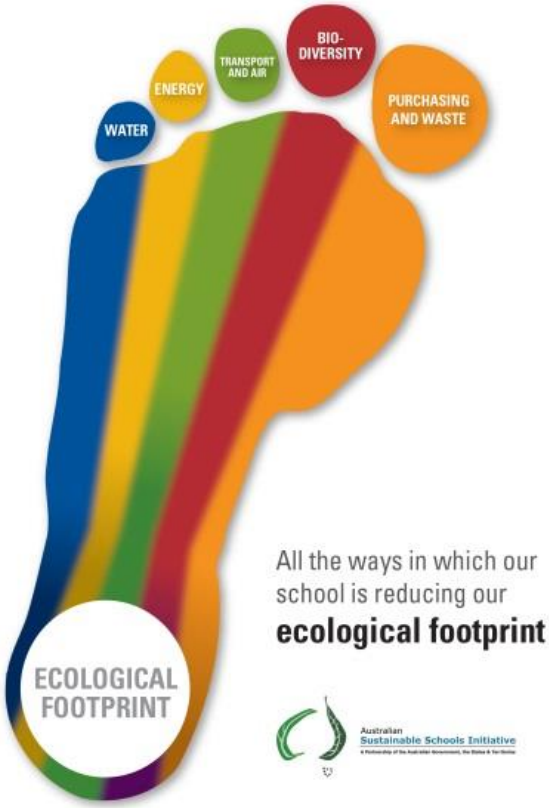
Local Transport, Global Impact

Summary	
In this lesson students look at the transport choices they can make when travelling to school. Students understand the environmental impacts of vehicles and the links between vehicle use, carbon emissions and global warming. They identify the benefits of active travel and set goals to increase the amount of time they walk and cycle to school. See links to Western Australian Curriculum at end of this lesson plan.	Year Level: Years 4 - 8 Teaching and Learning Resource

Learning outcomes

Students will be able to:

- Understand that vehicles have an impact on the environment in terms of: air quality, greenhouse gases, water quality, use of natural resources and noise;
- Understand that vehicles emit carbon dioxide (CO_2) which plays a role in global warming;
- Use mathematics skills to calculate CO_2 emissions from cars;
- Identify some of the benefits of walking, riding and catching public transport; and
- Set realistic goals to increase the amount of time they walk or cycle to and from school.



Department of Transport

Preparation

Resources

- One student worksheet per student.

Background notes

In 2013, there were almost 17.2 million motor vehicles registered in Australia. These vehicles travelled 167,456 million kilometres, the equivalent of driving 41 million times from Australia's most western point (Steep Point, WA) to the most eastern point (Cape Byron, NSW)[1].

Vehicles have an impact on the environment in terms of air quality, greenhouse gases, water quality, use of natural resources and noise.

Air quality - There are more than 4,000 chemicals that come out of the exhaust pipes of cars and many of these air pollutants are invisible. Emissions from vehicles include carbon monoxide, oxides of nitrogen, sulphur oxides, ozone-forming substances, hydrocarbons and fine particulates. Air pollution has negative health effects, especially for vulnerable people, including those with allergic and respiratory conditions, such as hay fever and sinusitis, respiratory and lung conditions and asthma. Air pollutants like benzene are carcinogenic.[2] In Australia it is estimated that in a single year, air pollution from motor vehicles causes between 900 and 2,000 early deaths and between 900 and 4,500 cases of bronchitis, cardiovascular and respiratory disease, costing between $1.5 and $3.8 billion[3]. The interiors of new cars give off formaldehyde and other contaminants[4] linked to cancer, birth defects, brain and nerve damage, and long term injury to the lungs and breathing passages[5].

Water quality – When it rains, car oil, petrol residues and particles from the wear of tyres, brakes and other components, and air pollution from cars, all get washed into stormwater drains and pollute waterways. Oil and pollutants can be toxic to aquatic life and smother plants and animals. Detergents from washing the car also contaminate waterways.

Use of natural resources – The manufacture, operation, delivery and maintenance of vehicles uses non-renewable resources such as metals (for car bodies), petroleum (for plastics and fuel), and other fossil fuels (e.g. coal for production of electricity). German research shows that each car produces 26.5 tonnes of rubbish[6].

