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Background Knowledge

Sound is created by **vibrations** that travel through the air in waves similar to the ones we see in water. The waves travel through a **medium**, which is anything that has molecules touching each other, including any gas, liquid or solid. If there is no medium, such as in a vacuum, than there is no sound because the sound is created from compressed molecules bumping into one another. When a vibration is created, the waves emanate in all direction from its source.

There are many different things that can create sound waves. Depending on the width and length of the object creating vibrations (or sound), one hears differing **itches**. For example, women have smaller vocal chords than men do, therefor; their voices are higher pitched. Generally the larger an object is that is creating the noise, the lower the pitch will sound and the smaller the object is, the higher the pitch will sound. The reason this happens is because the size of the object determines how quickly vibrations are created. Smaller objects tend to emit vibrations at a faster rate.

Another key term associated with sound is **volume**, which is determined by the intensity of the sound wave. The more intense the sound waves the louder the sound. Louder sounds create higher waves while short waves are created by soft sounds. An instrument called an oscilloscope can measure the waves. Oscilloscopes also show that higher pitch noises create waves that are bunched together and low pitch noises have waves that have large gaps between them.

The reason we can hear sound is because we have specially adapted bones in our ears that are receptive to the vibrations that move molecules. Nerves that are in the ear than send the message to our brains about the sound that is being emanated. One important thing to remember is that sound travels faster through solids and liquids than it does through gas. Therefor, sound travels faster underwater than it does through the air, which brings us to dolphins and whales.

In the ocean, the spot where the water particles are vibrating back and forth is called equilibrium position. This is a balance that the water particles have in order to produce sound. Sound is extremely important to animals such as whales and dolphins

that live in the ocean because only is the very top of the ocean receiving light from the sun. Thus the animals have a difficult time using their eyes. This means that once an animal dives deep they rely heavily on their hearing sense in order to communicate with one another and spot various obstacles. Furthermore, it helps them find their food sources.

The sounds that dolphins and whales create are intricate and serve many purposes as stated above. They create sounds of varying frequencies through their beaks, blowholes, nasal cavities, and melons. Humans can't even hear some of these frequencies. The two sounds typically heard by humans are either a high pitched whistle or a clicking noise. The whistle is usually for communication while the clicking is sonar. Sonar, also used by bats, is sound that reflects off objects and bounces back to the animal so that they basically see by hearing. This phenomenon is also called echolocation or in dolphins, sprays. Dolphins use an organ called a melon to direct their sprays, which can be so powerful that they can stun even whales. They do this to catch pray or protect themselves from predators. Dolphin's ability to use echolocation is so amazing that it is said that they can "see" through humans and even detect cancer.

<http://neptune.atlantis-intl.com/dolphins/sounds.html>

<http://longwood.cs.ucf.edu/~MidLink/whale.html>

<http://www.uen.org>

Noise Underwater (Ocean Unit)

Grade Level: 6th

Time: an hour-long field trip to a pool

Subjects: Science

Abstract: children will listen to the difference in the way noise sounds underwater verses out of water. Children will relate this to how whales and dolphins rely on sound underwater.

Utah Core Standards:

Science: Std. VI, Obj 3: Describe the production of sound in terms of vibration of objects that create vibrations in other materials.

Benchmark: Heat, light, and sound are all forms of energy. Heat can be transferred by radiation, conduction, and convection. Visible light can be produced, reflected, refracted, and separated into light of various colors. **Sound is created by vibration and cannot travel through a vacuum. Pitch is determined by the vibration rate of the sound source.**

Terminology:

Pitch- Low or high is determined by the size of the object emitting the noise.

Vibration- Comes from an object and creates sound.

Volume – Is determined by the differing levels of sound wave intensity.

ILO: Students will communicate effectively using science language and reasoning.

Objectives:

- Students will predict with reasoning how a sound will be heard underwater.
- Students will record and communicate their findings.

Materials: Recordings of air horn, triangle bell, and bass drum. An underwater CD player unless an underwater sound system exists at the facility you do your fieldtrip at. Every child should have swimsuits, towels, and a change of clothing for the fieldtrip. Children's journals. A pool facility with a lifeguard.

Prior Knowledge: Children should know how sound is a vibration or movement through particles. Prior lessons on how molecules bump into each other and then compress and expand causing a wave like action should be implemented. Also children should be explained that sound cannot be heard in a vacuums because the sound wave needs particles to produce sound. Finally, they should also know the difference in waves of high and low pitches. To assess them on prior knowledge, lead class in a discussion of these things and informally asses each student by their answers and engagement. Make sure each student is called upon to add to the discussion.

Steps/Procedures:

- 1) Plan the fieldtrip weeks in advance. Reserve the pool.

- 2) Get parent drivers and helpers if needed, tell children they will need their bathing suits, towels, goggles if they want, and a change of clothes.
- 3) When at the pool, first play the sounds outside of the pool. Review concepts with a discussion on how the sound moves through the air. Convey to students why this is important and how it relates to water.
- 4) Ask the children to grab their journals and record what they think they will hear when they are underwater and the sound is transmitted underwater. Make sure they also answer “why?” when they make their hypothesis.
- 5) Have them all jump into the shallow part of the pool. Make sure you have a lifeguard and parent helpers.
- 6) Before you press play tell them to go underwater and listen only to one sound until they need to come up for air or until after they heard the sound. Press play when they come up tell them they are going to do it for the next noise. Do this again with the last noise. While they are getting out of the pool, tell the students they need to remember and discuss with a partner what they heard.
- 7) Let them get out of the pool and dry off.
- 8) Discuss as a whole class what was heard. And why. Compare hypothesis with the results and have the children write their conclusions in their journals.
- 9) Add that water is considered a medium through which sound moves through. Sound can move through a liquid medium, gaseous medium, or solid medium. Ask student’s why they think the sounds were muffled a bit. Talk about how sound moves slower underwater because water molecules are denser than air molecules.
- 10) Ask why students think it’s important for creatures underwater to hear. Discuss how it’s often dark underwater so they can’t always depend on sight.

