ONTARIO ecoschools écoécoles de l'ONTARIO

ENVIRONMENTAL STEWARDSHIP

ACTIVE TRANSPORTATION CAMPAIGN KIT

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ACTIVE TRANSPORTATION INTRODUCTION

Background

Active transportation programs are fun ways to decrease a student's dependency on fossil fuels. Whether students cycle, bus, blade or walk to school, they are learning how to keep both themselves and the environment healthy.

DESIGNING YOUR CAMPAIGN

Plan your campaign

- Choose to host a one-time event or implement a week/month/year-round campaign
- Weekly campaign: Begin the campaign at the start of the year, announcing a weekly walk to school challenge for a chosen day of the week (e.g., Walking Wednesday, Footloose Friday)
- Gather support and actively engage parents (and community police, if possible) in the planning and implementation of this campaign

Communicate

- Hold a fun and informative school-wide kick-off assembly sharing the importance of active transportation for the environment (e.g., climate change, carbon emissions etc.)
- Send a newsletter/flyer home to parents outlining the goals and expectations of the campaign
- Post ongoing reminders to parents in your school or newsletter to maintain momentum

Implement and monitor success

- Track student participation individually or as classes and announce the winners
- Count and compare the vehicles in drop-off zones on 'Walk to School' days vs. regular days to calculate the environmental impact and share the results

Celebrate success, reflect and evaluate

- Create a Golden Shoe Award, or similar award, to be presented to the individual or class with the greatest active participation

Tips for success

- Conduct a survey on the travel patterns of staff and students, identifying barriers to success (distance to school, no bike racks etc.) and areas for improvement

Resources

iWalk: iWalk has declared October international walk to school month
www.iwalktoschool.org

Active & Safe Routes to School: A national organization dedicated to promoting safe, active travel to school through educational resources
www.saferoutestoschool.ca

EcoSchools in ACTION!

Treeline Public School in the Peel District School Board has held a Footloose Friday campaign throughout the year since September 2010. Through this campaign, Treeline has seen a 30-40% increase in students using sustainable transportations on Fridays. Great job Treeline!

SAFETY CONSIDERATIONS

Organize, plan and communicate: With 42% of students being driven to school,[1] high traffic congestion in school zones before and after school poses safety risks for students traveling to and from school. Parental fears concerning their children's safety discourage students and families from using active and sustainable transportation to school. The implementation of an Active Transportation program addresses these issues by establishing safe routes to school with more parental supervision along the way. It is always good idea to confirm board policy before implementing a new campaign.

Develop a school travel plan: Collaborate with campaign participants (schools, school boards, families, and municipalities) to identify potential safety issues, establish safe routes to school, and create an emergency procedure and contact list. Using maps of your school and local community, have students identify safe routes to school, including sidewalks, road signs, stop lights, and other features they should consider when walking to school. Post the student-created maps around your school. Request transit maps to support taking public transportation and information for safe cycling and walking routes from your city council and display them. Set up a ride board so that students and families can more easily connect to arrange carpooling.

Provide training: Pedestrian and road safety education has been incorporated into several school programs. Students could also benefit from bike and safety training courses provided by the school, school board, or local police department.

Consider waivers: Schools may decide to create a permission form or waiver for students and families to sign in order to be able to participate in an Active Transportation campaign/program.

Other safety concerns: visit www.saferoutestoschool.ca for active/ sustainable transportation resources and tips.

[1] www.saferoutestoschool.ca

LETTER TO PARENTS/GUARDIANS

[Insert Date]

Dear Parents/Guardians,

This year we will be implementing an Active Transportation Campaign to promote healthy physical activity and reduce our environmental impact.

We encourage students and families to walk, bike, skateboard, etc. to school [on/during day, week, month]. Can't walk or bike? Take public transit or carpool with schoolmates in your local area. Prior to the start of this campaign, we will be planning and mapping out safe routes to school, creating a ride board to organize carpooling, and educating students about the importance of safe and active sustainable transportation.