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[1] Australian Bureau of Statistics. Motor Vehicle Census, Australia, 31 Jan 2013.
[2] RAC Victoria (2010-2014) website - http://www.racv.com.au/wps/wcm/connect/racv/Internet/Primary/my+car/advice+_+information/motoring+_+the+environment/impact+of+cars+on+the+environment
[3] Bureau of Transport and Regional Economics, Health impacts of transport emissions in Australia: economic costs, 2005, Department of Transport and Regional Services, Canberra, p. 147, http://www.btre.gov.au/docs/workingpapers/wp63/wp63.pdf
[4] Air Quality Sciences, 2006, Indoor Air Quality Hazards of New Cars, Air Quality Sciences Inc., United States, http://www.aerias.org/uploads/Indoor%20Air%20Quality%20Hazards%20of%20New%20Cars.pdf
[5] Department of Environment and Water Resources, Australian Greenhouse Office, About TravelSmart web page, http://www.travelsmart.gov.au/about.html
[6] Whitelegg, J., undated, Dirty From Cradle to Grave, http://www.ecologica.co.uk/Dirtyfrom CradletoGrave.pdf

The 'embodied energy' used in the manufacture, delivery and maintenance of cars produces greenhouse and other pollution. A typical $30,000 car embodies 475 gigajoules of energy, or 41 tonnes of CO_2 equivalents and over one million litres of water. In contrast, a typical $500 bike would embody just 8.8 gigajoules of energy, 0.75 tonnes of CO2 equivalents and 19,000 litres of water[7].

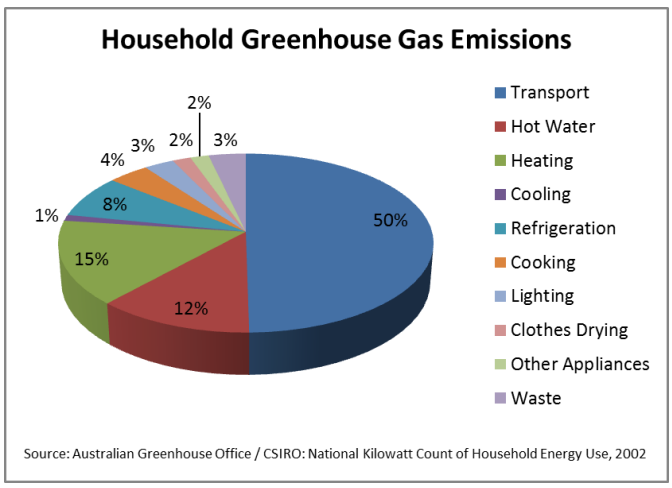
The 'chain of impact' of a car over its life-cycle includes the energy required for the infrastructure and services associated with vehicle use, such as the energy used to build roads, paths, car parks etc. It also includes a share of the materials and energy used for emergency services and hospital wards (that service the victims of both traffic accidents and illnesses related to pollution), and the energy and materials for repairs, maintenance, spray painting and providing new car parts.

Noise - in urban areas, road traffic is the one most important single source of community noise. Noise can cause or bring about disturbance to work, relaxation and sleep and mental stress. Noise increases with the size and speed of the vehicle, size of the road and its speed limits and the proximity to residential areas.

Greenhouse gases - cars produce greenhouse gases (GHG) like carbon dioxide, nitrous oxide and methane. In WA, passenger vehicles contribute about 12% of total greenhouse gas emissions[8]. The average passenger vehicle emits about four tonnes of carbon dioxide each year[9].

- 1 litre petrol generates approx. 2.5 kilograms of GHG
- 1 litre LPG generates approx. 1.7 kilograms GHG
- 1 litre diesel generates approx. 2.9 kilograms of GHG[10]

When we look at *household* GHG emissions, transport emerges as the greatest energy user and the biggest factor in household greenhouse emissions[11].



The National Greenhouse Gas Inventory shows that, while Australia's emissions as a whole increased by 23 per cent between 1990 and 2003, transport-related emissions increased by almost 30 per cent over the same period. Worldwide, a 2014 UN report[12] finds that motor vehicles are likely to be the fastest-growing source of greenhouse emissions right through to 2050 on current trends.

