### Orca Whales, Sound & Energy Waves



### Orca Whales, Sound & Energy Waves

### Chapter 1





## GRADE 4 | WAVES, ENERGY, AND INFORMATION

Lesson 1



# In this unit we will be <u>Oceanologist</u>

Oceanologist try to discover information about the ocean and its interactions.

## Introduction of the Unit Phenomenon







If you were a fish swimming in the ocean, what would it sound like?

Let's share some ideas about what we think the ocean sounds like and things that may be making sounds.



#### The Seattle Times

## With 3 pregnant J pod orcas, boaters told to keep away

Sep. 13, 2021 at 6:22 pm | Updated Sep. 13, 2021 at 6:25 pm



Three J pod orcas are pregnant, including J36, shown here... (John Durban, SEA, and Holly Fearnbach, SR3. Taken noninvasively with a drone flown at least 100 feet over the whales and under federal permit.) **More**  $\checkmark$ 

#### By Lynda V. Mapes 🛩

Seattle Times environment reporter

With three pregnant J pod orcas in local waters, boaters are being asked to keep their distance from the whales.

Click

me

The new rule is to help the pregnant whales, J36, J37, and J19 have successful and health births.

Pregnancies are common in this group of southern resident orcas but healthy births are very uncommon. Only 30 of every 100 pregnancies survive because of nutritional stress.

The goal in giving orcas more space is to help them get the food they need. Pregnant orcas need more food, especially toward the end of pregnancy for their quickly growing calf. After birth, orcas nurse their babies and need even more food to produce enough milk to keep their calves alive.

Orcas use sound to hunt and communicate. The noise and disturbance by boats can mask the sounds they need to hear and interrupt their hunts.

A recent research study found that large boat noise is especially damaging to female orcas, who will stop hunting when boats are closer than 400 yards.





## Show your initial ideas!

Big Question: How does sound pollution effect Orcas?

Directions; Using the image below, add information about how you think sound pollution may be negatively impacting Orcas. Remember to add drawings, labels and complete sentences to explain your ideas. [Note: this model is not to scale.]

Add drawings, words, labels and ideas about how you think sound pollution might be affecting the orcas.

Try and record all of your ideas, connections and even questions!

v do you think sound pollution effects Orcas?	What are some questions you have about what's happening?

#### Backside of the Model

Name(s):	Date:	-	
Draw and write about something in your life that this reminds you of			
List some examples of other animals being impacted or using sound.			



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LESSON 2



Today our goal is to learn a little bit about Orca whales before we start to think about sound and how sound pollution may be impacting them.



## Learning about Orcas. We are going to watch and read about orcas. As we do this, you will discuss the information with others in your group and record what you learned, connections you are making or questions you now have.



What did we learn about the name "killer whale"?

How might calling Orcas "killers" impact how humans relate and care about them? Discuss and record your ideas about what you learn.

It is interesting that \_\_\_\_\_

This makes me think \_\_\_\_\_

I am wondering about \_\_\_\_\_

Learning About Orcas Group Notes Names of Group Members:		
1		
2		
3		
4		
5		

Orcas' brains are designed to process sound better than our human brain and they have an extra area (lobe) that connects emotions with thought and communication!



-Orca brains are 5x bigger than humans

-They have an extra paralimbic lobe in their brain that connects emotions with thought and bridges the part of the brain that control communication because of this it is believed that Orcas are even more emotional beings than humans!

-They have an extra acoustic cortexes that helps them better process sounds.





#### **SOCIAL ANIMALS & MUMMY'S BOYS**

Orcas which hunt sea mammals live in groups of 2 to 7 individuals while groups specialising in hunting fish can consist of up to 40 animals. Family relations are close, offspring usually stay with their mother and every group is lead by the eldest female. Orcas living in the same pod speak the same dialect.



1 ON

hums

click

Orcas' speak different

dialects!

squeak

whistle

pops

Pulsed

calls

## **ECOTYPES**

Recent research shows that there are at least ten different existing ecotypes. These vary in appearance, distribution, behaviour, language and diet.

## Orcas have broader frequencies so they can hear more than humans. Their range allows for for communication between groups --- ecotones.



#### THE HEARING RANGE OF DIFFERENT MAMMALS

Before 1974 Orcas were hunted and captured for aquariums. Scientists believe that there were over 200 orcas in the Salish Sea before this time.

Even though they are now a protected animal, the population is struggling to increase because there is not enough salmon to eat, increased toxins in water and sound pollution.



We have just learned a lot about Orcas but there is something really important we have yet to learn about Orcas in the Salish Sea. Indigenous people have lived in harmony in with Orcas for thousands and thousands of years.

Many tribes play an important role in protecting and teaching others about Orcas.

These groups have special knowledge Orca history, location, population numbers and behaviors.



Orcas have been a symbol of the West Coast for many thousands of years. They they are an important part of the culture of many Indigenous peoples, belief systems, symbolism, art and storytelling.

The orca is often considered a symbol of luck, compassion and family. The orcas represent the strength of love and the bonds of family because of their strong group behaviour. Also, some communities think of Orcas as the guardians of the sea.





Today our goal was to learn about Orcas.

We will keep learning about them, but next lesson we are going to start thinking more about sound.





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LESSON 3



To do this we are going to go outside and listen to this loud air horn and talk about what we noticed.





# Let's predict what we think will happen!



- 1. If the distance is further from the airhorn, then the decibels will increase/decrease/stay the same because...
- 1. The decibels on the green line will be greater/smaller/same as the decibels on the \_\_\_\_ line because.

## Lab Directions:





 Stand with a partner 30, 90 or
 120 steps away
 from air horn.

2. Teacher <u>raises hand</u> this will cue you to turn off your voice and start listening. Raise your hand to indicate you are ready.

3. When all hands are raised air horn will blow.

## Lab Directions:



4. Talk to a partner about what you heard.





5. Find a new location to stand either 30, 90 or 120 steps away.

6. Repeat steps twice.

7. Return to room.

## Lab Directions:





4. Watch the orange number and remember the decibels for when the horn sound reaches you.

5. record the "MAX" decibels on the chart paper for trial 1. 6. Repeat steps for trial 2.

7. Return to room.

#### Look at the data we collected...

Distance from Source (strides)	Decibels of Green Line	Decibels of Red Line	Decibel of Purple Line
0	130.1	129.7	132.2
30	95	110	92
90	79	94	75
120	62	70	50

How does sound move from one place to another?

How does volume change as you move closer or further away from the source of the sound?

How does sound change because of surroundings?

How can we represent our data in ways that help us make sense of it? Let's share our representations with each other.







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LESSON 4

### Let's read about echolocation!

There is a reading we can pull.

Orcas have fatty melons in their heads that focus sound energy and work like flashlights for seeing in the dark ocean.

#### 3. MELON

The clicks pass through the melon, an organ at the front of the whale's head, made of specialized fats. The whale can change the shape of the melon and focus the sounds into an acoustic beam it uses to scan its environment, like a flashlight.

HHHH

< Previous Next >

1 Blowhole 2 Phonic lips 6 Brain 3 Melon 6 Fat-filled



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LESSON 5

### **KLEWS Summary Chart**

K	L	E	W	S
What we think we know about the phenomenon	What we are learning	Evidence (from our data)	Wonderings	Scientific Concepts and Words

# How does sound pollution affect Orca Whale pods?



### Orca Whales, Sound & Energy Waves

### Chapter 2





### Orca Whales, Sound & Energy Waves

### **Chapter 3**







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LESSON



https://explore.org/livecams/orcas/orcalab-rubbing-beach-underwater

## How do we measure

## sound?

			# of limes
Source	Intensity	Intensity Level	<b>Greater</b> Than
			TOH
Threshold of Hearing (TOH)	1*10 <sup>-12</sup> W/m <sup>2</sup>	0 dB	10 <sup>0</sup>
Rustling Leaves	1*10 <sup>-11</sup> W/m <sup>2</sup>	10 dB	10 <sup>1</sup>
Whisper	1*10 <sup>-10</sup> W/m <sup>2</sup>	20 dB	10 <sup>2</sup>
Normal Conversation	1*10 <sup>-6</sup> W/m <sup>2</sup>	60 dB	10 <sup>6</sup>
Busy Street Traffic	$1^{*}10^{-5}$ W/m <sup>2</sup>	70 dB	10 <sup>7</sup>
Vacuum Cleaner	1*10 <sup>-4</sup> W/m <sup>2</sup>	80 dB	10 <sup>8</sup>
Large Orchestra	6.3*10 <sup>-3</sup> W/m <sup>2</sup>	98 dB	10 <sup>9.8</sup>
Walkman at Maximum Level	$1^{*}10^{-2}$ W/m <sup>2</sup>	100 dB	10 <sup>10</sup>
Front Rows of Rock Concert	$1^{10^{-1}}$ W/m <sup>2</sup>	110 dB	10 <sup>11</sup>
Threshold of Pain	$1^{*}10^{1}$ W/m <sup>2</sup>	130 dB	10 <sup>13</sup>
Military Jet Takeoff	$1^{*}10^{2}$ W/m <sup>2</sup>	140 dB	10 <sup>14</sup>
Instant Perforation of Eardrum	1*10 <sup>4</sup> W/m <sup>2</sup>	160 dB	10 <sup>16</sup>

Decibels as a measure of sound intensity





#### Animals generating sound energy



The greengrocer cicada produces <u>120 dB</u> chirps at close range.



The bulldog bat has been recorded crying at **140 dB** as it hunts over lakes in Panama. Beyond our hearing at an ultrasonic 55 kHz.



Elephants make such loud rumbles "they literally make your body vibrate." The sound can be "deafening," **103 dB**\_measured at five meters.



Sperm whale communicative clicks have been measured at **230 dB.** Divers nearby have their bodies heated up and have to leave the water.

#### Directions:

Using a decibel meter, a book or a computer identify 6 different sources of sound and record the maximum number of decibels that this source can produce.

Source of Sound	Maximum Decibels Produced

What was most surprising from your research? Why was this surprising?

### **KLEWS Summary Chart**

ĸ	L	E	W	S
What we think we know about the phenomenon	What we are learning	Evidence (from our data)	Wonderings	Scientific Concepts and Words

## How do Orca whales communicate with one another?





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LESSON 5







## GRADE 4 | WAVES, ENERGY, AND INFORMATION

LESSON 4

## HOW DOES SOUND MOVE FROM ONE PLACE TO ANOTHER?