If you have any concerns about this campaign, please direct your comments and questions to [insert person's name and position]. Our school staff will take all necessary measures to create a campaign that is safe, accessible, and inclusive. Our goal is to improve the health of all of our students, while contributing to a healthy and sustainable planet.

Thank you for supporting our Active Transportation Campaign and for making a difference for our environment!

Sincerely,

The EcoTeam [Insert Name]

[Insert School Name]

Fillable PDF form is available at www.ontarioecoschools.org

SCHOOL COMMUNICATIONS

Use this information in school newsletters, campaign posters, and morning announcements.

Why Active Transport? Did you know that 42% of students are driven to school?[1] With increasing concerns about the health related to declining activity levels and environmental problems caused by air pollution it is important for schools to take action! This year [Insert School Name] will be participating in an Active Transportation. On this [day, week, month, etc.] we encourage students and families to use active and sustainable transportation such as walking or biking, and follow a safe route to school. Prior to this date and ongoing throughout the campaign, students will have the opportunity to participate in a variety of activities such as, [insert activities- workshops, bike training, mapping and planning safe routes to school, walk to school fashion show, etc.]. Thank you for your support in helping our students stay active and reduce our impact on the environment!

Calendar Highlights:

- October is International Walk to School Month.
- The first week of October is International Walk to School Week.
- The first Wednesday of October is International Walk to School Day.
- Canada's national Winter Walk Day is the first Wednesday in February.
- The first week of June is the Commuter Challenge, where organizations and cities compete to have the most number of people using sustainable transportation.
- June 4 is Clean Air Day. Use sustainable transportation to take action on clean air and climate change issues.

Active Transportation Facts & Trivia: Incorporate facts and trivia about Active Transportation into your daily announcements and encourage students to share their own knowledge and reflect on what they learn.

According to the Active Healthy Kids Canada 2011 Report Card, 42% of children are driven to school.[1]

Distances of up to 5 kilometres are traveled more quickly door to door by bicycle than by car.[1]

Eliminating four short car trips every week can reduce carbon dioxide emissions up to 100 kg per year. Nine families can reduce carbon dioxide emissions by 1000 kg if they participate in a Walking School Bus throughout the year.[1]

In 2012, Transportation accounted for 24% of Canada's greenhouse gas emissions, which contributed to the smog increase in in urban areas.[2]

One public transit bus can replace approximately 50 cars, while a 10-car GO train can replace up to 1,400 cars.[3]

The first ever-International Walk to School Day was October 4th, 2000. Canada was among the first countries to participate, starting in 1998 before the international campaign was officially established.[4]

[1] www.saferoutestoschool.ca
[2] https://ec.gc.ca/indicateurs-indicators/default.asp?lang=en&n=F60DB708-1
[3] http://www.gotransit.com/public/en/docs/publications/quickfacts/Quick_Facts_GO_Green_EN.pdf
[4] www.iwalktoschool.org

WHOLE SCHOOL ACTIVITIES

There are several opportunities to involve the whole school community in Active Transportation activities and campaigns. School EcoTeams can develop and present the following events and initiatives:

- Whole school assembly
- Student eco-themed skits
- Talent show/ coffee house
- Speaker series
- Student featured videos and presentations
- Student organized info booths
- Eco-themed spirit day

Weekly Walk to School Days: As a school, designate one day a week where everyone is encouraged to walk to school. Get creative with the name to engage students, for example Move it Monday, Walk or Wheel Wednesday, and Footlose Friday. To mark the seasonal changes, participate in Canada's Winter Walk Day in February and Spring into Spring walk days leading up to Earth Hour. The EcoTeam can give out hot chocolate, and/or provide a welcome party when students arrive.

Walking School Bus: Join up with two or more families and create a walking school bus. The group of families will follow a predetermined route, pick up walkers and bikers along the way, and travel to school together.