[7] Treloar, G., et al, 2000, Analysing the life-cycle energy of an Australian residential building and its householders, Building Research & Information, Vol 28(3), pp.184–195.
[8] WA Greenhouse Gas Inventory, 1999
[9] Carbon Neutral carbon calculator - http://www.carbonneutral.com.au/carbon-calculator/vehicles-and-fuel-use.html
[10] Full Fuel Cycle emissions - National Greenhouse Accounts Factors, July 2011
[11] Australian Greenhouse Office / CSIRO: National Kilowatt Count of Household Energy Use, 2002
[12] http://www.bloomberg.com/news/2014-04-08/cars-become-biggest-driver-of-greenhouse-gas-increases.html

Emissions intensity figures		
Transport mode	**Energy use (MJ per passenger-km)**	**Emissions (g CO2-e per passenger-km)**
Petrol Car	3.7	286
Motorcycle (1000 cc)	2.3	178
Bus	0.30	20
Train (electric)	0.04	14
Bike, scooter or skateboard	0	0
Walk	0	0

Source: Emissions intensity figures from Australian Greenhouse Office, AGO Factors and Methods Workbook 2006.

Increasing greenhouse gas emissions, mainly through burning coal and oil, is increasing the average temperature of the Earth, affecting local climates including temperature and rainfall. To find out more, see our *CO_2 Experiment and Greenhouse Effect* lesson plan.

Benefits of active transport

Aside from reducing environmental impacts, walking, riding and catching public transport has many benefits for the school community including -

Benefits for Teachers – practical reinforcement of sustainability and road safety lessons, morning exercise before school starts, improved student learning and concentration in class and improved time management skills.

Benefits for Students - more time outdoors; reduced air pollution around school; feel empowered to 'play your part' in reducing CO_2 emissions; improved fitness and health from exercise; spend quality time with parent or guardian on the way to school/from school; an excuse to hang out with friends; streets 'feel' safer as there are less cars and more 'eyes on the street'; fun way to learn road safety skills; greater independence; resilience as you are responsible for yourself; stronger 'sense of place' as you get to know and connect with your local neighbourhood; better concentration in class as you've exercised before school; improved time management skills; a great excuse to walk the dog and no more car sickness!

Benefits to Parents & Community - safer streets from reduced traffic around schools; safer streets as there are more people on footpaths and more 'eyes on the street'; more parking spaces at school for parents and visitors who need it; no need to expand parking; frees up space for veggie beds, bike parking, etc.; get to know the neighbours and your neighbourhood on the walk/ride to school; quality time spent with children; provides opportunities for conversations without car driving distractions; improved fitness and health from walking/riding to school; reduced air pollution around school; save money on petrol and car maintenance and better maintenance of footpaths and shared paths as more people use them.

Teaching and learning ideas

Teachers are encouraged to use a range of the teaching and learning ideas provided. The teaching and learning ideas provide opportunities to address multiple learning areas. Teachers can modify and extend ideas for different year levels and phases of schooling. Teaching ideas have been aligned to the Western Australian curriculum including identification of learning area, strand and sub-strand.

How did we get to school today?		
Mode of Transport	Number of students	Percentage of students
Car		
Bus		
Train		
Bike / scooter / skateboard		
Walk		
Total		

Activity 1 – Travel survey and environmental impacts

1. Survey all students regarding their mode of transport to school. Include modes of transport from table included and allow other modes to be included.
2. Display results.
3. Ask students to calculate totals and the percentages for each mode of transport and display this on the board.
4. Ask students to construct displays, including column graphs, dot plots and tables, appropriate for data type, with and without the use of digital technologies.
5. In small groups, interpret and compare results.
6. Ask students "Why am I so interested in your choice of transport to school?"

   (Traffic congestion, road safety, health and fitness, air pollution, greenhouse gas emissions, water quality, use of natural resources, noise)
7. Lead a discussion that allows students to become aware of the environmental impacts of vehicles:

Air quality - There are more than 4000 chemicals that come out of the exhaust pipes of cars and many of these air pollutants are invisible.

Greenhouse gases - cars burn fuel to enable them to run, carbon dioxide is one of the gases produced from the burning of this fuel and carbon dioxide is a greenhouse gas. The average car emits about four tonnes of carbon dioxide each year. Transport activity is around half of most household's emissions.

Water quality – When it rains car oil, petrol and air pollution from cars all get washed into stormwater drains and pollute waterways.

Use of natural resources – Building and looking after vehicles uses non-renewable resources such as metals (for car bodies), petroleum (for plastics and fuel), and other fossil fuels (e.g. coal for production of electricity). It also uses a lot of water.

