Anglophone School District - North

Grade 4 Science - Unit Lesson Guide

Sound

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The Aim of Science Education - Scientific Literacy

The aim of science education in the Atlantic Provinces is to develop scientific literacy.

Scientific Literacy is an evolving combination of the science-related attitudes, skills, and knowledge students need to develop inquiry, problem-solving, and decision-making abilities; to become lifelong learners; and to maintain a sense of wonder about the world around them. To develop scientific literacy, students require diverse learning experiences that provide opportunities to explore, analyze, evaluate, synthesize, appreciate, and understand the interrelationships among science, technology, society, and the environment.

The Three Processes of Scientific Literacy

An individual can be considered Scientifically Literate when he/she is familiar with, and able to engage in, three processes: Inquiry, problem solving, and decision making.

Inquiry

Scientific inquiry involves posing questions and developing explanation for phenomena. While there is a general agreement that there is no such sing as the scientific method, students require certain skills to participate in the activities of science. Skills such as questioning, observing, inferring, predicting, measuring, hypothesizing, classifying, designing experiments, collecting data, analysing data, and interpreting data are fundamental to engaging science. These activities provide students with opportunities to understand and practise the process of theory development in science and the nature of science.

Problem Solving

The process of problem solving involves seeking solutions to human problems. It consists of proposing, creating, and testing prototypes, products, and techniques to determine the best solution to a given problem.

Decision Making

The process of decision making involves determining what we, as citizens, should do in a particular context or in response to a given situation. Decision-making situations are important to their own right, and they also provide a relevant context for engaging in scientific inquiry and/or problem solving.

Science Assessment Overview

Science is a hybrid term that houses different disciplines such as: Physics, Chemistry, Biology, Environmental Studies, Engineering, Math, etc. Given this broad spectrum, it is not realistic that we can paint science assessment with a single brush in terms of probes that work for every science activity. However, regardless of school subject, let alone science, the frequency of assessment should be unbalanced with formative assessment occupying 80% of practise and summative with the remaining 20%.

80% Formative - 20% Summative

Formative Assessment
Formative assessment is a range of formal and informal assessment procedures employed by teachers during their learning process in order to modify teaching and learning activities to improve student attainment. It typically involves qualitative feedback (rather than scores) for both students and teacher that focuses on the detail of content and performance. Feedback is the central function of formative assessment. It typically involves a focus on the detailed content of what is being learnt.

Science Formative Assessment falls into 2 distinct categories, and they are divided about how feedback is given. Please be aware that an activity could be informal or formal, it is the purpose of the task that determines purpose.

Informal Formative
Informal Formative Science Assessment acts as a monitoring probe and is distinct because it is not graded.

Formal Formative
Formal Formative Science Assessment provides specific feedback to students, the teachers corresponds via anecdotal feedback, rubrics, and written responses to offer progress to student attainment.

Summative Assessment
Summative assessment seeks to monitor educational outcomes, often for the purposes of external accountability. Usually occurring at the end of a learning unit and determines if the content being taught was retained.

Sound

Focus and Context

This unit has a dual focus on inquiry and design technology. Students will inquire about sound production, and how pitch and intensity can be varied. Using this knowledge, they will be able to design musical instruments or sound-making devices.

Music provides an appropriate context for this unit. Students could explore sound production using music, and determine how various musical instruments can impart different qualities of sound.

Unit Instructional Overview

Object that Make Sound	Sound Vibrations	Pitch, Loudness, and Sound Technology	The Ear, Hearing Loss and Noise Pollution
Noise Makers	Empty Glasses Make the Most Noise	Prior Knowledge	Understanding the Ear
	Bottle Sounds	Access Prior Knowledge	Noise Pollution
	Air to Hear?	1st Cycle - Sound Makers Activity	
	Ear to the Ground	2nd Cycle - Storm Activity & Loudness Activity	
	Listening Underwater	3rd Cycle - Pitch Activity	
	Calculating the Speed of Sound	4th Cycle - Activity – My Next Sound Maker	
		Alternate Activity - Sound Sandwich	

* - EECD Grade 4 Inquiry package - available at https://portal.nbed.nb.ca/tr/lr/k-8Science/Pages/default.aspx

Sound - Curriculum Outcomes

Objects that Make Sound	303-9 identify objects by the sound they make	107-1 describe examples of sound technologies used by people to meet their everyday needs
Sound Vibrations	303-10 relate vibrations to sound productions	303-11 compare how vibrations travel differently through a variety of solids and liquids and through air
Pitch, Loudness, and Sound Technology	104-6, 204-1, 204-2 identify and rephrase questions about ways to change pitch and loudness in a testable form	204-3 state a prediction and hypothesis about the effect a modification will have on the pitch and loudness of a sound produced, based on the pattern of sound produced
	301-3 demonstrate and describe how the pitch and loudness of sound can be modified	104-6 use the term “decibels” correctly in descriptions of sound intensity
	104-1, 205-2 demonstrate processes for solving technological problems by designing and constructing a device which has the ability to create sounds of variables pitch and loudness	206-7 evaluate personally constructed musical devices with respect to their ability to vary their pitch and loudness
	107-12, 205-8 identify and use a variety of sources and technologies to gather pertinent information about Canadians who have contributed to sound technology	
The Ear, Hearing Loss and Noise Pollution	300-3 describe and illustrate how the human ear is designed to detect vibrations	300-4 compare the range of sounds heard by humans to that heard by some animals
	106-1 describe examples of devices that enhance our ability to hear and collect sound data, such as hearing aids, sonar, amplifiers, oscilloscopes, and ultrasound	104-1, 207-6 demonstrate processes for investigating the extent of noise pollution in their surroundings, and work with group members to evaluate the processes used in investigating noise pollution
	108-1, 206-9 identify the positive and negative effects of technological devices that produce loud sounds and identify the need for protection from loud sounds to prevent hearing loss	108-3 describe specific personal actions or products that can help reduce noise pollution
	105-1 identify examples of current research related to sound	

Sound

Strand - Objects that Make Sound

General Curriculum Outcomes	Specific Curriculum Outcomes
303-9 identify objects by the sounds they make	303-9 identify objects by the sound they make
107-1 describe examples, in the home and at school, of tools, techniques, and materials that can be used to respond to their needs	107-1 describe examples of sound technologies used by people to meet their everyday needs

Noise Makers

Outcomes:
303-9 identify objects by the sounds they make
107-1 describe examples of sound technologies used by people to meet their everyday needs

Lesson Activity Overview
The purpose of this lesson is to make students aware of the many sounds around them. Often people overlook the many background sounds that happen everyday. In many cases, sounds are used for the purpose of communicating a message. Most commonly, it happens person to person. Others exist that we take for granted, such as, machine to person (alarm clock, blinker, text and ringer alerts, etc) and person to machine (leaving a voice message, SIRI, Automated devices, etc).

Begin by brainstorming the different types of sound in the school day - categorize the responses (using a web) as person to person, machine to person, person to machine.

Make recordings or download recordings of various sounds such as a pencil sharpener, a boiling whistling kettle, a clock ticking, fluorescent lights, or the beep of a microwave when it is finished, Text message, iPhone ringer. Listen to the recording of various sounds and identify as many of them as possible. (303-9)

<u>Journal</u>
Make a list of things in you daily life that make sounds. Describe the use or purpose of the sounds (107-1)

Describe two sounds that tell you to do something. Describe two sounds that tell you that something is going to happen. Describe two sounds that you listen to for enjoyment. (107-1)

Assessment:Informal Formative
Ensure that students have participated in a Brainstorm about objects that make noise 303-9

Assessment:Formal Formative
Ensure that students were successful in identifying sounds and the objects that make that sound 303-9

Ensure that students are able to complete journal entries that describe sound technologies that meet everyday needs 107-1

Sound

Strand - Sound Vibrations

General Curriculum Outcomes	Specific Curriculum Outcomes
303-10 relate vibrations to sound production	303-10 relate vibrations to sound production
303-11 compare how vibrations travel differently through air and a variety of solids and liquids	303-11 compare how vibrations travel differently through a variety of solids and liquids and through air

Empty Glasses Make the Most Noise

Outcomes:
303-10 relate vibrations to sound production

Lesson Activity Overview
When you tap the empty can, it vibrates. These vibrations create sound waves. The full can doesn't ring as well as the empty can. The liquid in the full can "damps" down the vibrations. When you tap a glass with a thin piece of wire laid across the top, the glass vibrates but the vibrations make the piece of wire vibrate, move up and down, as well. You no longer hear the glass ringing with such a clear note.

Task - Empty Vessels make the most noise
A) tap a glass with a pencil. Listen to the way it rings.
B) Lay a tin piece of wire across the top of the glass. Do you think the way it rings will change when you tap it.?

Materials
2 glasses
short length of wire

Assessment:Informal Formative
Ensure that students were able to perform the task and create sound from vibrations 303-10

Assessment:Formal Formative
Ensure that students have appropriately completed the worksheet and that answers are acceptable 303-10

Empty Vessels Make the Most Noise

Predict
How do you think the sound produced by B will differ from A?

Please give your reason.

Observe
Let's try it! Describe what you hear

Explain
Try to explain why the sounds are different

Extension
What do you think will happen when the glass is filled with water?

What happens? Try to explain why.

Bottle Sounds

Outcomes:
303-10 relate vibrations to sound production

Lesson Activity Overview
Sound is caused by matter (solid, liquid, or gases) vibrating. When you blow into a bottle, the air vibrates: the shorter the column of air, the higher the note.
When you tap a bottle, the glass (above the water) vibrates: The shorter the length of the glass, the higher the note.

Task - Bottle Sounds
Have you ever stopped to wonder why the sound produced by a bottle goes up the scale as you fill it?

Fill 3 glass bottles with different amounts of water.

Assessment:Informal Formative
Ensure that students were able to perform the task and create sound from vibrations 303-10

Assessment:Formal Formative
Ensure that students have appropriately completed the worksheet and that answers are acceptable 303-10

Bottle Sounds

Predict
Which bottle do you think will produce the higher note?

A) Blowing _____ B) Tapping the top _____

Please give your reasons

_____

_____

Observe
A) Blowing (what happened?)

_____

B) Tapping the top (what happened?)

_____

Explain
Try to explain what you observed (use the word vibrate if you can).
Clue: Ask yourself what vibrates when you blow and what vibrates when you tap.