Recognition Awards: Create a Golden Shoe Award for the class with the most participants. Awards can be given out weekly or monthly. Special awards can be created for individuals or specific walk days, like a Golden Snow Boot for the winter Winter Walk Day. To maximize participation, introduce a personal or class tracking system.

Cross Canada Walk: Post a large map of Canada on a bulletin board and determine the number of kilometres it takes to cross the country. Students can add up their walking kilometres as a class or whole school and see how quickly they can "walk across Canada." For students who cannot walk to school, encourage them to participate by walking around the yard during recess.

Fashion Show: Organize a fashion show that encourages students to wear bright, fun clothing that is safe and suitable for walking and wheeling to school. Combine this with a shoe and/or bike decorating contest and provide students with the opportunity to model their designs for their peers.

Sidewalk Chalk Walk of Fame: Create a Walk of Fame in the schoolyard where students can trace their footprint in sidewalk chalk and sign their name to recognize their participation in walk to school days.

Freddie the Footprint: Create a giant footprint and hide it a short distance from school. Challenge the students to find "Freddie the Footprint" as they walk to school and track their discoveries. Classes can compete to see how many students find Freddie each day.

Kiss and Ride Count: Track the number of cars that idle during pick up and/or drop off each day. Tally the numbers each week and display the results in a graph in the school foyer or on the school website. Encourage students and families to reduce school numbers each week by entering license plates of cars that do not idle into a raffle.

EcoSchools in ACTION!

St. Ignatius, WCCDSB, held a Polar Bear Walk to raise awareness and funds for a WWF project-adopt a polar bear program.

Student Survey: Students can survey their peers and staff members to determine how they get to and from school each day. They can then record and communicate the results to the school community along with Active Transportation tips and suggestions, including where to buy student bus passes. Students can also work with school administration to provide more on-site bicycle racks.

LEARNING ACTIVITIES

LEARNING ACTIVITY

K-3

The Earth's blanket

Curriculum Connections:

The following activity meets a variety of Overall and Specific Expectations in the grades 1-3 Language curriculum, in addition to developing critical thinking skills. The Earth's blanket addresses reading comprehension, writing, and oral communication and can be adapted for specific grade levels. It can be modified for Kindergarten to focus on oral communication in Language and the Arts.

Teacher instructions

Materials: The Earth's blanket article, Vocabulary builder worksheet.
For curriculum links, see page 20.

Introducing the activity

- You may wish to bring in a blanket as a prop to bring this activity to life. Ask students how it feels when they snuggle up with a blanket? Why does the blanket feel warm? Is the blanket warm without them? *(No)* What warms the blanket? *(Our bodies!)*
- Explain the following: The Earth has something that keeps it warm too – it has an atmosphere. Like the blanket, the atmosphere itself is not warm but it holds the heat that is released from the Earth. The Sun heats the Earth and the Earth releases the heat back into space. Some of the heat is caught by the atmosphere and some is caught by the clouds. Gases in the atmosphere *(called greenhouse gases)* trap the heat that comes from the Earth the same way a blanket traps heat that comes from your body.
  (For a visual, see Encyclopedia Britannica Student Edition: http://cache.eb.com/eb/image?id=91945&rendTypeId=34)
- Ask the following: What happens to the temperature when the heat-absorbing gases increase? If vehicles are partly responsible for putting greenhouse gases in the atmosphere, then what happens when more vehicles are added to the roads? What happens when we take cars off the road? What other activities add greenhouse gases to our atmosphere? *(Using energy in our homes.)*
- Additional challenge: After discussing the Earth's blanket, make your own class blanket or quilt. Give each student a fabric square for them to design. Encourage them to reflect on the importance of clean air and the realities of climate change.