Assessment: assess that students hypothesized reasonably in their journals and then recorded their conclusion. An exception journal entry would have a hypothesis stated using the “if...than...because” sequence. The “than” and “because” answer should be in line with prior knowledge. And the “if” should be similar to “if sound travels through water than...”. A great conclusion would state the children’s findings in detail and be compared to their hypothesis.

Accommodations:

- If going to a pool is difficult use noises that are recorded underwater and play the recordings in class.
- If a child doesn’t want to go in the pool or can’t go in the pool; provide a recording of the sounds underwater or have them buddy up with someone who can tell them what they heard.

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Underwater Ecosystem
Sound Waves

Grade:	6 th Grade
Abstract:	The purpose of this lesson is to introduce students to the characteristic of sound, especially how it relates to sea animals.
Core Standard:	Standard IV: Students will understand properties and behavior of heat, light and sound.
Benchmarks:	Heat light, and sound are all forms of energy. Heat can be transferred by radiation, conduction and convection. Visible light can be produced reflected, refracted and separated into light of various colors. Sound is created by vibration and can not travel through a vacuum. Pitch is determined by the vibration rate of the sound source.
Objectives:	Objective 3: describe the production of sound in terms of vibration of objects that create vibrations in other materials
ILO's:	Use science process and thinking skills and communicate effectively using science language and reasoning
Prior Knowledge:	Students will be asked to explain, how they can hear? Why is hearing important? They will explore the sounds we hear every day and know from our background knowledge (refer to background knowledge for underwater ecosystem unit) that sound is formed by vibration or movement of air. They will then learn that through water vibration or movement of particles sound is also created underwater. To further this knowledge we will discuss the importance of hearing.
Connections:	Students will be able to connect how they can hear sound waves and communicate vs. the underwater ecosystem
Terminology:	wave: the way sound that travels is called a wave which travels through water or air. equilibrium: is the balanced spot in which the water particle is vibrating back and forward and the sound is heard

medium: can be any type of matter gas, liquid or solid. However, it may not travel through outer space because it is a vacuum that contains nothing to carry sound

longitudinal wave: the parallel movement of the wave

transverse wave: is an electromagnetic wave, any wave that oscillates across the two-dimensional plane through which it travels; any wave that causes a crosswise disturbance of the medium through which it travels

perpendicular disturbance: when the longitudinal/parallel gets intersected resulting in a change of direction

- Materials: CD, Terminology list, Venn diagram hand-out, white board, markers, blind folds, pencil or pen
- Invitation to learn: Begin by listening to the sounds of the dolphins/whales communicating CD. What are you hearing? Why do you think it is important for underwater species to communicate? How does sound work? Does sound work the same way underwater?
- Instruction: During the time that students are engaged listening to the dolphin/whale communication, ask what are you hearing? Challenge the students to dive into what sound truly is. Begin reviewing what sound is (a wave that travels through water or air). Review the concept of a liquid such as water is made up of many H₂O particles which provide the sound wave an easy way to travel through the push and pull of these particles. The spot in which the water particle is vibrating back and forward and the sound is heard is called equilibrium position. This is a balance that this particle has in order to produce the sound. Sound is extremely important to animals that live in the water because only the very top of the ocean receives light from the sun. Thus the animals have a difficult time using their eyes when they dive out of sunlight rays. This means that once an animal dives they rely heavily on their hearing sense. Sound travels through a medium. A medium can be any type of matter gas, liquid or solid. However, it may not travel through outer space because it is a vacuum that contains nothing to carry sound. A sound wave is called a longitudinal wave in which the particles move in a parallel direction in which the wave is traveling. (By contrast light is a transverse wave in which the electromagnetic disturbance is perpendicular to the direction of travel of the wave and needs no medium to travel through, light travels in a vacuum.) Even though sound waves in water and sound waves in air are basically similar, the way that sound levels in water and sound levels in air are reported is very different, and comparing sound levels in water and air must be done carefully. Scientists calculate the sound waves in the water

according to the pressure of 1 microPascal (μPa) as the reference intensity for underwater sound. Calculation of sound waves in the air is based on the intensity of a sound wave with the higher pressure of 20 microPascals (μPa) as the reference intensity. To convey the importance of sound I would design an activity in which some of the students were blind folded and had to listen to directions from their partner. I would then have the partners switch this activity. This would hopefully convey the importance of sound. At this point in the lesson we would pass out the Venn diagram worksheet. This is where the students would make comparisons between sounds on land vs. underwater. Instruct the students to write 3 similar idea of sound travel and 3 differences for air sound and underwater sound. The students may use the internet or other sources to determine the differences between air sound waves and underwater sound waves.

Accommodations: Have a terminology sheet available to the ESL students. Create a giant Venn diagram, on the chalk board, and discuss the importance of sound. Have the student's pair up and discuss the similarities and what the differences are between sound travels.

Assessment: At this point in the lesson we would pass out the Venn diagram worksheet. This is where the students would make comparisons between sounds on land vs. underwater. Instruct the students to write 3 similar idea of sound travel and 3 differences for air sound and underwater sound. The students may use the internet or other sources to determine the differences between air sound waves and underwater sound waves. **Assess: Upon completion of the Venn diagram make sure there are 3 similar ideas and 3 differences for each the underwater sound waves and air sound waves.**

Closure: Ask the students, what is one thing you learned this lesson? Challenge the student to go and discover one sound that occurs in the underwater ecosystem. (Remind them the more original the better.)