_____

_____

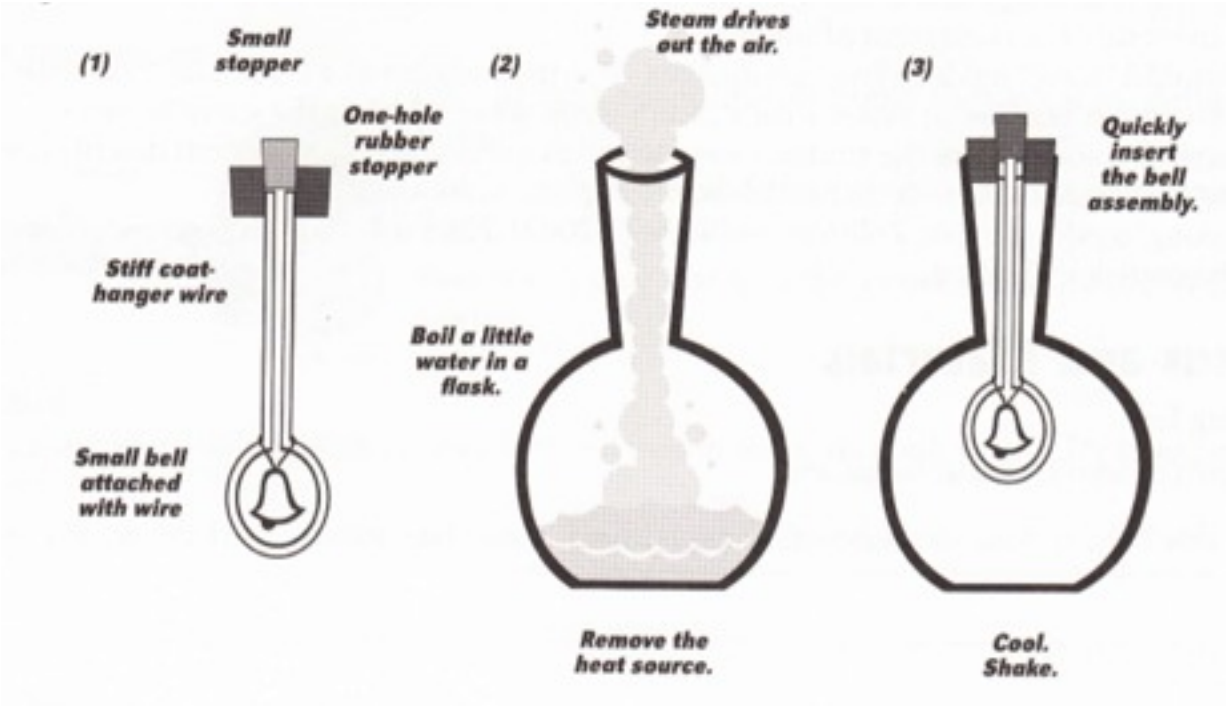
_____

Air to Hear?

Outcomes:
303-11 compare how vibrations travel differently through a variety of solids and liquids and through air

Lesson Activity Overview
As a flask cools down, the steam condenses and leaves less and less water vapor in its atmosphere (at room temperature there is almost a vacuum in the flask).
As the flask cools down, the sound of the bell decreases, if you listen carefully, you can just hear it at room temperature.
Sound is audible vibration. Vibration cannot pass through a vacuum because there is nothing there to vibrate.

Task- Air to Hear?
You need air to breathe, but do you need air to hear? There's no air on the Moon-could you hear anything on the moon?



Assessment:Informal Formative
Ensure that students were able to perform the task and compare sound vibrations through air 303-11

Assessment:Formal Formative
Ensure that students have appropriately completed the worksheet and that answers are acceptable 303-11

Air to Hear?

Predict

Will you be able to hear the bell? (check one)

Yes ( ) No( )

Please give your reasons.

_____

_____

Observe

Let;s do it! What happened?

_____

_____

_____

_____

Explain

Can you explain your observations?

_____

_____

_____

_____

Extension

What do you think will happen if you remove the small stopper and allow air to enter the flask? Try to explain your answer.

_____

_____

_____

_____

Ear to the Ground

Outcomes:
303-11 compare how vibrations travel differently through a variety of solids and liquids and through air

Lesson Activity Overview
Scratching (or a tuning fork) produces vibrations. These vibrations travel better through solids than through air because air is quite compressible and solids are less so. Hence sound travels better through solids.

Task - Ear to the Ground
Native people used to put their ear to the ground to hear if horses were approaching.

Do you think this works?

Do you think sound travels better through a solid than it does through air?

Hold a length of wood close to (but not touching) your ear. Scratch it with a pin
Now touch your ear with the wood. Does the sound get any louder?

Assessment:Informal Formative
Ensure that students were able to perform the task and compare sound vibrations through air 303-11

Assessment:Formal Formative
Ensure that students have appropriately completed the worksheet and that answers are acceptable 303-11

Ear to the Ground

Predict
Do you think you will be able to hear better through air or through wood? Try to explain your answer.

Observe
Check it out! What happens?

Explain
Sound comes from vibration. Can you use the word vibrate to explain what you heard?

Extension
Use a tuning fork to test how well sound travels through different materials (wood, plastic, metal, etc.)
Which works best?

1.

2.

3.

4.

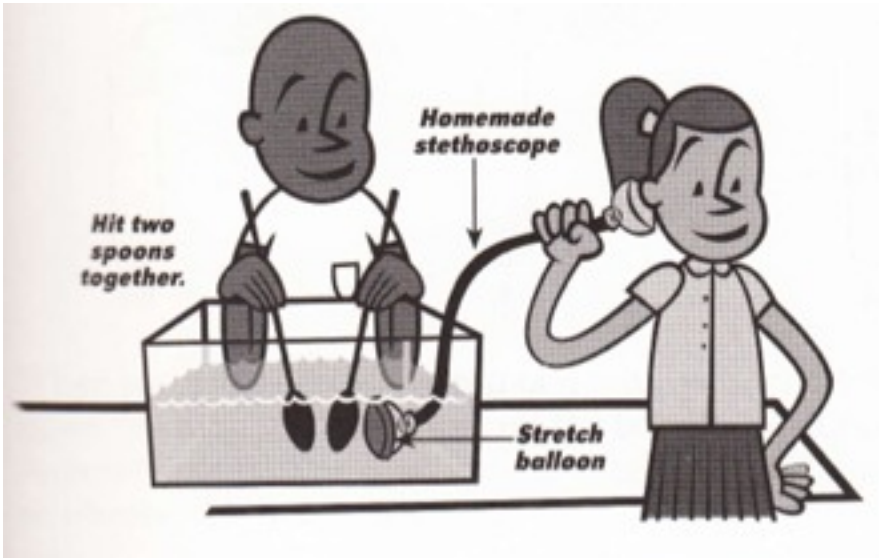
Try to explain Why.

Listening Underwater

Outcomes:
303-11 compare how vibrations travel differently through a variety of solids and liquids and through air

Lesson Activity Overview
When you tap two spoons together underwater, they produce vibrations (pulses or pushes). This is how sound vibrations travel. Imagine a crowded room. Someone at one end of the room begins pushing. The push is transmitted to the next person, who in turn bumps into the next one. The push travels across the room, even through the people stay in their original places. Now water vibrates better then air. Hence, the sound underwater is louder.

Task-Listening Underwater
Have you ever wondered if you can hear underwater? Next time you go to the swimming pool. put your head underwater and listen.
Do you think you would be able to hear your friend humming? How well does sound travel in the water?



Assessment:Informal Formative
Ensure that students were able to perform the task and compare sound vibrations through air 303-11

Assessment:Formal Formative
Ensure that students have appropriately completed the worksheet and that answers are acceptable 303-11

Listening Underwater

Predict
Do you think the sound of the spoons will be louder in air or when you listen through the stethoscope? Confirm it by pressing your ear against the tank. (check one)

Louder in air ( ) Louder in water ( ) No real difference ( )
Please give your reasons

_____

_____

Observe
Let's check it out. What do you observe?

_____

_____

_____

Explain
Try to explain what you observed (use the work vibrate if you can).

_____

_____

_____

_____

Calculating the Speed of Sound

Outcomes:
303-10 Relate vibrations to sound production
207-6 Work with group members to evaluate

Materials:
• Calculators
• A hammer and another piece of heavy metal that will make a loud noise when struck with a hammer
• A clock with sweep second hand
• Meter Stick
• Flashlight

Lesson Activity Overview

3. Ask students what they know about the speed of sound. Discuss the out-of-phase experiences that the students might have had when they saw lightning before they heard the thunder or they saw a baseball being hit from far away before they actually heard the crack of the bat. What other out-of-phase experiences have they had? Expand on these experiences to get at the notion that sound travels at a particular speed, and its speed is less than that of light. Ask students,
    - How could we measure the speed of sound?
2. In this activity, students should work in cooperative groups, but each student should keep his or her own data. First, students must determine the length of their average steps in meters. Place three meter sticks on the floor, and each student should measure the length of three steps, recording data on Activity Sheet 1, Table 1. When students divide the distance by three (the number of steps), they'll arrive at a calculation of meters per step They should make this measurement and calculation three times, and then divide by three to get an average figure for meters per step. (Run three trials of three steps here because our steps can vary a great deal.)

3. The next step in the procedure will take you and the class outside to any large, open area on the school grounds. Before going out, be sure that students know what is expected of them during this "field trip." Once outside, begin hitting any handy piece of metal (such as the blade or a short-handled shovel) with a hammer, making a loud "bang." You must make contact with the hammer once every second, using the sweep second hand of a wristwatch on your stationary arm to time your strikes. The trick here is to move your arm crisply and mechanically in an arclike motion, so that the hammer is clearly at one end of the arc every half second. At one half second, the hammer is clearly away from the shovel, and at the next half second it is contacting the shovel with a bang.

   Once you find your rhythm, have the students walk away, moving backward. When they are close, the sound and the sight of the hammer blow will be simultaneous, but as they move farther way from the sound and sight will become increasingly out of

phase. They must keep moving away until the sound and sight of the blow are on-half second out of phase, that is, until they hear the bang when the hammer is at the opposite end of the arc (i.e., hammer position B in diagram). Then students walk back to your position, counting the number of steps that they take to return to your (because you are the source of the sound). The number of steps should be recorded on Activity Sheet 1, Table 2 and the procedure should be repeated 3 times.

4. When you have returned to the classroom, the students can begin their calculations for the speed of sound using Activity Sheet 1, Table 3. The first task is to determine the distance, in meters, that they stepped off in Procedure 2. They need to multiply the number of steps (for each of the three trials from Procedure2) times the average number of meters per step determined in Procedure 1. this will give the speed that sound travels in one-half second (because the distance measured was based on the hammer;s sound and sight being on-half second out of phase). To get the speed of sound per second, simply multiply by two.

