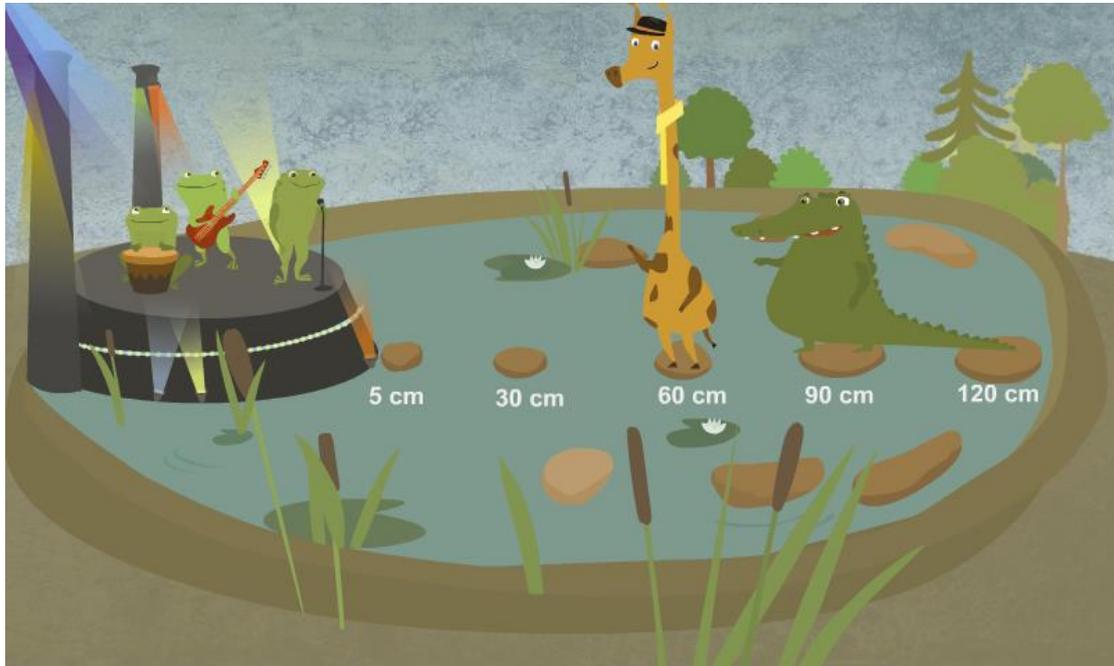


How Distance Affects Sound Intensity



Challenge

Let's visualize sound waves. To do that, take a shoe box and stretch plastic wrap tightly over the top and tape it in place. Place some grains of rice on the plastic wrap. Place a sound source such as a speaker below the box and observe. What happens to the plastic wrap and what happens to the rice as a result? Observe what happens when you change the volume of your sound source.

What will we investigate?

In this investigation we will explore how sound travels through the air. We will observe how the distance from the source of a sound influences the intensity level of the sound.



Equipment and Materials

- einstein™Tablet+ or einstein™Labmate+™ paired with a tablet
- Sound sensor
- Sound source
- Ruler
- Masking tape
- Large sheet of paper
- Writing utensil



123 Experimental Setup



Group Work

1. Turn on the einstein™Tablet+ or einstein™Labmate+™ paired with a tablet.
2. Tap the MiLAB () icon to open the application.



Sensor Setup

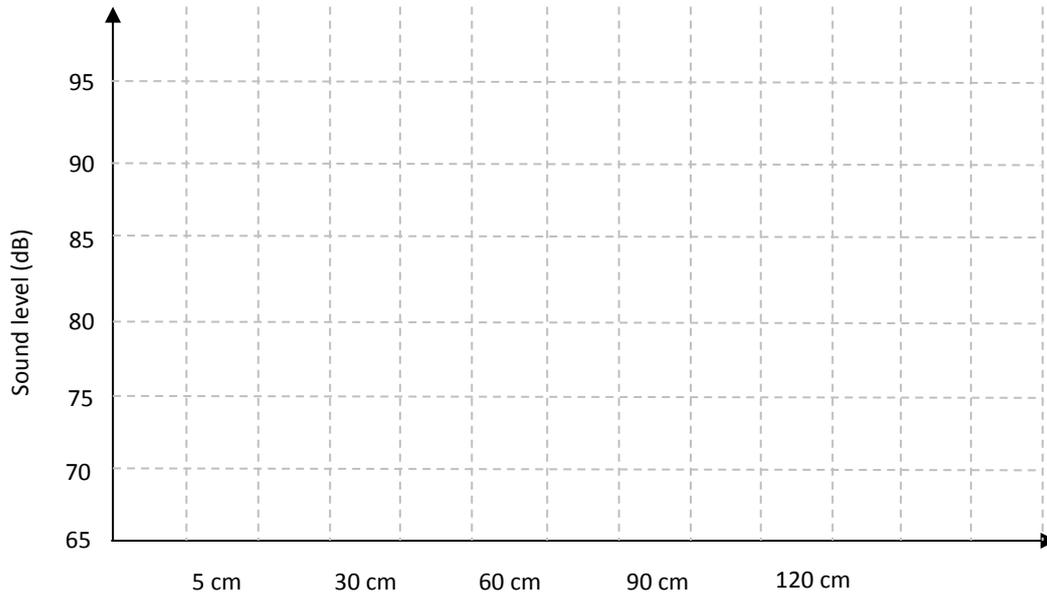
Tap the **Setup** cog () and use the table below to set up the measurement parameters:

Sensor:	Sound
Range:	65-110 dB
Rate:	10,000/sec
Duration:	10 Sec



Before You Begin

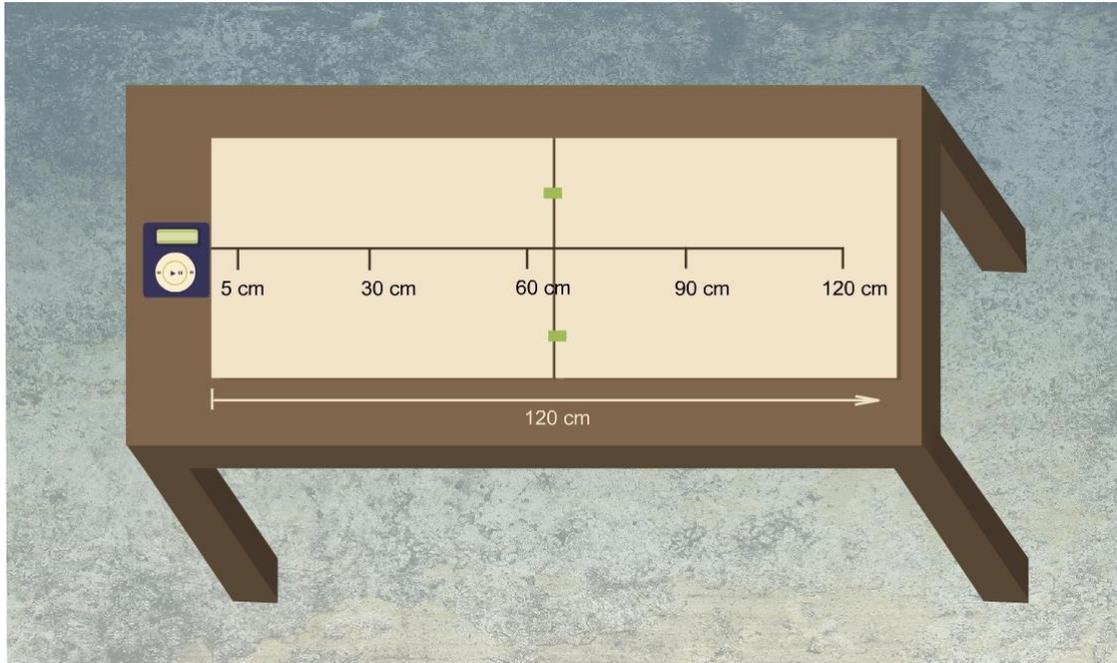
Predict: The sound intensity level will **increase/decrease/remain unchanged** as you move away from the source of the sound. Create a bar graph using the template below. Predict how the sound level at the different distances and draw a bar on the graph for each one.



Experimental Procedure – Step #1

Note: You must remain quiet while conducting this experiment

1. Connect the Sound sensor to the einstein™ device.
2. Use tape to secure the paper to a large table or to the floor.
3. Place your sound source at one end of the paper.
4. Draw a straight line 120 cm long along the length of the paper, beginning at the sound source.
5. Mark off points along the line at 5 cm, 30 cm, 60, 90 cm and 120 cm.
6. Place the Sound sensor at the 5 cm mark. Make sure that the holes on the end of the Sound sensor and the speakers of the sound source are facing each other.
7. Prepare a data table like the one below to record your measurements.
8. Turn on the sound source and tap **Run** () to begin collecting data.
9. Repeat this measurement three times.
10. Tap **Save** () to save your data.



