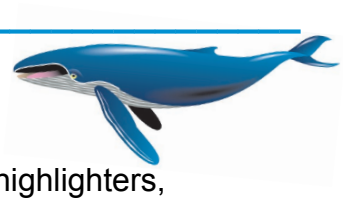
Harmonizing with Humpbacks Activity Sheet

Name: Teacher guide _____ **Date:** _____

Student answers will vary.

We have provided suggested things to look for in student thinking and responses.



Instructions:

1. Gather your materials to harmonize with humpbacks! (Colored pencils, highlighters, Internet connection and speakers.)
2. You will make a spectrogram to chart the sound you hear. You will be listening for differences in pitch and volume of the sounds.
    a. **Pitch**: the highness or lowness of sound. Think about a deep voice versus a high, squeaky voice.
    b. **Volume**: quantity or power of sound; degree of loudness. Think about a whisper versus a loud scream.
3. Read the guide below to help you understand how to plot the sound.

Spectrogram Background Information

A spectrogram is an image made by graphing sounds. Time is on the x-axis in seconds and pitch is on the y-axis. If the pitch increases, the line on the graph goes up.

Volume is represented by color. As the sound gets louder, the line gets brighter in color. If the sound stops, you will have a gap in the line for that given amount of time of silence. See Figure 1 for an example whale song that changes in pitch and volume.

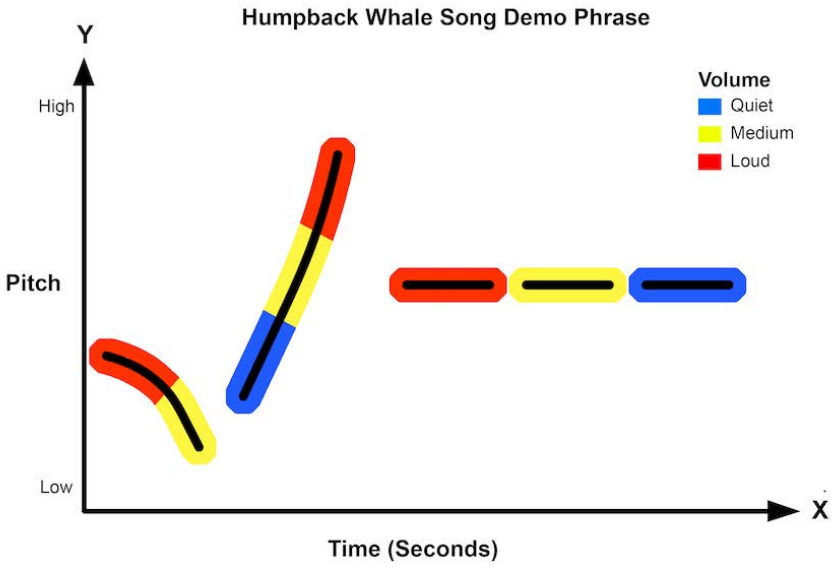
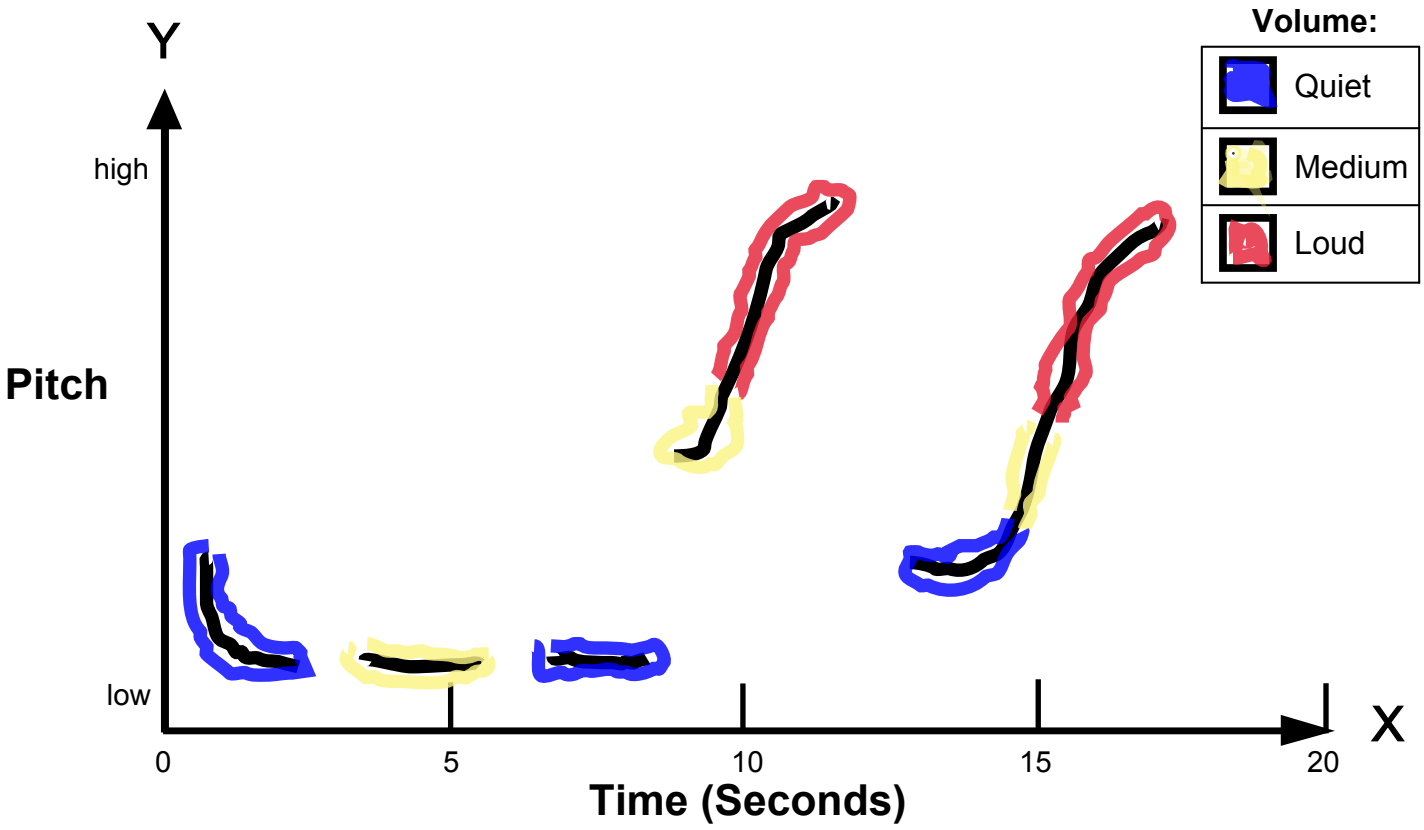