   To summarize the calculation:
   Distance in steps (Procedure 2) x number of meters per step (Procedure 1) x 2 = The speed of sound in meters per second
   or
   Distance (Steps/0.5 sec) x m/steps x 2 (0.5 sec/sec) = Speed of Sound (m/sec)

5. At this point, students can compare their results and discuss what they've learned about sound. Explore the following questions with the class:
   - How did the students' values for the speed of sound compared with the "official" value (343 m/sec or 1,125 ft./sec)? (Any student values that come within a factor of 10 are quite impressive, given the margin for error in this investigation.)
   - What was the class average?
   - How do students account for the differences between their values and the "official" value?
   - What were the sources of error in their procedures?
   - How could they obtain a more accurate figure for the speed of sound?

- What problems did they have with the calculations?
- What did they learn about sound?
- What else would they like to know?

6. So, why do we see the lightning before we hear the thunder? Shine a flashlight around the classroom, clicking it off and on repeatedly. Consider comparing the speed of sound to the speed of light (i.e., Why do we see something in the distance, such as lightning, before we hear it?)
   - Light travels at 299,324 km/sec.
   - To convert these figures into the appropriate units for comparison with the calculated speed of sound (meters per second), multiply 299,324 km/sec. times 1,000 m/km to get the speed in meters per second.
   - Record all figures in the appropriate spaces on Activity Sheet 1
     Once students compare the speed of sound with the speed of light, they should be able to explain they we see distant events (like lightning)before we hear them. (Because the light from an event travels much faster than the sound.)

Extension:

1.Have students find out what causes a sonic boom.

1. Have students find out how the speed of light was determined. How did their methods compare with your method of calculating the speed of sound in this activity?

Discussion Questions:

1. How accurate was your calculation of the speed of sound? Can you think of any sources of error that led to inaccuracies? If you were going to determine the speed of sound again, what, if anything, would you do differently?

2. Why is it that you see a distant event, like lightning, before you hear it?

3. What else would you like to know about sound and how it travels?

Assessment:

1. Were students able to successfully collect step data during their “field trip”? (Use observations made during Procedures 2 and 3 and Activity Sheet 1 as performance assessments.)

2. Could students calculate and compare their figures for the speed of sound? (Use Activity Sheet 1 as a performance assessment.)

3. Were students able to compare the speed of sound to the speed of light and explain why distant events like thunder and lightning appear to be out of phase? (Use student responses to Discussion Questions 1 - 3 as embedded assessments or as writing prompts for science journal entries.)

Rubric:

	Developing 1	Proficient 2	Exemplary 3
Were students able to successfully collect step data during their “field trip”?	Attempted to collect step data but were not successful	Successfully collected step data for use in calculations	Successfully collected step data and were able to explain rationales for the process
Could students calculate and compare their figures for the speed of sound?	Attempted to calculate and compare their figures but were not successful	Successfully calculated and compared their figures	Successfully calculated and compared their figures and were able to explain the mathematical operations used
Were students able to compare the speed of sound to the speed of light and explain why distant events like thunder and lightning appear to be out of phase?	Attempted to explain but were unsuccessful to any significant extent	Successfully explained the out-of-phase phenomenon	Successfully explained the out-of-phase phenomenon and did so using mathematical details

Activity Sheet 1

Calculating the Speed of Sound

1. Calculate the average number of meters per step.

Table 1

Trials	Distance (m)		Meters / step
1 - Three Steps		÷ 3	
2 - Three Steps		÷ 3	
3 - Three Steps		÷ 3	
			Average:

2. Record the distance from 0.5 seconds out of phase to the sound source (from “field trip”)

Table 2

Trial	Distance (in steps)
1	_____ Steps
2	_____ Steps
3	_____ Steps

3. Calculate the speed of sound in meters per second.

Table 3

Distance in Steps (From Table 2)	Average Meters per Step (From Table 1)		Speed of Sound in Meters per Second
_____ Steps		x2	
_____ Steps		x2	
_____ Steps		x2	
			Average:

4. What have you learned about the speed of sound?

5. Compare the speed of sound to the speed of light.

Speed of Light (in km/sec)		Speed of Light (in m/sec)
299,324	x1,000 m/km	

Speed of Light (In Meters/ Sec)	
Speed of Sound (In Meters/Sec)	

Why is it that you sometimes see a distant event before you hear the noise it makes (like seeing lighting before you hear the thunder)?

Sound

Strand - Pitch, Loudness, and Sound Technology

General Curriculum Outcomes	Specific Curriculum Outcomes
104-6 demonstrate that specific terminology is used in science and technology contexts	104-6, 204-1, 204-2 identify and rephrase questions about ways to change pitch and loudness in a testable form
204-1 propose questions to investigate and practical problems to solve	
204-2 rephrase questions in a testable form	
204-3 state a prediction and a hypothesis based on an observed pattern of events	204-3 state a prediction and hypothesis about the effect a modification will have on the pitch and loudness of a sound produced, based on a pattern of sound produced
301-3 demonstrate and describe how the pitch and loudness of sounds can be modified	301-3 demonstrate and describe how the pitch and loudness of sounds can be modified
104-6 demonstrate that specific terminology is used in science and technology contexts	104-6 use term “decibels” correctly in descriptions of sound intensity
104-1 demonstrate processes for investigating scientific questions and solving technological problems	104-1, 205-2 demonstrate processes for solving technological problems by designing and constructing a device which as the ability to create sound of variable pitch and loudness
205-2 select and use tools to manipulate materials and build models	
206-7 evaluate personally constructed devices with respect to safety, reliability, function, appearance, and efficient use of materials	206-7 evaluate personally constructed musical devices with respect to their ability to vary their pitch and loudness
107-12 provide examples of Canadians who have contributed to science and technology	107-12, 205-8 identify and use a variety of sources of technologies to gather pertinent information about Canadians who have contributed to sound technology
205-8 identify and use a variety of sources and technologies to gather pertinent information	

New Nouveau Brunswick
Be...in this place • Être...ici on le peut

Science Resource Package: Grade 4

Sound:

Pitch, Loudness and Sound Technology

New Brunswick Department of Education

August 2010

Prior Knowledge:

This resource package should be used after students have explored the relationship of vibrations and sound.

Students may know:

- Lots of things make sounds.
- Sounds can have different volumes (or intensities).
- There can be different pitches of sounds.
- Some ways to change pitch e.g. adjusting the length of rubber band
- There are different ways to produce sounds e.g. by blowing, hitting, rubbing.
- Different people like/dislike different kinds of sounds.

Common Misconceptions:

- There are places with no sound.
- Hitting an object harder or softer changes the pitch.
- Turning up the volume of a speaker makes the speaker vibrate faster.

Did You Know?

Sound is vibrations. These vibrations can make solids, liquids or gases vibrate. These vibrations move in all directions from the source. They in turn make different parts of our ear vibrate so we can hear and decipher those vibrations.

Two rules for things that make sound:

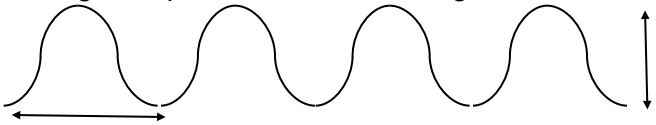
a) The shorter the column of air or the string being vibrated, the higher the pitch of the sound will be.

b) The harder an object is hit, blown or plucked, the louder the sound will be.

A neat experiment is with bottles of water (this has been included in the activities of this package). Place varying amounts of water into pop bottles. Blowing across the bottle makes the air inside the bottle vibrate; the more air (less water) in the bottle the lower the pitch is. By blowing across the top of the bottle, the bottle on the left will make a lower pitched sound than the bottle on the right. Now the opposite is true for tapping the bottle; the more air (less water) in the bottle, the higher the pitch since the glass and water is vibrating instead. When tapping on the bottles, the bottle on the left will make a higher pitched sound than the bottle on the right.

If you have played guitar or even played with a rubber band, you have seen how changes in amplitude (plucking harder) and frequency (changing the length of the band) affect the loudness and pitch.

To be able to visualize what sound looks like and how the picture changes when we change the pitch or loudness, imagine sound to be like a wave.



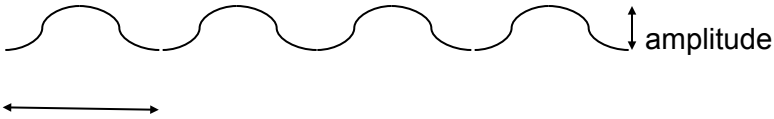
Amplitude = volume

wavelength = pitch

One wavelength is usually measured from one trough to the next trough or one crest to the next crest (these are the same distances, just measured from different starting points).

Amplitude is the height or how tall a wave is.

The amplitude of a wave determines the loudness – the amount of matter it can cause to vibrate. When an object is tapped on softly, the waves are shorter; the sound is quieter.



wavelength

When comparing the 2 diagrams above, notice that the wavelength stayed the same. The pitch will stay the same, but the sound is quieter.

To change the pitch (how high or low a sound is) the frequency needs to change. Frequency is usually measured in Hertz (this is equal to cycles per second).

Wavelength

The above sound would have a higher pitch than the original diagram. Notice how the waves are closer together. The frequency increased meaning the number of waves passing a given point in a certain amount of time is much greater than in the original diagram. To make a lower pitch at the same volume, the waves will stretch out but the height will stay the same.

Just as a note: Higher pitch sounds have a higher frequency (more waves passing a given point in a given amount of time) and a shorter wavelength (the crests of the waves are close together). Lower pitch sounds have a lower frequency (less waves pass a certain spot per second) and a longer wavelength.

Another interesting detail is that thick strings produce lower pitch sounds than thin strings of the same length and tension.

Objects that vibrate have certain frequencies that they vibrate strongly to. These are called the resonant frequency. That's why when you tap a "C" on a piano it plays the same "C" sound each time. That is the resonant frequency of that string.

