



SPACE

MESSENGERS

BioSTEAM Activity Guide

Sound & Light



SPACE MESSENGERS' WORKSHOP

Week 6: March 1-5
Sound & Light

OVERVIEW

In this lesson you will prepare your students for week 6 of the workshop called *Sound & Light*. In the workshop they will be working with artist Markus Dorninger, and meeting sound designer and educator David Novack. In this Art session we will learn about the artful physics and creative applications of light and sound that will be practiced for the traveling Space Messengers art installation in the fall. Additionally, we'll share the activities that students have created and/or uploaded to the Space Board gallery with plenty of time for discussion and questions.

We have explored and created unique space board questions and statements, and have generated gestures, symbols and images to express complex meanings about what we have learned. Two of the fundamental tools we will use to send and receive space messages to our audience is through light and sound. We have discussed and experimented with the light elements like shadows and projection. For space messengers, we will be engaging with sound in a number of ways which we will explore in this Art session.

Subjects

Art, physics of light and sound, data sonification

Estimated Time

Several class periods throughout the week and home activities for students.

Grade Level

6-12

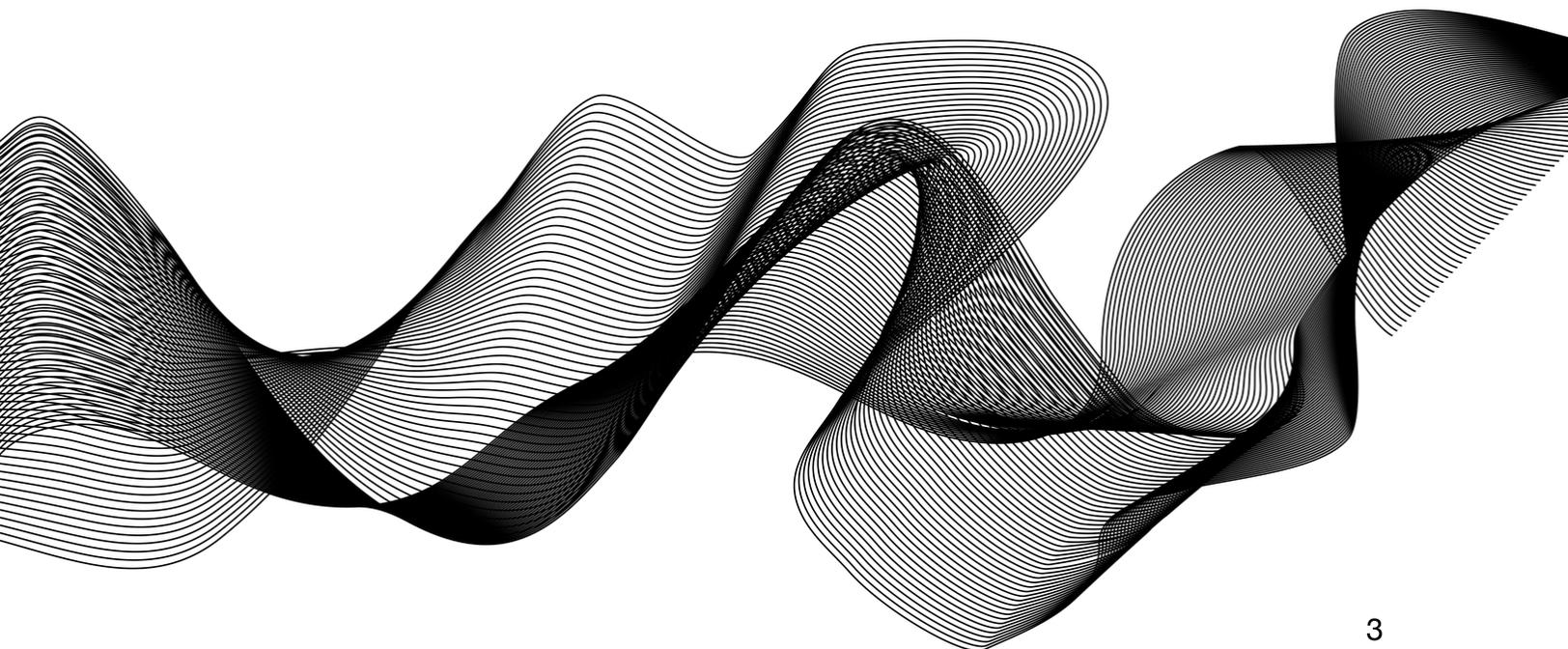
Objectives

Students will be able to:

- *Understand the physics behind light (electromagnetic waves) and sound (mechanical waves).*
- *Explore how light and sound are used to in science and in art to visualize data and the dimensions of our universe that are not visible to our human senses.*

INTRO

The human experience of sound is fundamental to our conception of space. Sound has the capacity to reach us from far beyond our visual field, defining our environments, reminding us of activity we cannot see, and at times bombarding us with noise. It can help us reach a meditative state of relaxation, or force our adrenaline to pump due to the lion's growl from behind the bush, or the horn of car speeding towards us. We can close our eyes. We cannot close our ears. In the pure absence of sound, our ears turn inward and hear our heartbeats, our lungs, our blood...our biological existence maintaining itself in stasis. Thus, our receptors for sound respond to an endless stream of data in the form of waves. *-David Novack*





CREATING A SOUNDSCAPE

Share with the students David's sound concept for the Space Messengers. He will review this in the workshop on Friday:

