Echolocation and SONAR

Name: _____

Using Sound Rather than Sight.

Activity 1

Go into a long narrow room. Put on a blind fold and have a friend spin you around until you loose your orientation. Now just by listening figure out which walls are closest and which are furthest away. Describe the results here:

Activity 2

One person wears the blindfold (do not cheat!). Stuff cotton balls under the blindfold below the eyes. The other person drops a pencil somewhere on the table or floor. The blindfolded person gets one chance to grab the object. They cannot *search* with their hands! Leave your hand where you grabbed. The other person measures how far off the grab is from the object with a ruler.

Now drop either the pencil or a pen/dry erase marker in a new spot. The blindfolded person must identify <u>what</u> was dropped and puts their hand where they think it is. Do this four more times.

Note: Make sure that sometimes it's behind them or between their feet!

Person1: _____

Drop	**Item dropped**	**Guessed item**	**How far off**	**Where dropped**	**Where guessed**
Example	*Pencil*	*Marker*	*36 cm*	*Half a meter on the right side on the floor*	*15 cm to the right of their feet*
1					
2					
3					
4					
5					

Person 2: _____

Drop	Item dropped	Guessed item	How far off	Where dropped	Where guessed
1					
2					
3					
4					
5					

1. What location was the easiest to identify?

2. What location was the hardest?

3. Describe the mistakes for each location:
    a. Close
    b. Far away
    c. Medium distance
    d. Behind the person
    e. Table
    f. Floor
    g. Between the feet

4. Did you get better?

5. How much practice do you think you'd need to be able to actually find objects?

6. How much practice do you think you'd need to identify objects 30 meters away? (Remember By this complex system of echolocation, dolphins and whales can determine size, shape, speed, distance, direction, *and even some of the internal structure* of objects in the water.)

Echolocation Homework

Name: _____

Watch this movie about a person who uses echolocation:

1. Why does this person use echolocation?

2. What is the range that this person is capable of?

3. Do you think you could learn how to do the same thing?

Adapted from Discovery of Sounds In The Sea http://www.DOSITS.org

Look at **Sound** sim – http://phet.colorado.edu. Choose interference by reflection, choose Pulse.

7. Send one pulse at a time. What do the waves do when they hit the barrier?

SONAR SOund Navigation and Ranging. Uses this idea of sound bouncing back. Scientists know how fast sound travels in water. They send out a sound and then wait for it to come back. The time it takes to come back tells them how far away objects are.

Of course they need to send lots of sounds in very specific directions and then they can tell not only how far away but where and how big the objects are.

Bat, Dolphin and Whale communications

Watch the video at http://www.dosits.org , chose “Audio Gallery”, choose Humpback Whale, scroll down to the “Underwater video of humpback whales” off the coast of Hawaii.

8. Can you *see* or *hear* the whales easier? (explain)

Background Information (*read all of this before moving on*):

Dolphins and porpoises are the smallest toothed whales. Including orcas and pilot whales, there are 32 species of oceanic dolphins, 5 species of river dolphins, and 6 species of porpoises. Bottlenose dolphins, like Flipper the TV star, are the most familiar. While humans rely primarily on sight to perceive their environment, scientists all agree that dolphins communicate with one another by using sounds and body language.

Clicks and whistles are the two main types of dolphin vocalization. Each individual dolphin has its own "signature whistle", which is a series of whistles, like a dolphin Morse code, which is distinct from any other member of the group. This signature whistle provides a way for dolphins to recognize and bond with others.

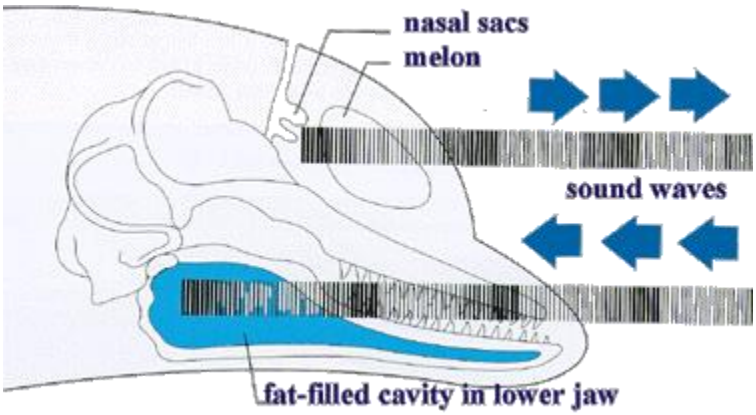
Some dolphins use ***echolocation*** to help them find and capture food. The term *echolocation* refers to an ability that enables bats, dolphins and whales to essentially "see" with their ears by listening for echoes. They echolocate by producing clicking sounds and then receiving and interpreting the resulting echo. Echolocation is Nature’s Sonar.

Dolphins produce directional clicks in trains. Each click lasts about 50 to 128 microseconds.

The click trains pass through the melon (the rounded region of a dolphin's forehead), which consists of lipids (fats). The melon acts as an acoustical lens to focus these sound waves into a beam, which is projected forward into water in front of the animal.

Sound waves travel through water at a speed of about 1.5 km/sec (0.9 mi/sec), which is 4.5 times faster than sound traveling through air. These sound waves bounce off objects in the water and return to the dolphin in the form of an echo.

High frequency sounds don't travel far in water. Low frequency sounds travel farther because of their longer wavelength and greater energy. Echolocation is most effective at close to intermediate range because dolphins and whales use high frequency sounds. Their range is about 5-200 meters for targets 5-15 centimeters in length. **In other words, some dolphins can use echolocation to detect a 15 centimeter (6 inch) long fish a football field away!**



The major areas of sound reception are the fat-filled cavities of the lower jaw bones. Sounds are received and conducted through the lower jaw to the middle ear, inner ear, and then to hearing centers in the brain via the auditory nerve.

The brain receives the sound waves in the form of nerve impulses, which relay the messages of sound and enable the dolphin to interpret the sound's meaning.

By this complex system of echolocation, dolphins and whales can determine size, shape, speed, distance, direction, *and even some of the internal structure* of objects in the water.

Bottlenose dolphins are able to learn and later recognize the echo signatures returned by preferred prey species.

Despite the effectiveness of echolocation, studies show that a visually-deprived dolphin takes more time to echolocate on an object than a dolphin using vision in tandem with echolocation.

Go to the audio gallery and choose "common dolphin" under "Toothed Whales". Listen to the two sound clips of the dolphins while you watch the graph of frequency.

9. Describe what you hear in both cases. What is different about the sounds in each case? What is different about the graphs in each case?

Dolphins produce non-verbal sounds by slapping a body part against the surface of the water, which makes both a sound and a splash. Tail or fluke slapping is also common. Kerplunks are another non-vocal sound made by the tail. Other parts of the body used to produce noise in a slapping manner are pectoral fins and the whole body. Finally, jaw claps are made either above or underwater.