Doppler Effect

This concept is probably too difficult for students but it will provide you with a deeper understanding of sound and changes in pitch for moving objects.Everything discussed above is true for a sound that comes from an object that is not moving. However, everyone has experienced either a train whistle or a car stereo that changes pitch as it goes by. Remember that sound waves move out in all directions from the source. When an object is moving, that is still true, but the car or train is actually catching up to the sound waves in front of it and moving away from the sound waves behind it. Any change in the distance between waves equals a change in frequency so a change in pitch. The waves in front of the moving object squish together. Remember the diagram above when the waves were closer together? The frequency, that is the number of waves passing a given point in a given amount of time, was higher meaning the sound heard is a higher pitch. The waves behind the moving object are stretched out. Again, when wavelengths are longer, the frequency decreases and the sound heard is a lower pitch. An interesting application of the Doppler Effect is Sonar. Sonar stands for sound navigation and ranging. Sonar uses sound waves to determine how far objects are from the source and uses the Doppler Effect to determine if an object is moving away or towards the sonar. Imagine you are on a boat that is not moving. The sonar sends out sound waves and then detects any changes in those waves as they are reflected and return. If the waves come back at the same frequency, the object that reflected the sound waves is not moving. The time it takes for those waves to return indicates the distance to the object that reflected the sound. If the sound waves come back at a higher frequency, those waves have been squished together and are taking less time to return to the detector. The object being detected is moving towards the boat. The opposite is true if the sound waves that return have a lower frequency.

Ultrasound machines work in much the same way, allowing babies or other organs to be seen. They use very high frequency sound, well beyond the range that people can hear, and decipher the reflected sound to provide a picture of what is inside people.

Further information about sound can be found at the following web sites:

http://www.sciencetech.technomuses.ca/english/schoolzone/info_sound.cfm#whatis – background info and commonly asked questions – bilingual

http://spigotsciencemag.com/ You are required to register, however there is no cost. Choose the issue on sound. There are articles and interesting facts about sound.

Instructional Plan

Access Prior Knowledge

Tell the students: *We've talked about vibrations and how sound is vibrations. Now we are going to hear how sounds can be made and how they are different from each other.*

Materials:

Straw, rubber band, piece of paper, paper towel roll, yogurt containers or cans

Give a different item to each group and ask them: *How many different ways can you make sounds using your item?*

Each group should brainstorm a list of ways to make sound (blowing, tapping, plucking, ripping, etc). Create a class chart of ways to make sound with the kind of items listed under each.

For example:

Blowing	Tapping	Plucking	Ripping	Shaking
Straw	Straw		Paper towel roll	
Paper towel roll	Can			
	Paper towel roll			

Cross-curricular links:
ELA
1. Students will be expected to:
a) Explore and discuss their thoughts, ideas, and experiences and consider those of their peers
b) Ask and respond to questions to clarify information and explore solutions to problems
c) Explain personal opinions and respond to questions and opinions of others

2. Students will be expected to:
a) Contribute to conversations, small-group and whole-group discussion, showing an awareness of when to speak and when to listen
b) Use word choice, tone of voice, facial expressions, and gestures appropriate to the speaking occasion
c) Give and follow instructions and respond to questions and directions

3a. Students will be expected to:
Show basic courtesies of conversation in group interactions

✓ **Assessment:**
Note the concepts and misconceptions students are expressing. You will need to know these to plan effective questions for subsequent activities and discussions so that students will examine and adjust their alternate conceptions.

Post student versions of curricular outcomes on chart paper (see page 27).
Inform students that these outcomes will be addressed over the next portion of the unit. Point out to students which outcomes are being addressed in each activity.

1st Cycle

✪ Curriculum Outcomes

104-1 Demonstrate processes for investigating scientific questions and solving technological problems
107-1 Describe examples, in the home and at school, of tools, techniques, and materials that can be used to respond to their needs
205-2 Select and use tools to manipulate materials and build models
206-7 Evaluate personally constructed devices with respect to safety, reliability, function, appearance, and efficient use of materials
206-9 Identify new questions or problems that arise from what was learned
207-6 Work with group members to evaluate the processes used in solving a problem
301-3 Demonstrate and describe how the pitch and loudness of sounds can be modified

Sound Makers Activity

This is to be a very open activity. Help and suggestions should be kept to a minimum to prevent influencing what the students design.

Materials:

A variety of containers (yogurt tubs, ice cream containers, tin cans, boxes, etc.)
Fabric
Plastic wrap
Beans/rocks/beads
Paper towel or toilet paper tubes
Construction paper
Scissors
Glue
Cotton balls
Wax paper
Tape (masking, duct, and scotch)
Straws
Pencils
String

- Explain to students that they will be making a sound maker that can do at least two things:
    a) Make a quiet sound and a loud sound

Cross-curricular links:

ELA

1. Students will be expected to:
a) Explore and discuss their thoughts, ideas, and experiences and consider those of their peers
b) Ask and respond to questions to clarify information and explore solutions to problems
c) Explain personal opinions and respond to questions and opinions of others

2. Students will be expected to:
a) Contribute to conversations, small-group and whole-group discussion, showing an awareness of when to speak and when to listen
b) Use word choice, tone of voice, facial expressions, and gestures appropriate to the speaking occasion
c) Give and follow instructions and respond to questions and directions

3a. Students will be expected to:
Show basic courtesies of conversation in group interactions

9a. Create written and media texts, collaboratively and independently, in different modes and in a variety of forms
- Recognize that particular forms require the use of specific features, structures, and patterns

MUSIC

4.7.2 Experiment with available technologies while creating and making music.

b) Make 2 different notes (pitches)

Students should be provided with the 2 requirements and a variety of materials.

- Prior to building, have students draw a sketch or make a brief plan of the sound maker they will construct and what materials they may need. See the "My First Sound Maker" sheet on page 28.

If certain materials are limited, do several rounds of having groups take turns selecting a few materials at a time. This will prevent one or two groups from taking all of the most popular items. (Students may have to revise their sketches based on the materials they actually obtained.)

- Have students begin the construction of their sound makers, giving them space to create. They should continue filling in their "My First Sound Maker" sheet as they work.

When students encounter problems with construction, ask questions to help guide them to a solution instead of offering solutions. For example, when they are having difficulties attaching different parts, ask *"What materials do we have that might help that stick together? What other ways can you think of to make 2 objects go together? What did you do last year when you studied materials and structures?"*

- Try to find a safe place to store sound makers until completed and for future use.

✓ **Assessment:**
During the student activity, make notes on outcomes (or parts of outcomes) you observe being addressed. Process skill outcomes are part of the curriculum and should be assessed. Using the observation chart or the checklist (see pages 32 to 34) on a clipboard may be helpful to you. Develop your own code for quick notes.

A suggested code:
√ for observed and appropriate,
WD with difficulty,
A absent.

This chart may be used on multiple days, using a different coloured pen or pencil each day and putting the date in the corner. You may not have a symbol or note for every child every day. Some teachers like to focus on a group or two each time. However you choose to make note of your observations, you will always have a sense of who you need to take more notice of and who might need extra support. The information will also help you when it is reporting time.

Reflection: Class Discussion

- Students can do a very short "show and tell" of their sound makers, demonstrating what materials they used and how it makes a loud/quiet sound as well as two different pitches.
- Once students have seen all of the sound makers, discuss how the different sound makers can be classified. *Whose makes sounds in the same kind of way? Who used the same kind of materials? Is your sound maker similar to someone else's? Did anyone use more than one method to make their sounds?*
- *Are there other ways to make sounds that we don't see in our class's designs (blowing, plucking, hitting, . . .)?*
- *Is it similar to a conventional instrument that you are familiar with?*

Revisit the Accessing Prior Knowledge activity (page 7). *Let's add a picture or a description of our sound makers under our headings (blowing, tapping, plucking, etc.). Are there any categories that should be added to or revised? Is there other information we could add?*

Remind your class about respectful discussion. The discussion tips on pages 24-25 may be helpful.

Cross-curricular links:
ELA
1. Students will be expected to:
a) Explore and discuss their thoughts, ideas, and experiences and consider those of their peers
b) Ask and respond to questions to clarify information and explore solutions to problems
d) Listen critically to others' ideas or opinions expressed

2. Students will be expected to:
a) Contribute to conversations, small-group and whole-group discussion, showing an awareness of when to speak and when to listen
b) Use word choice, tone of voice, facial expressions, and gestures appropriate to the speaking occasion
c) Give and follow instructions and respond to questions and directions
d) Engage in and respond to oral presentations

3a. Students will be expected to:
Show basic courtesies of conversation in group interactions

Reflection: Journaling

- Have students think about their first sound maker and fill in the materials part of the "My Next Sound Maker" chart (see page 31). In particular, students are to think about the materials they could use next time, why they chose them and how that would affect the sound of their sound maker.

Cross-curricular links:
ELA
8. Students will be expected to:
a) Use strategies in writing and other ways of representing to
- formulate questions and organize ideas
- record experiences

b) Experiment with different ways of making their own notes

c) Experiment with language appropriate to purpose, audience, and form, that enhances meaning and demonstrate imagination in writing and other ways of representing

✓ **Assessment:**
Journal entries should not receive a score or mark. A positive comment followed by a question to refocus attention or suggest the next step in learning is very effective.

Note whether students can identify what materials they used and how they could incorporate new ideas into their next sound maker.

My First Sound Maker

Materials used:	My group:
How is a loud sound made? How is a quiet sound made?	Problems encountered:
How can different notes (pitches) be made?	
Diagram(s) of sound maker:	

2nd Cycle

✪ Curriculum Outcomes

104-1 Demonstrate processes for investigating scientific questions and solving technologica problems
104-6 Demonstrate that specific terminology is used in science and technology problems
106-1 Describe examples of tools and techniques that extend our senses and enhance our ability to gather data and information about the world
204-1 Propose questions to investigate and practical problems to solve
204-2 Rephrase questions in a testable form
204-3 State a prediction and a hypothesis based on an observed pattern of events
301-3 Demonstrate and describe how the pitch and loudness of sounds can be modified

Part 1

Storm Activity

Cross-curricular links:
ELA
2c. Students will be expected to:
Give and follow instructions and respond to questions and directions

Use the activity below to introduce a range of volumes and how they can be used to make sounds (or music) sound different.

Have your students stand in a circle so they can all see and hear each other. Tell them that the class is going to make a storm come and go. They must do exactly what the person on their left does and listen carefully to see if they can hear the different stages of the storm.

The teacher starts the chain reaction and switches to the next action once the previous one has come all the way around the circle.

This is the sequence:

1) Rub hands (palms) together
2) Snap fingers
3) Clap hands
4) Slap thighs
5) Stomp feet and slap thighs
6) Then reverse order (slap thighs, clap hands, snap fingers, rub hands)

It sounds like a rain storm sweeping in and then passing by - pretty cool!

Optional: This activity could be repeated using the Decibel Meter to measure the change in loudness. This could act as a lead in when talking about Noise Pollution.

Part 2

Loudness Activity

Have students rotate through the activities. At each centre, have students explore how they can make sounds in a range of volumes. Students can record their strategies on the student sheet "Loudness" found on page 29.

