Measuring sound levels

Key Learning Area	Unit or lesson title and main focus questions	Most appropriate level and suggested number of lessons
Science	**Measuring sound levels** Are trains quieter than buses and cars?	**Stage 4** 2–4 lessons

Teacher briefing

This lesson examines noise and how to measure it. It addresses an important question in the field of environmental planning – 'Are trains quieter than buses and cars?'

Residents and commuters have been limited to road transport when travelling to and from Sydney's North West region, and are familiar with the noise generated by busy traffic on highways.

When undertaking these activities, remind students they are modelling the skills used by the scientists and engineers who developed the Sydney Metro Northwest plan. It will help them understand the 'real world' application of the scientific knowledge and skills they are learning.

Requirements for these lessons

- Smart phone, iPad or similar tablet with a built in microphone
- Sound level recording App.

Assessment

This exercise requires students to record and analyse data and draw conclusions from their observations and readings taken. Students can be assessed on their level of understanding about how to make their sound recordings as accurate as possible, and on the quality of their conclusions.

Key terms and vocabulary

Decibel, noise, vibration.

Background information

Noise

A 'noise' is generally thought of as an unwanted sound. Sound is a form of mechanical energy and energy can do physical work. Many activities that are a part of our modern world are generators of noise. If noise can be avoided most of us would takes steps to avoid it. Work places have a special requirement to make sure that noise is minimised to protect workers and the surrounding environment.

Sydney Metro Northwest is a large scale construction project that will operate for many decades. Before large scale projects like this, experts including scientists and engineers measure existing noise environments, and try to forecast operational and construction noise and vibration. These tests are undertaken to ensure the best possible outcomes for people and the environment. Data from these tests are published in Environmental Impact Statements (EIS).

Measuring noise

The instrument for measuring noise levels is a sound level meter. A professional sound level meter is regularly calibrated. The meter has a microphone that picks up sound and gives a reading of the noise based on a logarithmic scale (each increase of one unit on the scale means an increase in sound level intensity of ten) called the decibel scale. The meter measures a frequency-weighted and time-weighted value of the sound pressure level. Noise assessments should be carried out when workers and others may be exposed to damaging noise levels.

Web links

Sound level diagram

https://www.sydneymetro.info/sites/default/files/document-library/05_NWRL%20EIS%20Stage%202_%20Chapters%2010%20to%2013.pdf

See Teacher references (page 50) for more detailed information on noise.

Syllabus links

Science 7–10

(SC4–11PW) discusses how scientific understanding and technological development have contributed to finding solutions to problems involving energy transfers and transformations.

Learning experiences

Activity 1 – What effect does noise have on you?

Initiate a class discussion. Brainstorm the question 'What effect does noise have on you?' Record the responses on a white board.

Sample responses could include:

Exposure to noise in any environment can cause physiological (real impacts on the person's body) problems or conditions:

- Speech interference
- Sleep disturbance
- Fatigue and aggression
- Reduced immune response
- Increased risk of heart disease
- Hearing damage.

Exposure to noise in any environment can cause psychological (mental) problems or conditions:

- Irritability
- Interference with concentration
- Interference with thought processes.

The class may not recognise some of these effects or may not have thought about them.

Activity 2 – Understanding how to measure sound levels

Select and download an appropriate sound meter App to measure sound levels.

Using a sound meter

Many people now have a smart phone or tablet such as an iPad. Sound meter Apps are available for download for both Android and IOS (previously iPhone OS) based devices either free or at minimal cost. These Apps use the built-in phone microphone on the device to collect sound and give a reading on the decibel scale. These devices are not calibrated and hence not necessarily accurate, but they do give a good idea of sound level (relative sound level).

Figure 6: Examples of Apps for IOS devices.

Figure 7: Example of a reading output from a sound meter App.

Measuring sound level is measured in decibels (dB)

Distribute the following list and consider the effects to help understand the scale of different level readings.

Sound dB	Noise description
20	Faintest sound most people can hear
30	Quiet room or a quiet location away from development
45	Typical office space or the sound of the city at night
60	Noisy office
70	Sound of a car passing close by on the street
80	Loud music played at home or a noisy class
90	Sound of a big truck passing close by
100	Sound from a rock band or operating jackhammer
120	Pain threshold

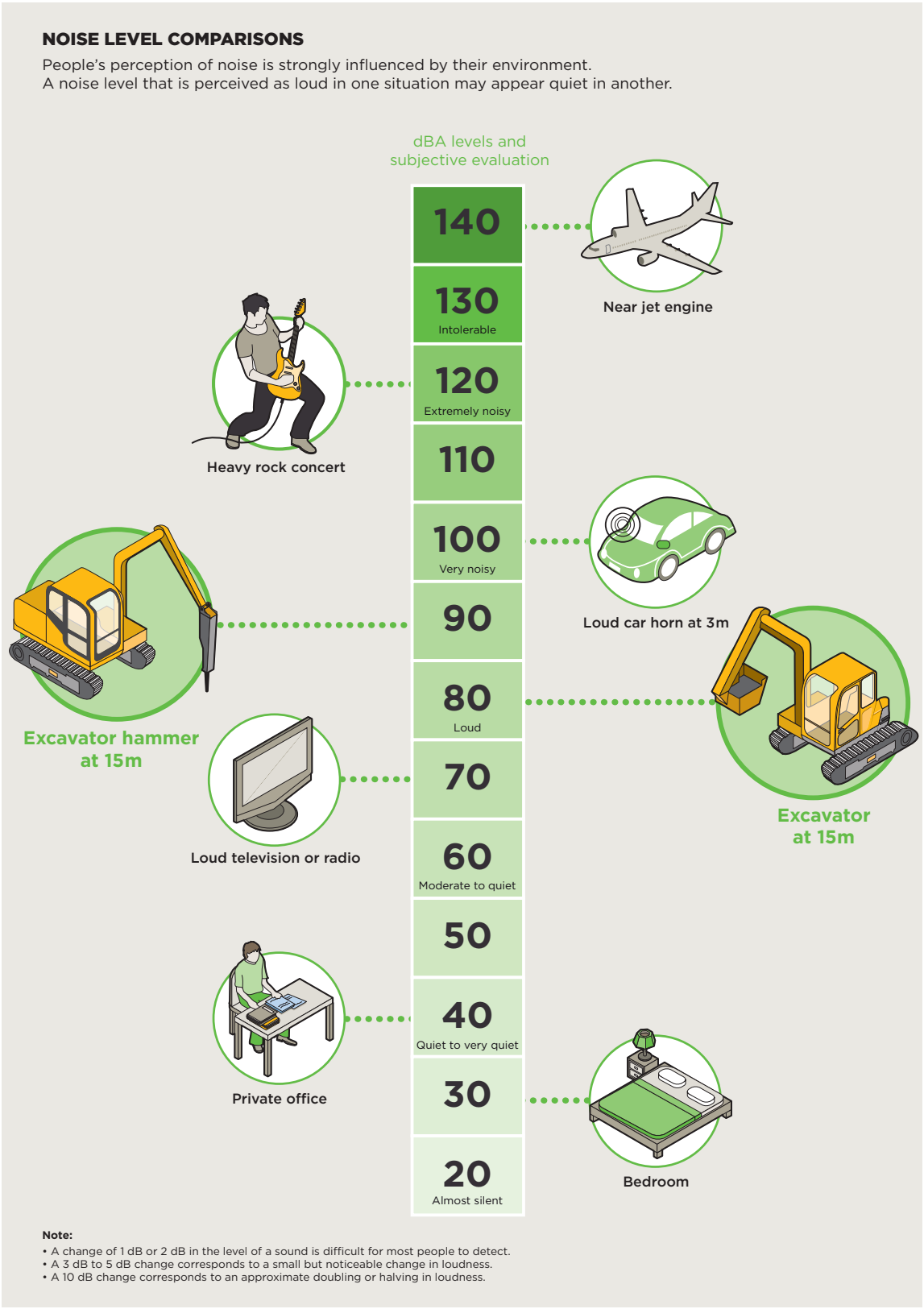

Figure 8: Noise level comparisons: The noise levels that could be typically encountered in the described situations.

Activity 3

This exercise requires students to either do the readings near their homes, on their way to and from school, or on the weekend. Alternatively, the class can do all the recordings at locations near the school during class time.

Discuss the logistics of where and when students can make the following recordings. Instructions are provided below for the lesson sequence.

Step 1

Use a sound level meter or App on a smart phone or tablet computer to measure average sound levels during a period of time in various locations around you. Check your meter is reading approximately the correct values by comparing your results to the examples in the list you have been given. Is your meter reading close to these values?

Step 2

Choose one location where there is little noise or sound and another location where you would describe the average sound level during a period of time as typical. Then, if possible record the noise level near to operating machinery or a busy road or adjacent to a passenger rail line. If you have a very busy road nearby it may have sound buffer fencing. You may be able to record the level of noise on both the road and house side of the barrier (refer to Figure 8 'noise level comparisons', page 48).

Step 3

Teachers may have to collect these readings themselves and present them to the class, as you will need to observe activities near a rail line to record the noise level when no train is passing (background sound level) and when a train is passing.

(Under no circumstances should children or teachers enter the actual rail corridor – this is dangerous and illegal).

Step 4

Make a table and record your sound level reading for each location. You should look for any variation over a minute or two and record a reading range for each source of the noise.

Step 5 – Discuss your readings

- How did the readings vary for different locations?
- If the readings were higher, was this uncomfortable for you?
- Do sound barriers make a difference to the sound from traffic?
- Are trains less noisy than cars and buses?

Teacher references and extension work

Extension activity

Explore different strategies used to mitigate transport noise levels in terms of their capacity to reduce sound levels. These strategies should include:

- Noise barrier fences
- Tracks in cuttings
- New trains.

All of these features are used in the Sydney Metro Northwest project as strategies to minimise the environmental impacts due to noise.

Web links

The NSW Government report on the Environmental criteria for road traffic noise in New South Wales

https://www.epa.nsw.gov.au/noise/traffic.htm

Specific sections of Sydney Metro Northwest *Environmental Impact Statement 2* that deal with issues related to noise and vibration are in Chapter 10

https://www.sydneymetro.info/sites/default/files/document-library/05_NWRL%20EIS%20Stage%202_%20Chapters%2010%20to%2013.pdf

Technical paper 3 of the Sydney Metro Northwest *Environmental Impact Statement 2* is dedicated to reporting on noise and vibration

https://www.sydneymetro.info/sites/default/files/36_Technical_Paper_3_-_Noise_and_Vibration_-_Part_1_of_4.pdf%3Fext%3D.pdf

Chapter 5 describes the process for predicting and assessing airborne operational noise impacts associated with train passbys.

AP-R277/05 Austroads research report, Modelling, measuring and mitigating road traffic noise. This free publication can be downloaded from **https://austroads.com.au/publications/environment/ap-r277-05** as a pdf document from the Austroads website after registering and obtaining a login.

Appendix 3 of this document, Measuring traffic noise and preparing a noise impact statement, provides technical information on measuring road noise.

Kellyville Station pedestrian bridge, November 2018.