practice together before we get to the main demonstration.

Say
[to the whole group]: Please listen so that you can provide feedback afterward.

Begin with a basic sequence like "norm-soft-norm-loud-norm-stop". Pause for about 5 to 10 seconds between each intensity direction. It's important to not change intensity too quickly, because the group will need time to perceive the change. Make sure your directions are loud enough to be heard above the volunteer's voice. You should also make sure your directions don't come across as demanding or demeaning. If you choose, you can extend this practice with more complex patterns of intensity.

Ask
[the volunteer]: Do you feel comfortable and confident in your role?

Ask
[the whole group]: Do you have feedback? Can you hear the volunteer at all three intensity levels? Are there any dead spots in the space where it is harder to hear? (If needed, adjust to ensure the success of the rest of the demonstration.) Any other initial observations?

As the group shares observations, take note of anyone who eagerly volunteers. This might help you identify the extroverts early and prepare to get others more involved as the discussion progresses.

Fun Fact

Why can't you hear someone talking when the water faucet is running? It is because low frequency sounds mask higher frequency sounds which are softer at the listener's ear.
HyperPhysics, Georgia State University

Procedures (continued)

Step 2. Prepare the Group

The next step in this activity is dividing the group into two different roles.

Say

[to the whole group]: Let's count off "1, 2, 3, 1, 2, 3..." around the space. Everyone remember your number.

This should result in subgroups that is mixed. The demonstration will make use of this intermingling, so do not let anyone move or ask the subgroups to cluster.

Introduce the term "masking" - when the presence of one sound affects or interferes with the perception of a second sound.

Say

People who work with sound use this word to describe the way certain sounds prevent us from hearing other sounds. The group is going to help us demonstrate this through their two roles: "maskers" or "listeners". We have two distinct roles because it is difficult to both make sound and listen carefully at the same time. Everyone in group 1 raise your hand. You are now "listeners". You won't be making any sound, but this is not a passive role. It's a very active and important part of the demonstration. By listening together and sharing your observations, you will help us better understand masking.

Say

[to the whole group]: Let's give the listeners a chance to practice. Everyone please be as quiet as possible. I'm going to watch the time for 10 seconds while the group is silent. When time is up, I'll ask our listeners to share their observations. OK? [Follow through and watch the time.]

Ask

[the listeners]: Can you share any initial observations with everyone? What sounds are you noticing in this space?

Say

[to the whole group]: Everyone in group 2 and 3 raise your hand. You are now working together as "maskers". Your job is to pair up with the person next to you and make conversation, each two working with a three and vice versa. Start with quick introductions in case you don't already know each other. Then take 30 seconds to agree on some discussion topics or questions. Avoid simple yes-no questions because you will need to sustain the conversation for a few minutes. You should find topics that are interesting for both of you and avoid topics that are too one-sided.

Allow a few minutes for these introductions. After you've regained the group's attention, check with each pair of maskers and ask if everything is clear about their role. Answering their questions now can increase the chances of success for the demonstration. If necessary, advise them that the conversation does not need to be as loud as possible. The masking effect should work with a normal conversation level.

Procedures (continued)

Step 3. Demonstration

Say

Let's review everyone's individual roles:

- The volunteer will be repeating a two-syllable phrase at three different intensity levels.
- The maskers will be engaged in conversation pairs.
- The listeners will be focused on trying to hear the volunteer over the maskers.

Ask

Do any of the listeners have a hypothesis about what will happen? Will the volunteer be audible at all three intensity levels? Will they be masked entirely by the conversations?

Make note of these hypotheses so that you can revisit them after the demonstration.

Follow these steps with the group as you monitor time with your watch:

- Everyone quiet for 10 seconds.
- Start maskers in conversations. Wait 10 seconds.
- Tell the volunteer to start by saying "norm." Wait 10 seconds.
- Tell the volunteer "soft." Wait 10 seconds.
- Tell the volunteer "norm." Wait 10 seconds.
- Tell the volunteer "loud." Wait 10 seconds.
- Tell the volunteer "norm."
- Repeat the commands or improvise other variations.
- End the demonstration and ask everyone to return to quiet.

Step 4. Initial responses

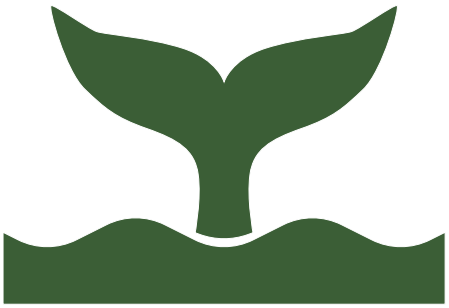
Ask

- Listeners who shared a hypothesis before, explain if your experience confirmed it or not.
- Do any of the remaining listeners want to share their experience? Were you able to hear the volunteer clearly at every level?
- Do any of the maskers want to share their experience? Were you able to focus on your individual conversations, or did the intensity level of other sounds distract them? Did you change the intensity of your conversation in response to any of the other sounds?
- Volunteer, share your experience. Were you able to produce your vocalizations at consistent levels? Did you get tired trying to make yourself heard?
- Are there any general observations we can make about masking based on this demonstration?