Ideas for teaching the article and worksheet

- Copy and distribute The Earth's blanket article and the vocabulary worksheet.
- Ask students to look at the image on the top of the article and have them explain the connection between this and the title of the worksheet. Ask them also why they think certain words are underlined. These words may be new to them and are important to learn.
- Review the article aloud with students, stopping to check comprehension after each paragraph. Ask students if they were surprised by anything that they heard and record their responses on the board. Finally, ask if they think that what they read in the article is true. After a few responses, tell them that the government (public health) worked with a teacher to develop this unit. This exercise gets students into the habit of thinking critically about what they read as not everything will be true.

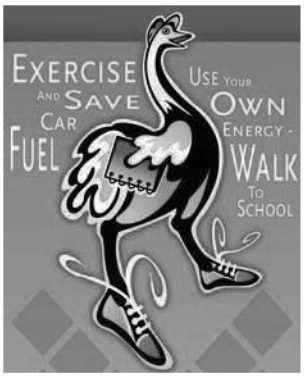
The Earth's blanket

Have you ever snuggled up with a blanket to keep you warm? The Earth does that all the time. Of course, the Earth's blanket, called the atmosphere, looks different from yours. In fact, the Earth's blanket is almost invisible and is made from gases.

These gases are called greenhouse gases. Without these gases, the Earth would be too cold for us. BUT, too many greenhouse gases make it too hot. There must be a balance. It seems that the gases are off balance and this has resulted in climate change.

What puts the gases off balance? It takes energy to drive our vehicles, to heat or cool our homes, and to power our computers and televisions. Every time we use energy, we are burning fossil fuels including gas, oil and coal. Burning fossil fuels sends pollution and greenhouse gases into the air. ***This is what puts the gases off balance*** and contributes to smog and climate change.

The Earth's blanket



How many of the following words do you know?
Look up those that you don't know in the dictionary. Add to the chart any other words you know that are related to the atmosphere or energy use.

	Vocabulary	Definition
1	Fossil fuels	
2	Smog	
3	Pollution	
4	Greenhouse gases	
5	Climate change	
6	Energy consumption	
7	(Your choice)	
8	(Your choice)	

The Earth's blanket

Teacher Resources

Definition Answer Key (taken from the 20/20 Glossary of Terms)

	Vocabulary	Definition
1	Fossil fuels	Fuels that are made from decomposed ancient plants and animals. Examples include coal, oil, and natural gas. They are buried deep in the ground and took millions of years to form.
2	Smog	A haze that forms when sunlight reacts with pollutants in the air. Smog makes it difficult for many people to breathe and can cause breathing problems.
3	Pollution	Substance(s) in the environment which result(s) in damage to the water, air, or soil.
4	Greenhouse gases	Any of the gases that contribute to the greenhouse effect. These include carbon dioxide (CO2), methane (CH4), nitrous oxide (N20), ozone (O3), water vapour, and hydrochlorofluorocarbons (HCFCs).
5	Climate change	This is the change in the average weather that a given region experiences. Different areas of the globe will experience different changes, including higher or lower temperatures, increased rainfall, more storm activity or extended drought periods.
6	Energy consumption	The act of using energy.
7 & 8	Student's choice	

LEARNING ACTIVITY
4-8

Cars and bikes – can they share the road?

Curriculum Connections:

The following activity meets a variety of Overall and Specific Expectations in the grades 4-8 Language curriculum, in addition to developing critical thinking skills. It addresses reading comprehension, writing, oral communication and media literacy, and can be adapted for specific grade levels. For example, the reading comprehension questions can be rewritten to reflect the learning objectives for students in grade 7 and 8. For curriculum links see page 20.

Materials: Media article; vocabulary builder handouts

Council Approves Jarvis Bike Lanes

May 25, 2009
Paul Moloney & Donovan Vincent
CITY HALL BUREAU

Note: This article has been modified from www.thestar.com

Toronto city council has approved a plan to build a bike lane on Jarvis Street. The $6.3 million "Jarvis streetscape improvement" was approved by a 28-16 vote after a day-long debate. The bike lane idea was supported by those councillors who are enthusiastic cyclists, but not supported by councillors who are worried about the increased amount of traffic the bike lane would produce.