Noise - Noise increases with the size and speed of the vehicle. In Perth, road traffic is the greatest *single source of community noise.*

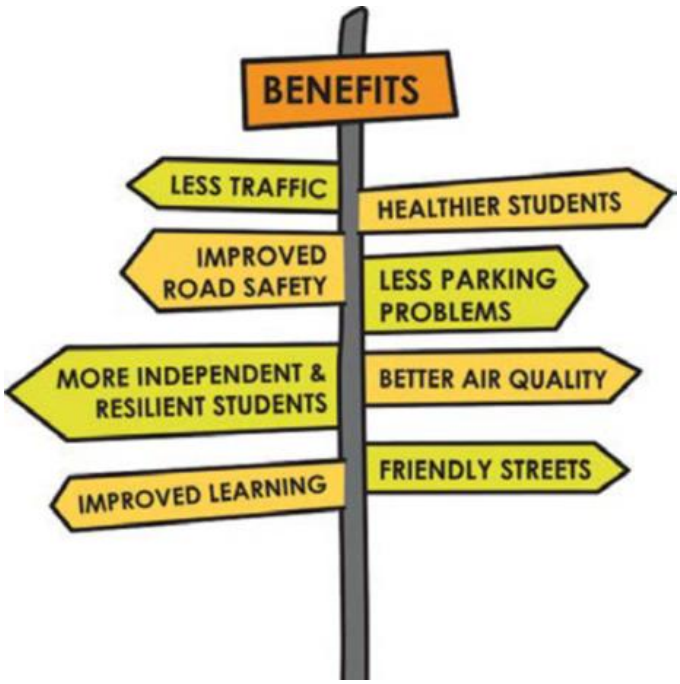
1. Distribute a copy of the 'Student Worksheet', ask students to copy the results of the hands-up survey into the second column of Activity 1. Then ask students to calculate the kilograms of CO_2 emitted from the class's journey to school that day and fill in their impact evaluations (high or low).
2. Ask students to consider the negative impacts on air pollution, water quality, use of natural resources and noise from each mode of transport and complete columns 5 to 8.
3. Ask students to identify the mode of transport that has the greatest impact on the environment and expand of their answer to include why.

Activity 2 - Identifying benefits of active travel and setting goals

1. Revisit the results from the hands-up travel survey (in Activity 1).
2. Ask students to consider alternative ways to travel to school. For example, can they walk, ride their bike, scooter or skateboard, or catch public transport?
3. Brainstorm strategies that promote a healthy lifestyle.
4. Lead a discussion that allows students to become aware of the benefits of walking, riding and catching public transport to school. (Examples of benefits: more time outdoors; reduced air pollution around school; improved fitness and health from exercise; spend quality time with parent; an excuse to hang out with friends; streets 'feel' safer as there are less cars and more 'eyes on the street'; greater independence; you get to know and connect with your local neighbourhood; a great excuse to walk the dog and no more car sickness!)
5. Students locate and collect information and/or data from a range of appropriate primary sources and secondary sources on ways to increase active transport distance (e.g. museums, media, library catalogues, interviews, internet).
6. Students represent information and/or data using appropriate formats to suit audience and purpose (e.g. tables/graphs, visual displays, models, timelines, maps, other graphic organisers).
7. Ask them to list some of these benefits on their Student Worksheet in Activity 2.
8. Ask students to consider how they could walk, ride or catch public transport more often? For example, can they walk once or twice a week to school? If they live a long way from school, can they walk part of the way to school? If they already walk to school, could they also walk to the shops?
9. Ask students to propose and implement opportunities to increase their physical activity levels at school, at home and to and from school. Include active transport distance goals per week.

10. Encourage students to discuss alternatives with a partner, and identify the benefits of each. Then ask students to complete the "goal template" on their Student Worksheet. Ask them to set at least two realistic goals to decrease the amount of time they spend travelling to school in a car. The goals need to be realistic and followed for at least the next week.
    Some examples are -

- I will walk to school on Wednesday and Friday morning next week.
- Instead of asking mum to drive me, I will ride my bike to school once next week
- I will ask mum to take me to school on public transport.