Fun Fact

Constant underwater noise generated by vessels can be perceived by marine mammals as an "acoustic fog". Some species, such as fin whales, stop singing when man-made noise levels drown out (or mask) their calls. Others, such as orcas, "speak up" and call more loudly when background noise gets louder.

OceanCare Marine Conservation and Holt et al., 2009



Procedures (continued)

Step 5. Optional Extensions

The following are brief suggestions for extending this activity beyond the basic demonstration.

- Changing roles: Since there are three different roles, you could repeat the activity. Different people could take turns as the solo volunteer, listeners, and maskers.
- Sound level meter: If you are comfortable using one of these devices, use it to measure the decibels at each step. Many sources cite 60 dB as the intensity level of a normal conversation. Use this as a benchmark for the "norm" level of your volunteer. Their soft intensity would then be 6 to 10 dB lower, and the loud intensity should be 6 to 10 dB higher.
- Animal ears: The NPS Junior Ranger Sounds Explorer workbook features an activity about animal ears. You can use cupped hands to explore the shape of different animal ears. Other items like paper towel rolls provide quick, inexpensive ways to reshape the human ear. The demonstration in Step 3 could be repeated with some of the listeners reshaping their ears before the start.
- Ear plugs: Ear plugs can be purchased at most drug stores. When placed in the ear canal, they will lower the perceived intensity of sound overall. A few volunteers could wear ear plugs while the group repeats the demonstration.

Final Discussion

After completing this activity, continue the conversation by using the following discussion prompts:

- How would you summarize the relationship between intensity and masking? Were loud sounds easy to hear over the conversations? Were soft sounds completely covered by the conversations?
- Which sounds were the most (or least) effective for masking?
- Have you ever experienced a loud sound that blocked out another sound? Would anyone be willing to share their example with the group?
- Sometimes we want to hear soft sounds, but loud ones get in the way. What actions can we personally take to hear those soft sounds clearly? What actions can we reasonably ask others to take?
- How do you think animals are affected by masking in their natural habitats?

Fun Fact

When you visit a park, you may see different birds along a trail than you will near a road, due to masking. A study in Prince William Forest Park and Manassas National Battlefield, VA, found that birds will avoid roads when their calls can't be heard. But some birdsongs are in a different frequency range than typical traffic noise. These species don't seem to mind being by a road.
Goodwin & Shriver, 2011

Resources

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Acknowledgments

Created by Dr. Nathan Wolek at Stetson University, Eve Payor at Atlantic Center for the Arts, and Edith Stein at the Florida School for the Deaf and Blind. The Young Sound Seekers program has been supported by the Natural Sounds and Night Skies Division of the National Park Service.

STETSON UNIVERSITY

ACA
Atlantic Center for the Arts
New Smyrna Beach, Florida

Masking Mayhem Field Notes

Step 1. Prepare a Volunteer

- Select a volunteer who is comfortable with their voice and not shy about being at the group's center.
- Choose a two-syllable phrase to repeat such as "bah-bah" or "hey-you-hey-you."
- Instruct the volunteer to repeat the phrase for 10 seconds at normal volume, then confirm everyone can hear clearly.
- Coach the volunteer to vary the intensity, making the phrase softer and louder without shouting.
- Practice directing your volunteer to change intensity with four short commands: "soft," "norm," "loud," and "stop."
- Confirm that your volunteer is comfortable and that the group can clearly hear at all three levels.

Step 2. Prepare the Group

- Have participants count off "1, 2, 3" to assign them other roles.
- Introduce the concept of masking: one sound can prevent hearing another sound clearly.
- 1s will be "listeners", tasked with actively focusing on the soundscape.
- Listen silently to the location for 10 seconds. Ask listeners to share what they are noticing about the soundscape.
- 2s and 3s will be "maskers", tasked with creating conversation in pairs.
- Allow 30 seconds for maskers to introduce themselves and brainstorm topics. Advise them to maintain a natural conversation volume.

Step 3. Demonstration

- Remind everyone of their individual roles.
- Ask listeners if anyone has a hypothesis about what will happen.

Follow this outline:

- Everyone quiet for 10 seconds.
- Start maskers in conversations. Wait 10 seconds
- Tell the volunteer to start by saying "norm." Wait 10 seconds.
- Tell the volunteer "soft." Wait 10 seconds.
- Tell the volunteer "norm." Wait 10 seconds.
- Tell the volunteer "loud." Wait 10 seconds.
- Tell the volunteer "norm."
- Repeat the commands or improvise other variations.
- End the demonstration and ask everyone to return to quiet.

Step 4. Initial Responses

- Review hypotheses and ask listeners, maskers, and a volunteer to share their experiences.
- Return to the concept of masking. Ask participants for feedback and insights based on the activity.

Final Discussion

- How does intensity affect masking? Were loud sounds clearer, and were soft sounds difficult to hear?
- Would anyone be willing to share an example of masking from your past experience?
- What actions can help us hear soft sounds more clearly in noisy environments?
- How do you think animals are affected by masking in their natural habitats?