Materials:

See table below

Cross-curricular links:

ELA

1b. Students will be expected to:
Ask and respond to questions to clarify information and explore solutions to problems

2. Students will be expected to:
a) Contribute to conversations, small-group and whole-group discussion, showing an awareness of when to speak and when to listen
b) Use word choice, tone of voice, facial expressions, and gestures appropriate to the speaking occasion
c) Give and follow instructions and respond to questions and directions

3a. Students will be expected to:
Show basic courtesies of conversation in group interactions

8b. Students will be expected to:
Experiment with different ways of making their own notes

MUSIC

4.1.3 Demonstrate an awareness of rhythmic/melodic concepts, form, and texture, through language, movement, and performance.

Activity	Materials	Instructions	Teacher's Note
1. Straw flute	Straws Scissors	Students cut straw tip to form an upside down "V" and blow to make music.	Students may blow or tap the straw to try to change the volume.
2. Rubber bands	Rubber band	Stretch a rubber band between finger and thumb. Pluck to hear sound.	Different thicknesses could be tested to see if thickness has an impact on loudness. Remember that different thicknesses will change the pitch.
3. Tuning forks and different materials	Tuning fork, towel, desk, pile of paper, textbook, box of tissues, filing cabinet or bookshelf, etc.	Place vibrating tuning fork on different surfaces to observe if surfaces affect loudness.	Try to get the students to note the loudness of the tuning fork first, then place it on the surface. Did the volume change?
4. Coffee can calls	Coffee can (without cover) with hole in bottom for shoe lace Thick shoe lace with knot at one end	Wet shoe lace. Pinch one end of shoe lace between fingers with one hand. With other hand, pinch lace between finger and thumb and run them down length of lace. Next, put the lace through the hole in the bottom of the can. The knot should be inside the can. Make sure the string is wet then pinch the shoe lace between finger and thumb and run fingers down length of string quickly.	
5.Coffee cans	Coffee cans or two sizes of containers	Tap on the cans and listen to the sounds. Are they different?	
6. Decibels	Decibel meter and voices	Have students try to talk as softly as they can and record the decibels. Now ask them to make the meter show 50 dB, 65dB and 75dB.	Try to use a quiet corner. Lots of noise from surrounding activities will make it hard to get a low reading.

✓ **Assessment:**
On observation chart (or other record), note how students are performing on the skill outcomes.

Reflection: Class Discussion

Have students share strategies for getting quiet and loud sounds from each activity. These can be recorded in a class chart.

For example:

Activity	Quiet sound	Louder sound
Straw flute		
Rubber bands		
Tuning forks and textures		
Coffee can calls		
Coffee cans		
Voice/Decibels		

Did all students use the same strategies to vary the volume of their sounds?

You may wish to start a class list/word wall of words to describe the volume of sound. For example: Is a soft sound the same as a quiet sound?

Remind students that scientists agree to meanings for words and use them in a precise way so there are not misunderstandings. It is helpful to do that within the class also.

Things to focus on as you discuss the stations:

1. Straw flute – *Did anyone do something other than blow into the straw?*
2. Rubber bands – *Did the thickness affect loudness?*
3. Tuning forks with different materials – *What kind of surfaces make the tuning forks sound louder?*
4. Coffee can and string – *Why could they hear the sound better when they put the shoe lace through the can than when they just rubbed the shoe lace alone?* Note that the can acts as an amplifier, to focus the vibrations in one direction and allowing the sound waves to build and add to each other, making it louder. Using this knowledge, how would students make themselves heard over loud noises or to people farther away?
5. Coffee cans or containers – *Did the size of the container affect the loudness?*
6. Voice/Decibel meters – *Was it hard to get the number of decibels you wanted?* Discuss how Decibels are a way of measuring volume (see chart in core resource p. 31). Talk about the lowest number (Decibel reading) they were able to get during the activity. *How could they make it even lower? Are there sounds that are around us every day that we could measure?* (Students could test different areas of the school

Cross-curricular links:
ELA
1. Students will be expected to:
a) Explore and discuss their thoughts, ideas, and experiences and consider those of their peers
b) Ask and respond to questions to clarify information and explore solutions to problems
d) Listen critically to others' ideas or opinions expressed

2. Students will be expected to:
a) Contribute to conversations, small-group and whole-group discussion, showing an awareness of when to speak and when to listen
b) Use word choice, tone of voice, facial expressions, and gestures appropriate to the speaking occasion
c) Give and follow instructions and respond to questions and directions
d) Engage in and respond to oral presentations

3a. Students will be expected to:
Show basic courtesies of conversation in group interactions

7. such as the empty classroom with the lights off, then with the lights on, then a full classroom, the gym, near the buses, etc.)

Tell students:

> *There are a lot of different inventions that make sounds and most of them have a way to control how loud they are. Why would we want to be able to have sounds of different volumes?*
>
> *What other questions about the loudness of sounds could be investigated?* In small groups, have students make a list to share with the class. Record all questions on a class chart. Have students rephrase the questions into testable form. These could be tested for homework and/or extension activities.

At this point the discussion could be limited to how it may be hard to hear something with all kinds of other sounds around and sometimes a lot of sounds can get annoying or could be damaging. *(This can be revisited when talking about noise pollution and the ear)*.

Revisit the Accessing Prior Knowledge activity (page 7). Ask: *Do we have new ways of making sound to add to our list*? Add new materials to the headings. Remind your class about respectful discussion. The discussion tips on pages 24-25 may be helpful.

Reflection: Journaling

Which method gives you the most control over loudness: plucking, hitting, blowing, or rubbing? Explain why.

Cross-curricular links:
ELA
8. Students will be expected to:
a) Use strategies in writing and other ways of representing to
- formulate questions and organize ideas
- record experiences

b) Experiment with different ways of making their own notes

c) Experiment with language appropriate to purpose, audience, and form, that enhances meaning and demonstrate imagination in writing and other ways of representing

✓ **Assessment:**
Journal entries should not receive a score or mark. A positive comment followed by a question to refocus attention or suggest the next step in learning is very effective.

Note whether students can explain how loudness can be modified.

Loudness

Materials	How I **think** I can change the loudness	What I **actually did** to make the sound quieter	What I **actually did** to make the sound louder
Straw			
Rubber band			
Tuning forks			
Decibel meter			
Coffee cans and shoelace			
2 sizes of cans			

3rd Cycle

✪ Curriculum Outcomes

104-1 Demonstrate processes for investigating scientific questions and solving technological problems
104-6 Demonstrate that specific terminology is used in science and technology contexts
204-1 Propose questions to investigate and practical problems to solve
204-3 State a prediction and a hypothesis based on an observed pattern of events
301-3 Demonstrate and describe how the pitch and loudness of sounds can be modified

Pitch Activity

Tell students that they are going to take a closer look at how to change the notes, or pitch, that materials make.

Have students rotate through activities to explore how pitch can be changed by blowing, hitting, and plucking. As they work through each station, the "Pitch" student sheet found on page 30 can be completed.

Materials:
See table below

Cross-curricular links:

ELA

1b. Students will be expected to:
Ask and respond to questions to clarify information and explore solutions to problems

2. Students will be expected to:
a) Contribute to conversations, small-group and whole-group discussion, showing an awareness of when to speak and when to listen
b) Use word choice, tone of voice, facial expressions, and gestures appropriate to the speaking occasion
c) Give and follow instructions and respond to questions and directions

3a. Students will be expected to:
Show basic courtesies of conversation in group interactions

MUSIC

4.1.3 Demonstrate an awareness of rhythmic/melodic concepts, form, and texture, through language, movement, and performance.

Activity	Materials	Instructions	Teacher's Note
1. Straw flute	Straws, Scissors	Students cut straw tip to form an upside down "V". They experiment to find how to change the pitch.	Students should be allowed to discover that the pitch can be changed (made higher) by shortening the straw. If you have straws with 2 different diameters, one can be placed inside the other and slid in and out to vary the length of the air tube (like a trombone).
2. Rubber bands	Rubber bands of varying thicknesses	Stretch a rubber band between finger and thumb. Pluck to hear sound. Change distance between finger and thumb and pluck again. How did the sound change?	Tighter or more stretched gives a higher pitch. Also, thicker rubber bands give lower pitches.
3.Glasses or bottles	One or two glasses or bottles	Fill the bottles with different amounts of water and tap to hear the pitches. Are they different?	For tapping, more water (less air) creates a lower pitch; less water (more air) higher pitch.
4. Bottles	One or two pop bottles	Blow across the top of the bottle to hear the sound. Change the amount of water in the bottle and repeat.	For blowing, less water means more air to vibrate so a lower pitch is produced. Increase the amount of water, less air to vibrate, higher pitch.
5.Coffee cans	Coffee cans (without covers) or two sizes of containers	Tap on the cans and listen to the sounds. Are they different?	Smaller can has higher pitch than larger can.
6.Container and piece of balloon	Container like large ice cream pail or can, Balloon, stretched by blowing up then cut to leave an opening that will stretch over container mouth	Place balloon over container and tap on it. Stretch it tighter and try again.	Balloon may need to be held in place by a rubber band or tape. Tighter balloon will give a higher pitch.

✓ **Assessment:**
On observation chart (or other record), note how students are performing on the skill outcomes.

Reflection: Class Discussion

Discuss the strategy used by the students for changing pitch at each centre (For all the ways of making sound).

What kinds of changes raise the pitch? Lower the pitch?

You may wish to start/continue a class list/word wall of words to describe the pitch of sound. Remind students that scientists agree to meanings for words and use them in a precise way so there are not misunderstandings. It is helpful to do that within the class also.

Cross-curricular links:
ELA
1. Students will be expected to:
   a) Explore and discuss their thoughts, ideas, and experiences and consider those of their peers
   b) Ask and respond to questions to clarify information and explore solutions to problems
   d) Listen critically to others' ideas or opinions expressed
2. Students will be expected to:
   a) Contribute to conversations, small-group and whole-group discussion, showing an awareness of when to speak and when to listen
   b) Use word choice, tone of voice, facial expressions, and gestures appropriate to the speaking occasion
   c) Give and follow instructions and respond to questions and directions
   d) Engage in and respond to oral presentations

3a. Students will be expected to:
Show basic courtesies of conversation in group interactions

Record how to change pitch in a class table.

For example:

Blowing	**Tapping**	**Plucking**	**Ripping**	**Shaking**
Straws- changed length		Rubber bands - stretching		

Were there some stations where the pitch could not be changed?

Do students notice that smaller, shorter, or thinner items have a higher pitch than larger, longer, or thicker items?

<u>Distinguish between changing pitch and volume</u>:

To help students distinguish between changes in pitch and changes in loudness, tie this activity back to previous cycle's activities.