The Jarvis streetscape improvement includes:

- widening the east sidewalk;
- planting more trees; and
- adding heritage plaques.

The improvement project will now go to the province so that it can be approved. The bike lanes would cost about $75,000 to build and be fairly easy to install. They may possibly be completed as early as the fall of 2009. The remaining improvements would require longer to complete.

Councillor Kyle Rae, who pushed for the changes, said the road should be shared among drivers, cyclists and pedestrians. "What you want on Jarvis is to maintain the traffic, but to share that with all the users - not just for the car alone," he said.

Cars and bikes – can they share the road?

Media article; vocabulary builder (continued)

Mayor David Miller kicked off the debate by calling on motorists to accept longer driving times to provide more space for the growing number of cyclists to ride safely. "We're not talking about a huge transformation for drivers; we're talking about minimal inconvenience, if any," Miller told council, noting that there is a two-minute difference in driving time. “The current situation just doesn't work for cyclists,” he said.

The city needs a network so cyclists can travel their entire trip safely using bike lanes, Miller said. "Cycling and the number of people who cycle in this city is booming," he said.

Cars and bikes – can they share the road?

Part 1 – Student worksheet for media article

Each morning, you get up and go to school by car, walking, biking or taking public transit. Thousands of other kids and working adults use the same types of transportation. With all these people trying to get somewhere at the same time, the streets can get crowed with vehicles. The result of having so much traffic is traffic jams. This causes increased emissions of greenhouse gases (such as carbon dioxide), which are warming the planet. It also causes air pollution which makes it hard to breathe.

We need to be able to use a variety of ways to get to school and work. We need different ways of travelling that are less polluting like walking, bike riding, or carpooling.

Answer the following questions. Use the article to find the answers:

1. What has City council approved on Jarvis Street? _____

2. Did all councillors agree this should happen? _____
   Explain:_____
   _____

3. Do you think having a bike lane on Jarvis Street is a good idea? _____
   Explain: _____
   _____

4. If you were told to recommend more bike lanes on city streets, which streets would you recommend? _____
   Why? _____

5. We make bike lanes by painting a line on the side of existing roads. Is there another way to create bike lanes that will get more people biking in the City? Explain: _____
   _____

Cars and bikes – can they share the road?

Part 1 – Student worksheet for media article (continued)

6. Sketch a map of your neighbourhood below. Outline in green, all the routes that you could take your bike on.

Cars and bikes – can they share the road?

Part 2 – Student survey worksheet

Step 1: How do students in your classroom travel to school?

(A) Survey the students in your classroom. Tally how many:

Are driven to school	Take public transit	Take the school bus	Walk/cycle	Come in a carpool with other students	Other (e.g. skateboard, rollerblade)

(B) Draw a bar chart to show the final results

Step 2: How willing are your classmates to try more non-polluting ways to get to school?

(C) Survey students in your classroom who **are driven to school**. Find out if they would like to try another cleaner option for a two-week period. (For those who say "yes", put the tally in the option they would like to try.)

Take public transit	Walk/cycle	Join a walking school bus	Come in a carpool with other students	Other (e.g. skateboard, roller blade)

Cars and bikes – can they share the road?

Part 2 – Student survey worksheet (continued)

Step 3: If all the students who are driven to school were able to switch to cleaner transportation, how much could your classroom reduce vehicle use? Find out the percentage of reduction by filling in the blanks below!

1. The total number of students tallied in (C) are: _____
2. The number of students who **are driven to school,** tallied in (A) are: ___
3. Take your answer from number 1 and divide it by your answer in number 2. Like this:

$$\frac{\text{total number of students tallied in (C)}}{\text{number of students who } \textbf{are driven to school,} \text{ tallied in (A)}} = \_\_\_\_\_$$

4. Take your answer from number 3 and multiply it by 100. Enter your answer here: _____%. Your classroom could reduce vehicle use by this much!