11. As homework, ask them to take their goal sheet home to their parents or guardians, explaining why they have set these goals and ask for help to achieve them.
12. After the week is over, students should reflect on how successful they were in achieving their set goals. Did they achieve their goals? Why/why not? What did they find difficult and/or easy? What could be changed to make it easier to achieve their goals?
13. Students research and create routes to increase active transport distance per day/week to meet goal.
14. Ask students to create a 2D or 3D map using a variety of techniques and forms such as sculpture, mixed media, printing, drawing and painting.
15. Reflect on at least two aspects of the tasks, identify new understandings and act on findings in different ways (e.g. suggest additional questions to be investigated, propose a course of action on an issue that is significant to them).

Extension

If the students are successful at achieving the goals set in activity 2, encourage them to continue with this change for the remainder of the term. If students were unsuccessful in achieving their goals, ask them to set a new goal which is more realistic or to identify a change so they can meet their goal (e.g. buy an umbrella, ask Dad to fix bike).
Conduct a hands-up travel survey of the whole school and calculate the kilograms of CO_2 emitted from the school's journey to school that day.
To learn more about carbon dioxide, do the "*CO_2 Experiment and Greenhouse Effect*" classroom activity.
Set up a classroom "tick" chart so students can record how they get to school each day. See the "*Classroom Competition*".

Assessment ideas

- Did student contribute to class discussion on environmental impacts of vehicles?
- Using Student Worksheets, assess the data collected and calculations made.
- Did student correctly calculate the CO_2 emitted from the class's journey to school that day?
- Did student contribute to class discussion on benefits of walking and cycling to school?
- Did student identify two realistic goals?
- Did student reflect on how successful they were in achieving their set goals?

Weblinks

http://www.carbonneutral.com.au/carbon-calculator/vehicles-and-fuel-use.html - the Carbon Neutral carbon calculator helps you calculate the greenhouse gas emissions from your vehicle or fuel use.

http://www.greenvehicleguide.gov.au/GVGPublicUI/home.aspx - The Green Vehicle guide helps you by rating new Australian vehicles based on greenhouse and air pollution emissions.

http://www.abs.gov.au/ - This website can be used to discover figures for car use and CO_2 emissions in Australia.

Links to Australian Curriculum

Subject	Strand	Substrand
Science	Science understanding	• Earth and space sciences
	Science as a human endeavour	• Nature and development of science • Use and influence of science
	Science inquiry skills	• Processing and analysing data and information • Evaluating • Communicating
Humanities and Social Sciences	Geographical knowledge and understanding	• The Earth's environment sustains all life (year 4) • Factors that shape the human and environmental characteristics of places (year 5)
	Humanities and Social Sciences skills	• Questioning and Researching • Analysing • Evaluating • Communicating and Reflecting
Health and Physical Education	Personal, social and community health	• Being healthy, safe and active
	Movement and physical activity	• Understanding movement • Learning through movement
Mathematics	Statistics and probability	• Data representation and interpretation
The Arts: Visual Arts	Making	• Developing skills and processes • Ideas • Skills • Production • Inquiry

Cross curriculum Links: Maths, English

Cross curriculum Priorities: Sustainability

General Capabilities: Literacy, Numeracy, Critical and creative thinking, Personal and social capability, Ethical understanding

Student Worksheet Name: _____

Activity 1: Travel Survey and Environmental Impacts

How did we get to school today and what are the environmental impacts?

How did we get to school today?						
Impact	Car 	Bus 	Train 	Bike, scooter or skate 	Walk 	Total
Student No.						
Total g of CO2 emitted per passenger km[13]						
Total kg of CO2 emitted per km						
Air pollution (H, L)						
Water pollution (H, L)						
Use of natural resources (H, L)						
Noise pollution (H, L)						
Which mode has greatest impact on environment?						

[13] Source: Emissions intensity figures from Australian Greenhouse Office, AGO Factors and Methods Workbook 2006.

Activity 2: Benefits of Active Travel

Goal-setting

Think about different ways to travel to school. Can you walk, ride your bike, or catch public transport? Can you ride your scooter or skateboard? If you live a long way from school, can you walk part of the way to school? If you already walk to school, could you also walk to the shops?

Set at least two realistic goals to reduce the time you travel in a car for at least the next week. For example -

- I will walk to school on Wednesday and Friday morning next week.
- Instead of asking mum to drive me, I will ride my bike to school once next week.
- I will ask mum to take me to school on public transport.

My goal next week is to:
I want to achieve this goal because:
My goal next week is to:
I want to achieve this goal because: