Calculating and graphing vehicle speeds

Key Learning Area	Unit or lesson title and main focus questions	Most appropriate level and suggested number of lessons
Science	Calculating and graphing vehicle speeds How fast is my train?	Stage 4
Mathematics		1–2 lessons

Teacher briefing

Extracting information from diagrams, flowcharts, tables and graphs is an important skill. In this lesson sequence, students investigate a graph of train speeds, visually showing the journey along Sydney Metro Northwest where maximum train speeds reach up to 100 km/h within the tunnel section and up to 110 km/h on the surface track section. All major transport infrastructure projects analyse the speed vehicles will achieve throughout their journey. The following activities provide students with an opportunity to model the analytic skills of transport engineers.

Requirements for these lessons

A copy of the chart from Sydney Metro Northwest *Environmental Impact Statement 2*, Chapter 10 Noise and Vibration, page 5.

Web links

Sydney Metro Northwest *Environmental Impact Statement 2*, Chapter 10 – Noise and Vibration

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

Syllabus links

Science 7–10

SC4-7WS processes and analyses data from a first-hand investigation and secondary sources to identify trends, patterns and relationships, and draw conclusions.

(WS7.1) students process data and information by:

(a) summarising data from students' own investigations and secondary sources

(b) extracting information from diagrams, flowcharts, tables, databases, other texts, multimedia resources and graphs including histograms and column, sector and line graphs.

Mathematics K–10

(MA4-19SP) collects, represents and interprets single sets of data, using appropriate statistical displays.

Learning experiences

Step 1 – Class discussion

Examine the graph shown below with students. The journey of trains on Sydney Metro Northwest is described graphically. The maximum train speeds are up to 100 km/h within the tunnel section and up to 110 km/h on the surface track section.

Note: In the case of roads or other linear infrastructure, the term 'chainage' is used for distance. It is derived from Gunter's chain, a very old measuring device used for land surveying. 1 chain is equal to 66 feet or 100 links. Today, distance is measured in metres and kilometres.
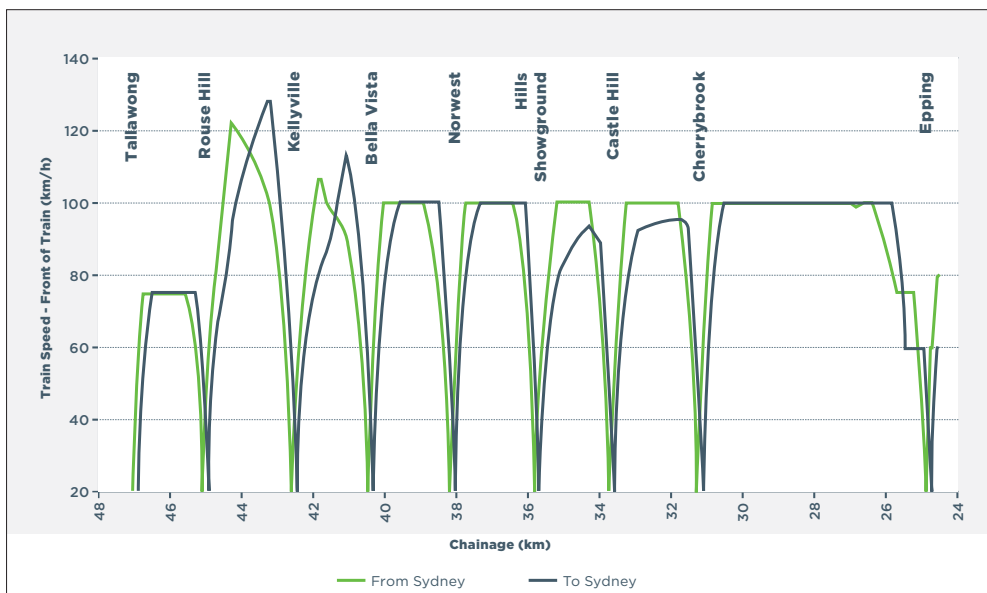

Figure 6: Chart from Sydney Metro Northwest *Environmental Impact Statement 2*, Chapter 10 Noise and Vibration.

Step 2 – Questions for analysis and discussion

- Read the key for the graph. Why is there a green and a blue line for this journey?

- What is the train speed at each station?

- Why do you think the journey between stations such as Rouse Hill and Kellyville, and Kellyville and Bella Vista, appear to mirror each other?

- Between which stations do you think there will be extensive use of tunnels? Give reasons for your answer

- How can you use the graph to estimate the acceleration of the train?

- Where on the journey do you think the train will be most easily (or clearly) heard aside from at stations? Give reasons for your answer.

Teacher references and extension work

Instructions for students

Download or copy a timetable from an existing rail service. If you travel by train choose a journey you make regularly.

Use the timetable to determine the time between stations, then use a computer application such as Google Earth or Google Maps to estimate the distance between stations.

Now construct your own graph modelled on the one above. You may need to estimate changes in velocity over parts of the journey.

A link to lessons on noise and sound

This lesson may be integrated into a sequence that includes the lesson in Topic One on measuring sound levels (page 44).

Trains travelling on Sydney Metro Northwest will provide passengers with a faster way to travel to the city and return home. Estimating the speed of the train is important because there is a direct connection between the speed of the train and the noise it creates. The extensive use of tunnels in Sydney Metro Northwest is also important because it means noise is effectively reduced.

Download links

Download an App for a Smart phone such as 'runtastic roadbike' or 'map my ride'. These free Apps allow an actual journey to be recorded and the map showing the journey can be downloaded.

Runtastic roadbike

https://www.runtastic.com/en/apps/roadbike

Map my ride

https://www.mapmyride.com

These Apps may graph the journey and provide data such as average speed, maximum speed, distance travelled and elevation changes over the journey. Individual journeys can be saved.

Using an App such as this can provide large amounts of data for analysis. If you travel by train for some of your weekend activities, these Apps can provide you with interesting insights into your journey.

Kellyville station pedestrian bridge lift, November 2018.