Fig. 1. This spectrogram is an example of a whale song that started with 1) a loud, low pitch that dropped even lower while getting quieter; 2) a swooping sound that got higher in both pitch and volume; 3) and finally 3 short sounds with the same pitch but decreasing volume.

Note: You may want to build in extra time for students to play with The Chrome Music Lab! They can use their voices, other instruments, or play the whale recordings to see the spectrogram created by the program.

4. Practice making sounds with different pitches and volumes.
    a. Visit The Chrome Music Lab to experiment with using your own voice to make a spectrogram. This will help you to 'see' the sounds you are making. Try and make the spectrogram from Figure 2 above! (*www.musiclab.chromeexperiments.com/Spectrogram/*)
5. Go to the NOAA Fisheries Sounds in the Ocean page to listen to the sample humpback whale song (19 sec). (*www.fisheries.noaa.gov/national/science-data/sounds-ocean#humpback-whale*)
6. Describe the sound you heard.
   Look for students to describe the type of sound, but not necessarily using words like pitch and volume. For example, students might describe the humpback whale sound as mumbling, grunting, talking, or even swishing the water.
7. Listen again to the same whale song. Use the graph below to plot the **pitch** of the whale song over time. *Note: You may have to listen to the sound repeatedly as you create your spectrogram.*
8. Assign three different colors of highlighters to represent **volume**: quiet, medium, and loud. Fill in the table legend on the graph on your worksheet to indicate which color you are using to represent each volume.



9. Listen once more to the same song and highlight the line as the sounds change in volume.
10. Describe the sound again using the spectrogram as a reference.
    Look for students to reference terms from the spectrogram in their description, such as pitch and volume. For example, students might describe the humpback whale sound from the NOAA recording as starting off quiet and low in pitch, with separate sounds and high pitch, loud sounds near the end. The separate sounds also change in pitch over time. And, the spectrogram also helps to visualize the distance, or quiet times (pauses), between sounds.

Activity Questions

Name: _____

1. How did making the spectrogram help you to describe the whale song? Look for students to reference vocabulary, organization of thoughts, and things they noticed visually. For example, students might say that the spectrogram helped assign words to their thoughts and to organize their description. The spectrogram also helps to show that there are breaks, or quiet periods in the song.
2. What kind of information can scientists get from a spectrogram of a whale song (compared to just listening)? Just like the spectrogram helps us to organize our thinking and description of the whale song, spectrograms help scientists to see and hear patterns in sound more clearly. The spectrogram can be used for visual comparison between songs, and the spectrogram graph can be converted to numbers for analysis. It can also help to show when there are multiple whales singing.
3. Read the paragraph about whale songs and fill in the blanks using the vocabulary below:

Humpback Whale Background Information

Humpback whales are famous for their complex songs. Only the male humpbacks sing, and they only sing during the mating season in Hawai'i. The singer is usually alone in a head-down, tail-up position. If the singer is following a cow and calf pair, he is called a(n) escort. When another whale joins in on the song, he is called a(n) joiner. Humpback whales do not have vocal cords. They produce sounds by pushing air through tubes and chambers in their respiratory system. Scientists use hydrophones to listen to, and record, whale songs. Researchers can play the songs into a computer that creates a(n) spectrogram, which is a picture of each sound. Whale researchers study patterns on spectrograms to learn about why whales sing, and how they react to other whales around them. Scientists have developed some hypotheses to try to explain why whales sing. Scientists also study whale songs to learn about how noise pollution, caused by people, affects the behavior of whales. Ship engines, military sonar, and explosions used by oil and construction companies make loud sounds under water that may cause changes in the whales' behavior.

Vocabulary:				
	***behavior**	***escort**	***mating**	***singer**
	***hydrophones**	***noise pollution**	***spectrogram**	***joiner**
	***respiratory**	***hypotheses**		

4. Did you see any evidence of noise pollution in your music lab spectrograms (*Hint: what happened when people were talking nearby*)?
   Yes! We noticed a lot of noise pollution! Every time someone talked or made any kind of noise, it showed up on the spectrogram. Even birds from outside showed up!

5. How do you think noise pollution can affect whale behavior?
   Noises might interrupt their communication, confuse them, make it harder to navigate, or make them upset (students might relate to not being able to think in a noisy environment and how this is upsetting).

6. Research and describe other ways sound is represented visually.
   Look for students to be creative! Sound is represented visually in dance, paintings, colors, and art. Sound is also represented visually in musical notes on a page.