Sample Data Table

Distance from Sound Source (cm)	Sound Intensity Level (dB)			
	Measurement #1	Measurement #2	Measurement #3	Average
5				
30				
60				
90				
120				



Understanding the Measurements

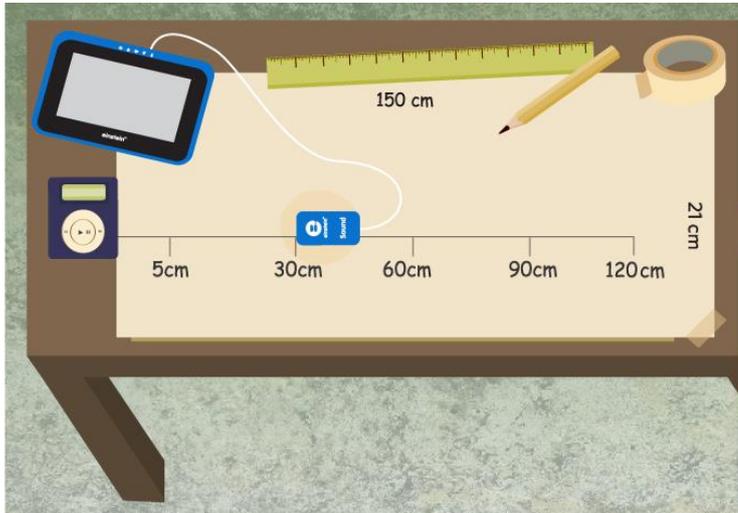
- Record your measurements in your data table:
 - Use the cursor on the graph to read the sound intensity level for each measurement.
 - The x- and y-values at the cursor are given at the bottom of the screen.
 - It may be easier to use the **Meters** window () , which will display the final sound intensity level measured.
- Calculate the average of your measurements and record this value in the data table.



Experimental Procedure – Step #2

- Move the Sound sensor to the 30 cm mark.

2. Turn on the sound source and tap **Run** () to begin collecting data.
3. Repeat this measurement three times.
4. Tap **Save** () to save your data.

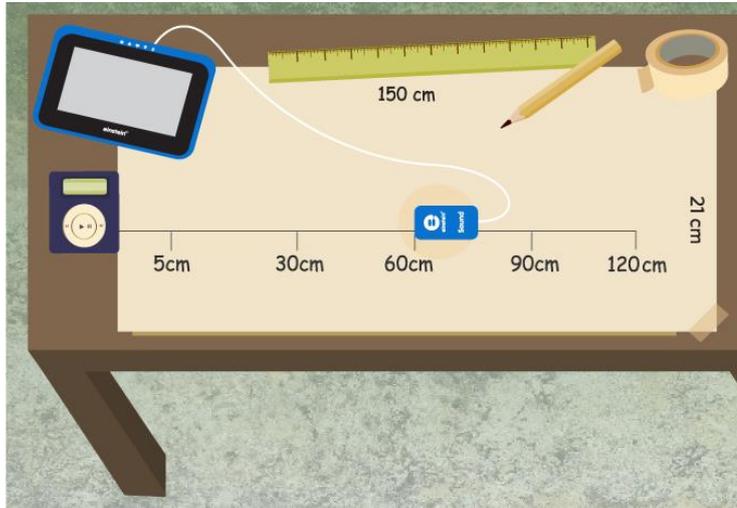


Understanding the Measurements

1. Record your measurements in your data table:
 - a. Use the cursor on the graph to read the sound intensity level for each measurement.
 - b. The x- and y-values at the cursor are given at the bottom of the screen.
 - c. It may be easier to use the **Meters** window (), which will display the final sound intensity level measured.
2. Calculate the average of your measurements and record this value in the data table.

Experimental Procedure – Step #3

1. Move the Sound sensor to the 60 cm mark.
2. Turn on the sound source and tap **Run** () to begin collecting data.
3. Repeat this measurement three times.
4. Tap **Save** () to save your data.

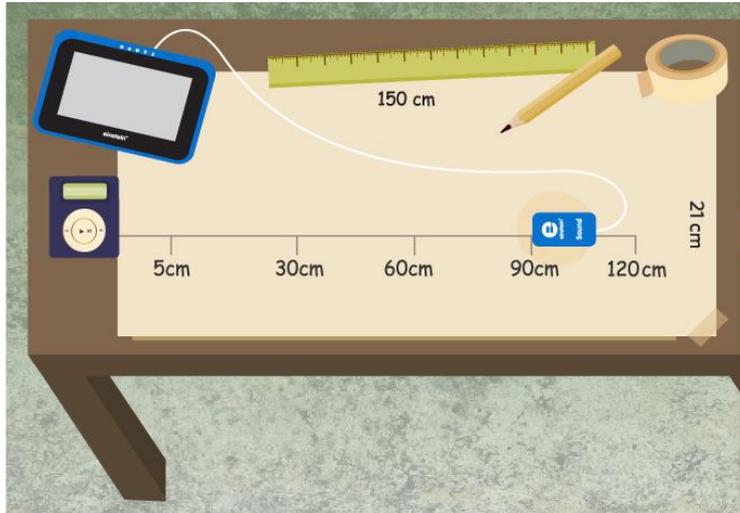


Understanding the Measurements

1. Record your measurements in your data table:
 - a. Use the cursor on the graph to read the sound intensity level for each measurement.
 - b. The x- and y-values at the cursor are given at the bottom of the screen.
 - c. It may be easier to use the **Meters** window () , which will display the final sound intensity level measured.
2. Calculate the average of your measurements and record this value in the data table.

Experimental Procedure – Step #4

1. Move the Sound sensor to the 90 cm mark.
2. Turn on the sound source and tap **Run** () to begin collecting data.
3. Repeat this measurement three times.
4. Tap **Save** () to save your data.

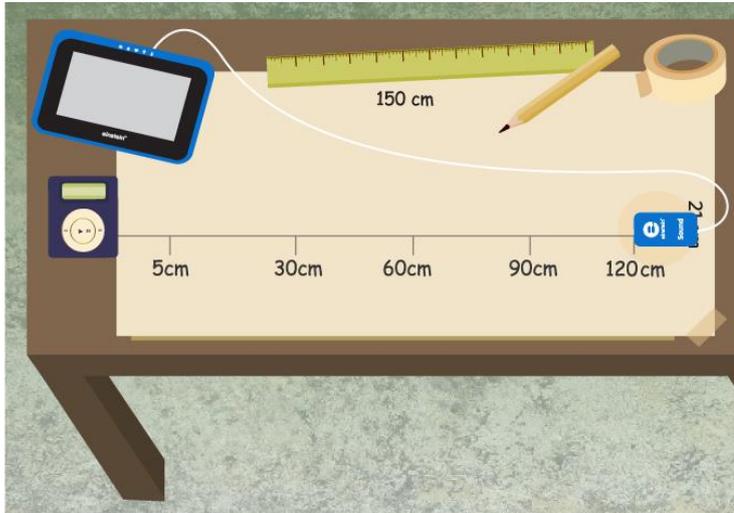


Understanding the Measurements

1. Record your measurements in your data table:
 - a. Use the cursor on the graph to read the sound intensity level for each measurement.
 - b. The x- and y-values at the cursor are given at the bottom of the screen.
 - c. It may be easier to use the **Meters** window () , which will display the final sound intensity level measured.
2. Calculate the average of your measurements and record this value in the data table.

Experimental Procedure – Step #5

1. Move the Sound sensor to the 120 cm mark.
2. Turn on the sound source and tap **Run** () to begin collecting data.
3. Repeat this measurement three times.
4. Tap **Save** () to save your data.



Understanding the Measurements

1. Record your measurements in your data table:
 - a. Use the cursor on the graph to read the sound intensity level for each measurement.
 - b. The x- and y-values at the cursor are given at the bottom of the screen.
 - c. It may be easier to use the **Meters** window () , which will display the final sound intensity level measured.
2. Calculate the average of your measurements and record this value in the data table.

Understanding the Experiment

Compare your prediction to the results of your experiment. Discuss the following questions:

In Depth Learning

1. Observe what happened to the sound intensity level as the distance from the sound source increased:
 - a. At which distance was the sound level highest.
 - b. At which distance was the sound level lowest.
2. Choose the correct statement:
 - a. As you move away from a sound source, the sound level (measured in decibels) increases.
 - b. As you move away from a sound source, the sound level (measured in decibels) decreases.

Using What You Learned

Investigate the laws where you live. Are there laws about noise levels? Are different noise levels permitted in a residential neighborhood than in an industrial neighborhood?

Option #1: Design and sketch a small neighborhood which includes housing, a main street, 2 factories and a shopping area.

- What are the various sources of noise in your neighborhood?
- Where will the factories be located?
- How will you overcome the noise from trucks unloading goods in the shopping area?
- Where will you locate the main street?

Option #2: Your city is planning to build a small airport beside your neighborhood. Write a letter to the city planners explaining why they should locate the airport a considerable distance from the residential area.

Understanding the Science

People and animals use sounds as one of their means of communication with each other. Sounds travel through the air in waves. A sound begins with a vibrating object. The vibrating object causes the medium around it to vibrate, whether it is a gas, a liquid or a solid. In this experiment, these vibrations travel through the air to the Sound sensor, and to your ears. The stronger the vibrations are, the louder the sound will be. As you move further away from the source of a sound, the sound level goes down. The sound travels away from its source in all directions. As the sound travels further and further away from its source, all those vibrations are spread out over a larger and larger area, so that the sound is less intense as it travels further from its source.