Unlike light, which is an electromagnetic wave, sound waves need something physical to travel through. In our everyday life, the molecules of air are the material (or medium) through which sound travels, making the air molecules vibrate in a microscopic dance of varying air pressure. When we dive underwater and hear, it is the water molecules that provide the medium of vibration. But things sound different, right? That's because the density and composition of the water is different than air, alternating the kinds of sounds that can travel through the medium. Today, scientists and sound engineers have captured sounds from space! How can that be? Space is silent after all, because there are no air particles, or water particles, or any other particles that can be used as the medium for sound. The truth is, scientists are recording other types of waves, namely electromagnetic radio waves (which are like light waves but in different frequencies than the light we can see). These radio waves are just like how radio works. With radio, we can take a sound and then represent it with a radio wave to broadcast it anywhere, even through space, and then receive that wave and convert it back to sound.

SOUND-SCAPE

For Space Messengers, we will create a randomized sound-scape made up of the radio waves collected from space by NASA, which have already been transformed into sounds, as if sent to us by some distant radio station millions of light-years away.

WORD CHOIR

Attached to your space messages will be the sounds of your voices reading certain words within those texts. Those words will come from a word cloud, a visual representation of how often a word appears. The words most common will be the ones you will read and record. As the texts are randomly generated to appear on the screen, likewise your words will be heard synchronously with the text. In order to accommodate this, we will be recording your words and "tagging" them to the texts. The capturing of your voices will happen in the spring when we capture your silhouettes.

ACTIVITIES: LIGHT AND SOUND MESSAGES

6.1

Listen to and draw sounds in your personal space

Have students do this activity created by David Novack and write or draw their experience.

1. Find a space where you can be alone and still for 10 minutes. Outside is a good choice, but inside can work also. Listen. Listen more. Listen still more. Write down everything that you hear. Everything... from a distant beeping of a delivery truck in reverse, to your dog breathing next to you. If you don't know what it is, try to describe the sound instead. Then answer, what might these sounds tell you about the space you are in and the environment beyond. What stories might you attach to actions that produce these sound? Use your imagination at interpreting the sound data you are receiving.
2. Focus on one sound you heard and draw it!



Listen to and visualize sounds from outer space

Space is not empty, nor is it silent. While technically a vacuum, space nonetheless contains energetic charged particles, governed by magnetic and electric fields, and it behaves unlike anything we experience on Earth. In regions laced with magnetic fields, such as the space environment surrounding our planet, particles are continually tossed to and fro by the motion of various electromagnetic waves known as plasma waves. These plasma waves, like the roaring ocean surf, create a rhythmic cacophony that -- with the right tools -- we can hear across space.

1. Watch the following video clips with your class which provide inspiring background on how sounds from outer space are recorded. The resource links on the next page have more videos and articles to explore. Choose videos appropriate for your students.
 - Stephen Colbert (8:20) of interviewing Brien Greene on gravitational waves. Brien Greene beautifully explains and demonstrates how sounds are created from these waves. It also has a nice visual explanation of the fabric of space-time. <https://www.youtube.com/watch?v=ajZojAwfEb>
 - Watch/listen to this video of the sounds of different planets. Discuss the what the sounds make them feel or think. What images come to mind? How are the sounds of each planet different? <https://www.youtube.com/watch?v=-wnxx-IKW9c>
2. Have students choose their favorite space sounds from links below or from their own research. Ask students to do the following activity.
 - Draw or create a light shadow silhouette that acts out or represents your chosen space sound(s). How could you use your body to interpret data or sound? Or use the sounds as your soundtrack for your silhouette. Record your drawing or recording to be shared in the workshop.

SPACE SOUNDS

NASA sounds

<https://www.nasa.gov/connect/sounds/index.html>

Sound of two black holes colliding

<https://www.ligo.caltech.edu/video/ligo20160211v2>

Eavesdropping in Space: How NASA records eerie sounds around Earth

<https://blogs.nasa.gov/sunspot/2018/12/11/eavesdropping-in-space-how-nasa-records-eerie-sounds-around-earth/>

Sounds of space: New 'chorus' recording by RBSP's EMFISIS instrument

<https://phys.org/news/2012-09-space-chorus-rbsp-emfisis-instrument.html>

NASA collections of sounds

https://www.nasa.gov/vision/universe/features/halloween_sounds.html

Sounds of spacetime (LIGO- gravitational waves)

<https://www.soundsofspacetime.org/sources--sounds-overview.html>

Sun sonification

https://www.youtube.com/watch?v=-l-zdmg_Dno

SCIENCE RESOURCES

Waves, Light and Sound - Physics 101 / AP Physics 1 Review with Physics Girl

<https://www.youtube.com/watch?v=Y1LbQBgvISs>

Sound Properties: Amplitude, period, frequency, wavelength

<https://www.khanacademy.org/science/high-school-physics/x2a2d643227022488:waves/introduction-to-sound/v/sound-properties-amplitude-period-frequency-wavelength>

Is there Sound in Space?

<https://www.youtube.com/watch?v=BpgPXZh1WEQ>

Radio and Plasma Wave Science, or RPWS, instrument

<https://solarsystem.nasa.gov/missions/cassini/mission/spacecraft/cassini-orbiter/radio-and-plasma-wave-science/>

This Blind Astrophysicist 'Sees' the Universe in the Most Amazing Way

<https://www.youtube.com/watch?v=S8qMpohp23k>