> Ask the students: *When you changed the pitch, did it change the loudness? Can the loudness stay the same?*
>
> Allow students to really discuss/struggle with this. You may want to ask them to get in small groups to explore/investigate this. Come back together as a whole class to share and discuss findings. This is a nice parallel to what actual scientists do.

Another way to help students focus on the differences between pitch and loudness is to have students take turns coming to the front of the class and making two sounds. The rest of the class needs to identify if the student has changed the pitch, changed the loudness or both.

Have students fill in the "My Next Sound Maker" sheet, recording what they might use to make different pitches.

Revisit the Accessing Prior Knowledge activity (page 7). Add new materials under each heading for ways to make sound. Ask: *Do we have new ways of making sound to add to our list*?

Next, compare the table from this cycle to the table from the "Accessing Prior Knowledge" section. Go through each item and the method used to make sound to determine if and how they could also change the pitch.

Remind your class about respectful discussion. The discussion tips on pages 24-25 may be helpful.

Cross-curricular links:
ELA
8. Students will be expected to:
a) Use strategies in writing and other ways of representing to
- formulate questions and organize ideas
- record experiences

b) Experiment with different ways of making their own notes

c) Experiment with language appropriate to purpose, audience, and form, that enhances meaning and demonstrate imagination in writing and other ways of representing

Reflection: Journaling

How do you think this instrument would work? How would you vary the pitch? How might you make this instrument work better?

or

✓ **Assessment:**
Journal entries should not receive a score or mark. A positive comment followed by a question to refocus attention or suggest the next step in learning is very effective.

Note whether students understand that longer strings or taller columns of air or water make lower pitch sounds and vice versa.

Here are several websites that could be used as a follow up to this cycle:

a) Vary the loudness and pitch on a guitar. http://www.bbc.co.uk/schools/ks2bitesize/science/physical_processes/changing_sounds/play.shtml

b) Make "bonkos" from different sized cans. http://www.exploratorium.edu/science_explorer/can.html

c) Make a kazoo and change the pitch by covering the holes. http://www.billnye.com/for-kids-teachers/home-demo-details/?homedemo=Tube+Kazoo&start=13&category=Physics

Think like a scientist

Asking good questions is an important skill in science. Initially students will need support. Model the skill with the whole class and students will begin to have the confidence to contribute. After some practice, students will be able to generate questions successfully individually.

Cross-curricular links:
ELA
8a. Students will be expected to:
Use writing and other forms of representation to
- formulate questions

Present students with a situation and ask them to generate questions that could be investigated scientifically. (These situations and questions do not have to be limited to those that can be done in a classroom.)

Situation:

> Some blind people learn to use sound to find their way around. They make sounds such as tapping their canes, stomping their feet or even making clicking noises with their mouths. The pitch and loudness of the reflected sounds gives them information about their surroundings.
>
> What is one question that could be investigated scientifically?

For example:

> How close to an object do they need to be to know that something is there?
> Does a loud sound give them more information than a quiet sound?

Possible Extension:

How can your voice change pitch? Are there voices you know with a different range of pitches from yours? How would your voice sound if it only had one pitch? Ask the students to try to have a conversation with someone using only one pitch – first with a very low pitch then with a very high pitch. How does it make their throats feel?

Another activity could be to sing the ABC song using different pitches. First try to sing it high then low. Could everyone do it? Take a survey of what was most comfortable.

Here is a website with a cool extension activity for sound on bird calls/songs: http://www.scholastic.com/magicschoolbus/simplescience/archive/labs/tweet.htm

Pitch

Materials	How I **think** I change the pitch	What I **actually did** to change pitch
Straw		
Rubber band		
Glasses or bottles		
Bottles		
Coffee cans or containers		
Container and balloon		

4th Cycle

✪ Curriculum Outcomes

104-1 Demonstrate processes for investigating scientific questions and solving technological problems
104-6 Demonstrate that specific terminology is used in science and technology problems
107-1 Describe examples, in the home and at school, of tools, techniques, and materials that can be used to respond to their needs
204-2 Rephrase questions in a testable form
204-3 State a prediction and a hypothesis based on an observed pattern of events
205-2 Select and use tools to manipulate materials and build models
206-7 Evaluate personally constructed devices with respect to safety, reliability, function, appearance, and efficient use of materials
206-9 Identify new questions or problems that arise from what was learned

Activity – My Next Sound Maker

Based on what students have learned, they will now make another sound maker. They do not need to duplicate or try to improve on their first sound maker, but should justify a complete change in design.

Students should be able to produce an instrument with more control over the sound made or more variation in the sounds made than with their first sound maker.

Materials:

- A variety of containers (yogurt tubs, ice cream containers, tin cans, boxes, etc.)
- Fabric
- Plastic wrap
- Beans/rocks/beads
- Paper towel or toilet paper tubes
- Construction paper
- Scissors
- Glue
- Cotton balls
- Wax paper
- Tape (masking, duct, and scotch)
- Straws
- Pencils
- String

Explain to students that they will be making a sound maker that can do at least two things:

Cross-curricular links:

ELA

1. Students will be expected to:
   a) Explore and discuss their thoughts, ideas, and experiences and consider those of their peers
   b) Ask and respond to questions to clarify information and explore solutions to problems
   c) Explain personal opinions and respond to questions and opinions of others
2. Students will be expected to:
   a) Contribute to conversations, small-group and whole-group discussion, showing an awareness of when to speak and when to listen
   b) Use word choice, tone of voice, facial expressions, and gestures appropriate to the speaking occasion
   c) Give and follow instructions and respond to questions and directions
   d) Engage in and respond to oral presentations
3. Students will be expected to:
   a) Show basic courtesies of conversation in group interactions
   c) Show an awareness of the kinds of language appropriate to different situations and audiences

MUSIC

4.7.2 Experiment with available technologies while creating and making music.

c) Make a quiet sound and a loud sound

d) Make 2 different notes (pitches)

Students should be provided with the 2 requirements and provided with materials. Help and suggestions should be kept to a minimum to prevent influencing what the students design.

Prior to building, have students draw a sketch or make a brief plan of the sound maker they will construct and what materials they may need. If certain materials are limited, do several rounds of having groups take turns selecting a few materials at a time. This will prevent one or two groups from taking all of the most popular items. Students may have to revise their sketches based on the materials they actually obtained.

Have students begin the construction of their sound makers, giving them space to create. When students encounter problems with construction, ask questions to help guide them to a solution instead of offering solutions. For example, when they are having difficulties attaching different parts, ask *"What materials do we have that might help that stick together? What other ways can you think of to make 2 objects go together? What did you do last year when you studied materials and structures?"*

✓ **Assessment:**
On observation chart (or other record), note how students are performing on the skill outcomes.

Reflection: Class Discussion

- Students can do a very short "show and tell" of their sound makers demonstrating what materials they used and how it makes a loud/quiet sound as well as two different pitches.
  Once students have seen all of the sound makers, discuss how the different sound makers can be classified. For each group, ask: *Is this the same kind of design as your first sound maker? Why or why not? What problems did you encounter and how did you solve them?*
- *Is it similar to a conventional instrument you are familiar with?*

Revisit the Accessing Prior Knowledge activity (page 7). *Let's add a picture or a description of our sound makers under our headings (blowing, tapping, plucking, etc.) Are there any categories that should be added to or revised? Is there other information we could add?*

Remind your class about respectful discussion. The discussion tips on pages 24-25 may be helpful.

Reflection: Journaling

For your instrument, describe how you were able to change:

a) loudness
b) pitch

Cross-curricular links:
ELA
8. Students will be expected to:
a) Use strategies in writing and other ways of representing to
- formulate questions and organize ideas
- record experiences

b) Experiment with different ways of making their own notes

c) Experiment with language appropriate to purpose, audience, and form, that enhances meaning and demonstrate imagination in writing and other ways of representing

✓ **Assessment:**
Journal entries should not receive a score or mark. A positive comment followed by a question to refocus attention or suggest the next step in learning is very effective.

Note whether students can explain how loudness and pitch can be modified.

Possible Extensions:

- What makes music interesting? Pitch? Rhythm? Loudness?

  Students can bring in samples of their favourite or least favourite music and discuss what they like about it or don't like about it.

  A range of music from different cultures could also be introduced providing students with the opportunity to hear patterns of rhythms and pitches that they may not be familiar with.

- Make a head harp using a coat hanger or string and spoons. http://www.exploratorium.edu/science_explorer/secret_bells.html

- Create an instrument from a vegetable, such as a cauliflower conch or a carrot kazoo. See http://www.growingsounds.sound101.org/cauliflower_conch.html for directions.

My Next Sound Maker

Materials to use and why:	My group:
How to change the pitch: How to change the loudness (volume):	Problems encountered and how they were solved?
Diagram(s) of possible sound maker: Tell why you are using certain materials:	

Sound Sandwich

Outcomes:
301-3 Demonstrate and describe how the pitch and loudness of sound can be modified

Materials:
• Wooden sticks (popsicle sticks)
• Straws or pipe cleaners
• Rubber bands
• Scissors

Lesson Activity Overview
1. Ask,
    • Name some devices that make sounds?
    • Do all devices make the same sounds?
    •How do these different devices make different sounds?

   As students respond, be sure they realize that not all the devices that make sounds are considered musical. Ask students if they can think of any other devices that are not musical that make sounds and describe the sound they make. Have students answer the following questions:
    - How do the sound devices differ from one another?
    - What do the devices have in common?

2. Give student groups the materials needed: 2 wooden sticks, 2 straws or pipe cleaners, 3 rubber bands, and scissors. Students will place a wide rubber band lengthwise over one of the wooden sticks. Cut tow pieces of straw or pipe cleaner. Put one piece of the straw or pipe cleaner between the wide rubber band and the stick. Place the other wooden stick on the top of the first one. Wrap one of the other smaller rubber bands around the end of the sticks so that the two sticks are pinched together. Put a second piece or pipe cleaner on the opposite end of the two sticks. This time put it on top of the wide rubber band, in the middle of the 2 sticks. Wrap the third smaller rubber band around the end of the sticks, making sure that the ends are pinched together. Now put your mouth in the middle and BLOW!

3. Ask students,
    - What kind of noise did your Sound Sandwich make?
    - How do you think the Sound Sandwich makes sound?
    - How can you make the pitch lower or higher?

Extension:

1. Student can be given the freedom to make their own unique designs to the Sound Sandwich and see how their alterations affect the sounds that the device makes. Once they have developed their new prototype have them share the design, reason, and pitch with the class.

Discussion Questions:

1. What types of characteristics do sound devices have in common?

2. What contributed to the pitch and loudness changes in the device?

3. Which sound device from the collection is your favorite? Why?

Assessment:

1. Were students able to demonstrate and describe how the pitch and loudness of sound can be modified

2. Were students able to demonstrate processes for solving technological problems by designing and construction a devices which has the ability to create sounds of variable pitch and loudness

3. Did students evaluate personally constructed musical devices with respect to their ability to vary pitch and loudness

Rubric:

	Developing 1	Proficient 2	Exemplary 3
Were students able to demonstrate and describe how the pitch and loudness of sound can be modified?	Students attempted to demonstrate how sound can be modified but were unsuccessful	Students successfully demonstrated the modifications	Students successfully demonstrated the modifications and took a leadership role with the task
Were students able to demonstrate processes for solving technological problems by designing and construction a devices which has the ability to create sounds of variable pitch and loudness	Students attempted to create a sound device	Students successfully created a sound making device	Students successfully created a sound making device and were able to make anticipate problems and possible modifications to the design
Did students evaluate personally constructed musical devices with respect to their ability to vary pitch and loudness	Students evaluated the musical device	Students successfully evaluated the musical device	Students successfully evaluated the musical device and offered real life situations where this takes place

Sound

Strand - The Ear, Hearing Loss and Noise Pollution

General Curriculum Outcomes	Specific Curriculum Outcomes
300-3 describe how the human ear is designed to detect vibrations	300-3 describe and illustrate how the human ear is designed to detect vibrations
300-4 compare the range of sounds heard by humans to that heard by other animals	300-4 compare the range of sounds heard by humans to that heard by some animals
106-1 describe examples of tools and techniques that extend our senses and enhance our ability to gather data and information about the world	106-1 describe examples of devices that enhance our abilities to hear and collect sound data, such as hearing aids, sonar, amplifiers, oscilloscopes, and ultrasound
104-1 demonstrate processes for investigating scientific questions and solving technological problems	104-1, 207-6 demonstrate processes for investigating the extent of noise pollution in their surroundings, and work with group members to evaluate the processes used in investigating noise pollution
207-6 work with group members to evaluate the process used in solving a problem	
108-1 identify positive and negative effects of familiar technologies	108-1, 206-9 identify the positive and negative effects of technological devices that produce loud sounds and identify the need for protection from loud sounds to prevent hearing loss
206-9 identify new questions or problems that arise from what was learned	
108-3 describe how personal actions help conserve natural resources and care for living things and their habitats	108-3 describe specific personal actions or products that can help reduce noise pollution
105-1 identify examples of scientific questions and technological problems currently being studied	105-1 identify examples of current research related to sound

Understanding the Ear

Outcomes:
303-3 describe and illustrate how the human ear is designed to detect vibrations
303-4 compare the range of sounds heard by humans to that heard by some animals
106-1 describe examples of devices that enhance our abilities to hear and collect sound data, such as hearing aids, sonar, amplifiers, oscilloscopes, and ultrasound

Lesson Activity Overview
Having investigated the properties of sound, students are now in a position to investigate how sound vibrations are collected by the ear. Students can complete activities that illustrate why the ear is shaped as it is.

Task
Stand next to an object that is making a constant soft noise, like a clock. Slowly walk away from the object, and measure how far away you are before you cannot hear the sound. Repeat the activity, but this time hold a piece of paper that has been shaped into a funnel close to your ear. What difference does this make? (300-3)

Diagrams and three-dimensional models will help students understand the function of the various parts of the human ear, and how the parts work together to hear sounds. **Students should not be expected to name the parts of the ear for summative tests.**

Optional Task
As a project, students may make their own models of the ear. 303-3

The above activities can lead investigation about the ability of animals to hear differently from humans. Some good examples of animals with which to compare ability to hear are dogs, bats, dolphins, and elephants.

Can Some Animals Hear Better Than Us? (303-4)

Animal	Higher Pitch	Lower Pitch	Hearing Used For...
Bat			
Dog			
Dolphin			
Elephant			

Students may also compare the hearing abilities of people of various ages. This can be a survey, research from the internet or a conversation. 106-1

This activity can lead to questions about why some students have better hearing than others, and how students need to protect their ears from loud noises to prevent hearing loss.
Students can investigate the effect of simple sound amplifying devices such as megaphones, parabolic dishes, hearing aids, radios, televisions, CD players, and tape recorders. They can compare the effectiveness of these devices by seeing how far they can move away and still be able to hear a sound that has been amplified. Other examples of more sophisticated instruments, such as sonar and oscilloscopes, can be introduced so that students are familiar with their name and function.

Task
Create a poster to show devices that measure and use sound waves. Under each picture, describe briefly the use of the device. (106-1)

Assessment:Informal Formative
Ensure that students participate in discussion about the anatomy of the ear 303-3

Ensure that students have had discussion on the differences in hearing of animals and humans 303-4

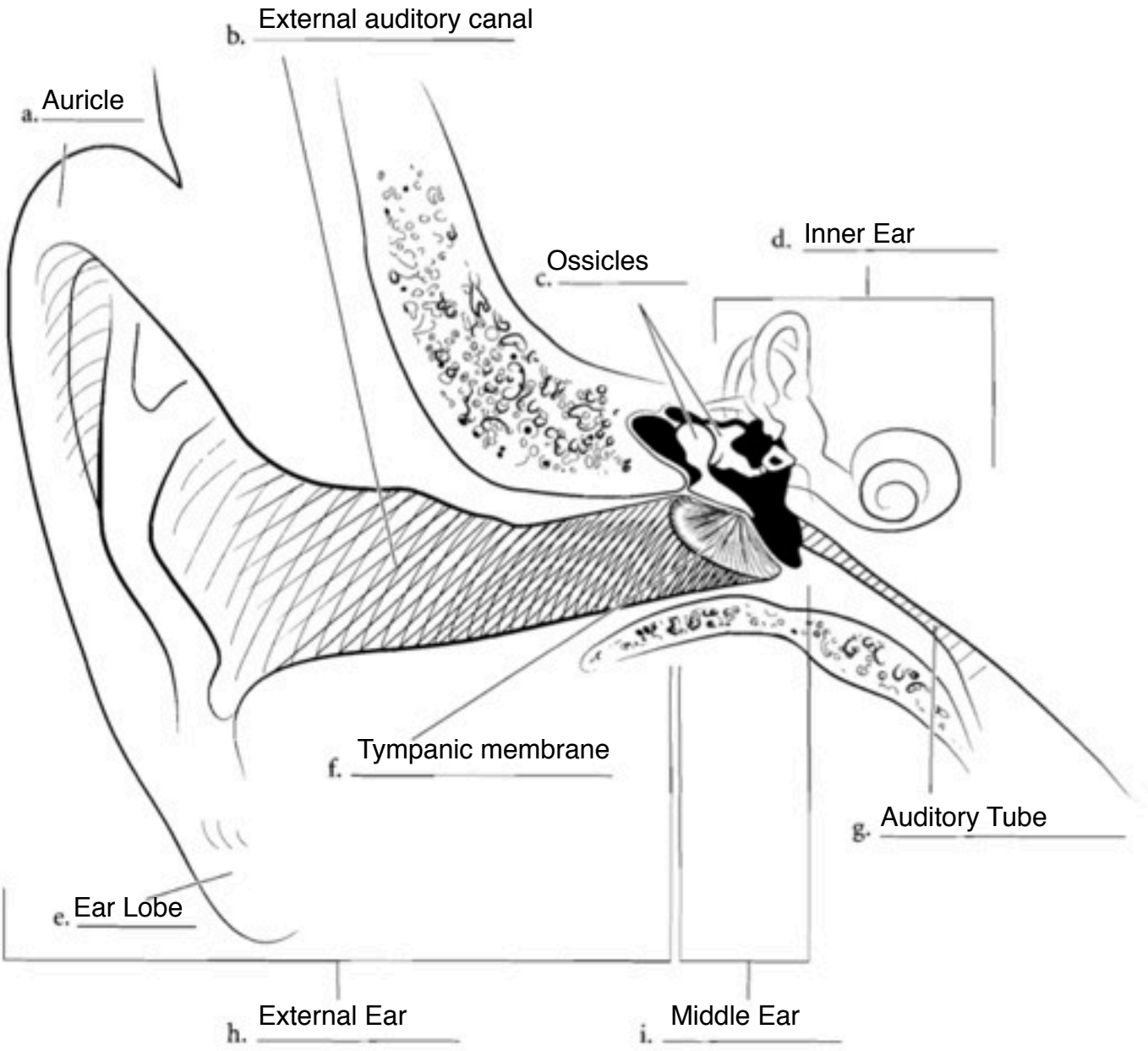
Ensure that students have studied in some format, the hearing loss due to age and various technologies to combat this 106-1

Assessment:Formal Formative
Ensure that students have completed an investigation where they quantitatively record data that measure hearing 303-3

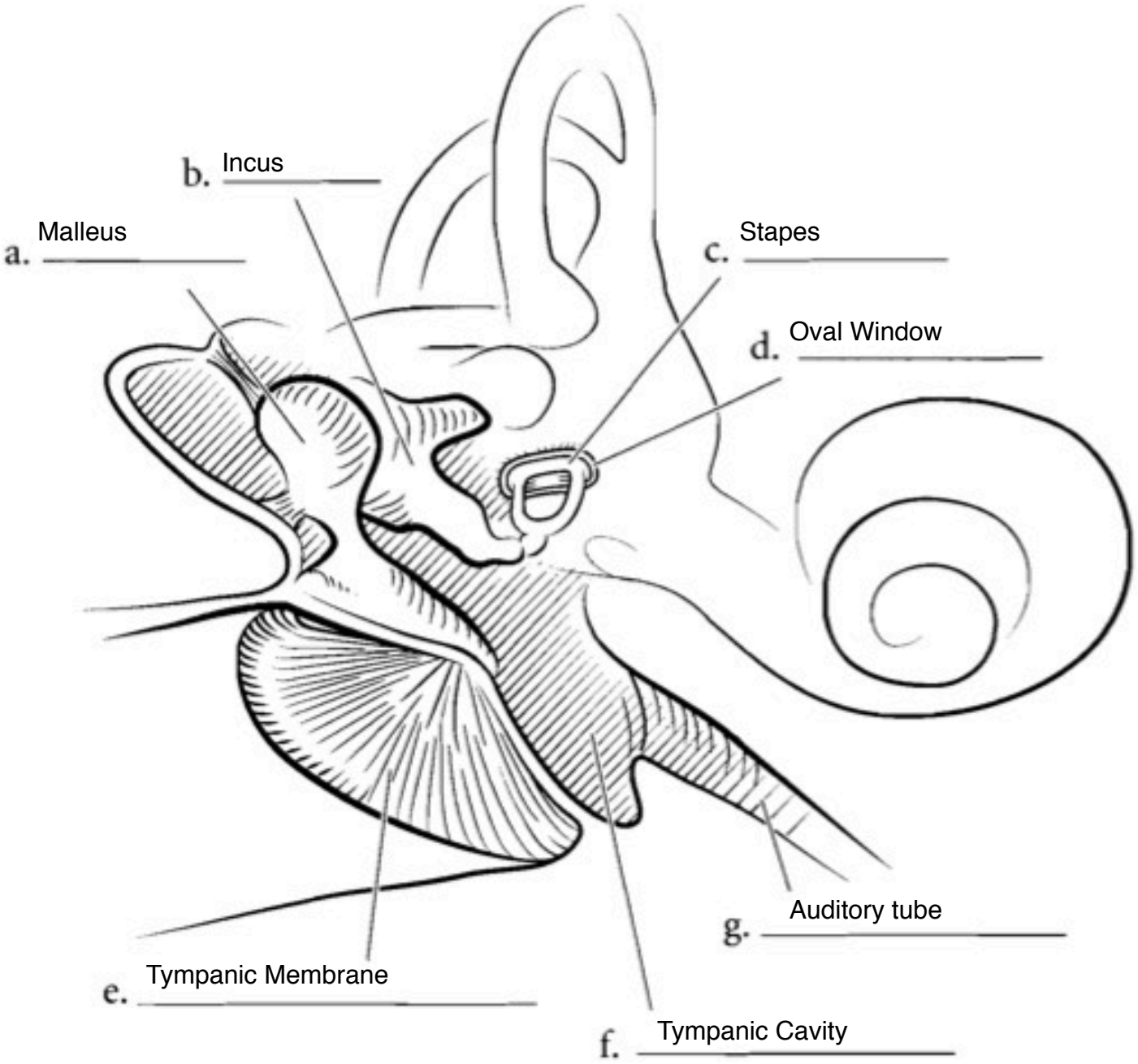
Ensure that students have completed a data table based on research of the hearing of different animals 303-4

Ensure that students have created a poster that shows devices used to enhance sounds 106-1

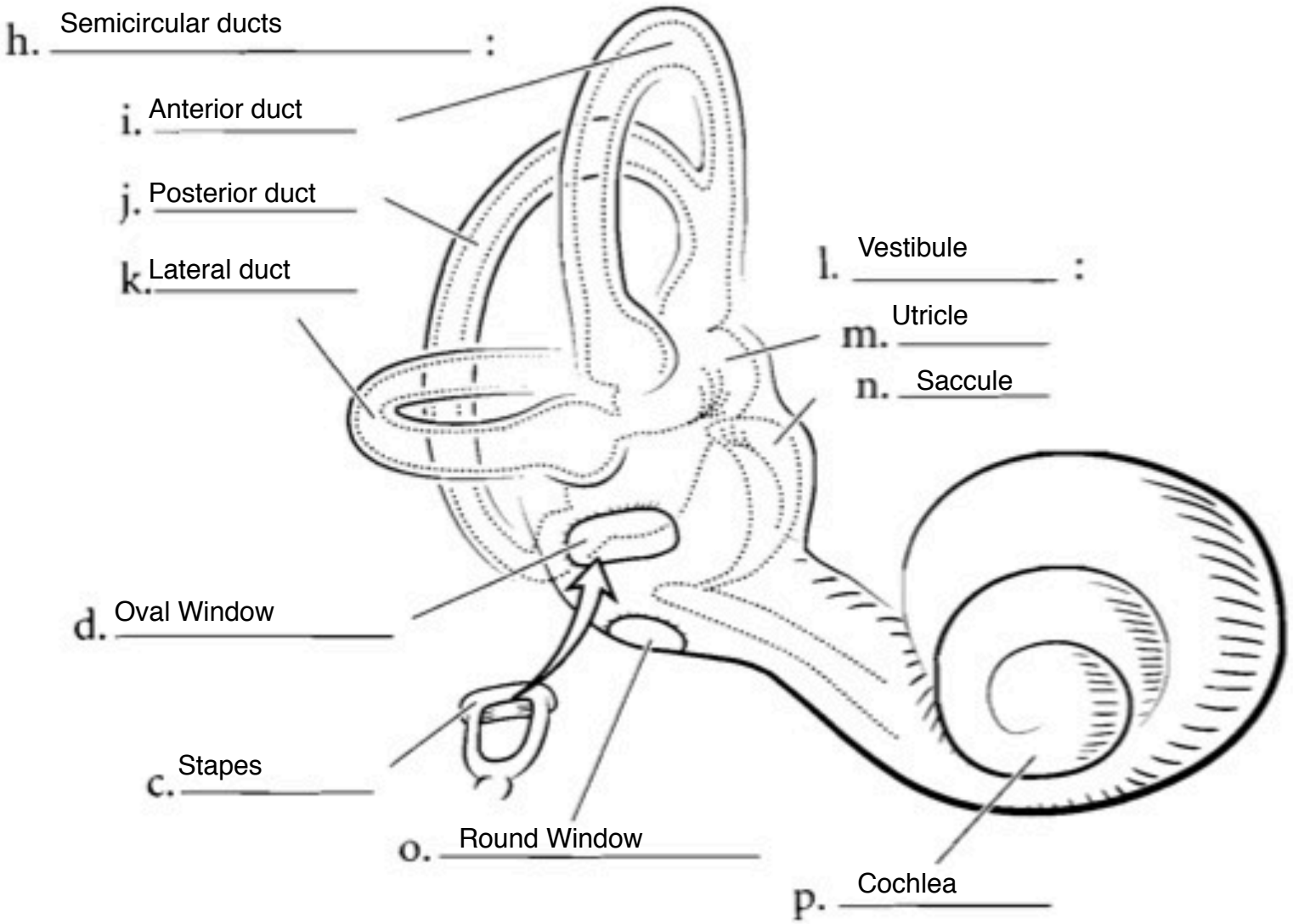
Overview of Ear



Middle Ear


a. Malleus
b. Incus
c. Stapes
d. Oval Window
e. Tympanic Membrane
f. Tympanic Cavity
g. Auditory tube

Inner Ear


h. Semicircular ducts :
i. Anterior duct
j. Posterior duct
k. Lateral duct
l. Vestibule :
m. Utricle
n. Saccule
d. Oval Window
c. Stapes
o. Round Window
p. Cochlea

Noise Pollution

Outcomes:
104-1, 207-6 demonstrate processes for investigating the extent of noise pollution in their surroundings, and work with group members to evaluate the processes used in investigating noise pollution
108-1, 206-9 identify the positive and negative effects of technological devices that produce loud sounds and identify the need for protection form loud sounds to prevent hearing loss
108-3 describe specific personal actions or products that can help reduce noise pollution
105-1 identify examples of current research related to sound

Lesson Activity Overview
Begin with a conversation in which students create an understanding of what Noise Pollution is.

Students will have had opportunities throughout this unit to learn about technological products that make loud noises, such as personal stereo systems, jackhammers, and jets. All of the devices have been designed for a purpose. For example, a jack hammer is needed to break concrete or rock. However, some of the devices also produce loud noises that can damage hearing. Very loud, short duration sounds damage hearing quickly, while continuous, loud sound has long term effects on hearing. Discuss the technological products used in various occupations to reduce noise levels, or protect the ears. This discussion helps students appreciate that the applications of science and technology can have both intended and unintended effects.(108-1, 206-9)

Task
Investigate the noise levels at various locations Record and present your findings. (104-1, 207-6). An inquiry process would be appropriate for investigating the extent of noise pollution. Students can demonstrate this process by identifying a question to investigate, selecting equipment and tools with which to collect data, making and recording observations, compiling results and drawing conclusions.
Questions to investigate could include: “Where is the noise level the highest in this school?” or “Which materials are best for absorbing sound?” A sound meter could be used to determine noise levels. Alternatively, a microphone connected to computer interface equipment or a tape recorder with a sound meter could be used. If these are not available, students could measure how far away from the sound source they are before they can no longer hear it. Students can collect noise level data from a variety of areas, and compare which types of devices make the most noise, which areas are the noisiest, or which materials provides the best sound insulation. As they work together to investigate noise pollution, the importance of considering their own observations and ideas, as well as those of others, before drawing conclusions is encouraged. (104-1, 207-6)

Based on the results of the investigation of noise pollution, students should have the opportunity discuss how these finding have led to innovations in preventing hearing loss. Discussion can explore technologies such as ear plugs or sound absorbing materials. (108-3) Students could also be given the opportunity to research current sound-related issues that are being studied. If this is too complex, present examples of current issues that are being studied. (105-1)

Task
Based on the discussion about loud noises, have students complete the table below(108-1, 108-3, 206-9)

Loud Technology

Loud Device	Positive Points	Negative Points	Potential for Hearing Loss (low, med, high)	Safety Procedures
Personal Stereo	I can listen to my favourite song	If it is too loud, I may damage my hearing	Depend on how loud you play it	Do not turn it up too loud
Jackhammer				
Jet				

Journal
If I worked in a noisy factory I would be worried about....
I would write or call....
I would suggest...
(108-1, 108-3, 206-9)

Write a paragraph about efforts to reduce noise levels, sound amplification, the effects of noise pollution, sound technology, or a related topic (105-1)

Assessment:Informal Formative
Ensure that students have had discussion and created a working understanding of Noise Pollution

Ensure that students have had discussion about technological products used in various occupations to reduce noise levels, or protect the ears. (108-1, 206-9)

Ensure that students have had discussion about products designed to reduce noise pollution (108-3)

Ensure that students have researched or been exposed to current research related sound sound (105-1)

Assessment:Formal Formative
Ensure that students investigate the noise levels at various locations Record and present their findings. (104-1, 207-6).

Ensure that students have completed the data table in which students evaluated sound devices (108-1, 108-3, 206-9)

Ensure that students have created a journal entry about personal actions of students to ensure hearing safety (108-1, 108-3, 206-9)

Ensure that have written a paragraph about current research to reduce noise levels (105-1)

Investigate the Noise Levels at various locations

Purpose	Testable Question that measures noise

Design	Materials and Tools Needed to collect data

Hypothesis	Prediction with Justification

Observations	Record your Observations and Data

Results	Make A Graph from your Data

Conclusion	Answer your Question, Respond to your Prediction and Explain what you have learned