CARS and BIKES

Can they share the road?

Cars and bikes – can they share the road?

Teacher instructions

Introducing the activity

- Ask students about the different ways students might be able to get to and from school. Answers will likely include being driven, taking the school bus, walking, cycling or public transit.

- Ask students to estimate how long they think it took them to get to school that day, whether they thought it was a faster or slower trip than usual and why. This will likely lead to a discussion about traffic. If is does not, probe further by asking students if they think the roads (and school area) are busiest with traffic in the morning, lunch or after school.

- Poll students to find out their favourite way to get to and from school. This thinking will set them up for their worksheet exercises and may even spawn some new ideas for future transportation options!

Ideas for teaching Part 1 – student worksheet for media article

- Have students read the article and then ask them to select five words or phrases that they find most interesting or don't know.

- Write those words on the board and if there are any words that they don't know, discuss them and use the members of the class as consultants.

- Read the article again with the students and review the worksheet questions out loud. Record their answers on the front board to make it easy for students to complete their own worksheet.

- When taking up the answers to question 3, you may want to divide the classroom and set up a debate. For example, students could craft some arguments that they think may have been put forward during the vote "for" and "against" bike lanes.

- When taking up the answers to question 5, ask your students if they know of other countries that have a better bike-path system than Canada. *(Holland has the best cycling lane network in the world, with 19,000 kilometres of dedicated bike paths and lanes).* You may want to turn this question into a research project.

Cars and bikes – can they share the road?

Teacher instructions (continued)

Ideas for teaching Part 1 – student worksheet for media article (continued)

- This article also provides you with an opportunity to explore issues related to government and municipal politics. Ask students which level of government was responsible for the vote on the Jarvis Street Improvement. Poll students to find out how many have gone with their parents to vote and whether they know how old you need to be to vote. *(18 years of age.)* Do they think this age too old or too young and why? Probe their knowledge of other levels of government or government bodies such as the United Nations.

Ideas for teaching Part 2 – student survey worksheet

- **This is a good exercise to do in class before you begin the transportation part of the 20/20 Planner**. It simply gets students to think about or imagine how they might "clean air commute" to school, which is a good lead in to the actual commitment they (and their Clean Air Buddy at home) make in the 2-week transportation program outlined in the 20/20 Planner.

- Review the student survey worksheet with your class. For **Step 1,** you can divide your students into small groups and rotate them to survey each other. You can also simply poll the classroom out loud and have students record the answers on their worksheet.

- For **Step 2**, you may want to open this up to a classroom discussion, with students who get driven to school taking the lead. It will allow all students to brainstorm ideas for helping each other find cleaner ways to get to school and overcome some of the obstacles for doing so (e.g., how does a child convince a parent not to drive? how does a child deal with the fear about biking?)

- **Step 3** requires math skills, so depending on your grade level, you may either have students work through this on their own or else guide them through it out loud. The final result should give students a sense of the potential reductions in vehicle use that their classroom could achieve when kids who are driven to school are able to switch to cleaner options.

CURRICULUM LINKS K-3 AND 4-8

Curriculum links are listed below for the K-3 and 4-8 whole class activities. The activities can be adapted and modified to meet other curriculum requirements and learning objectives across grade levels.

The Earth's Blanket Curriculum Links

Kindergarten Science and Technology

Overall Expectation 3: demonstrate an understanding of the natural world and the need to care for and respect the environment; SE: 3.3

Grade 1-3 Language

Reading Comprehension

Overall Expectation 1: Read and demonstrate an understanding of a variety of literary, graphic, and informational texts, using a range of strategies to construct meaning; SE: 1.3, 1.4, 1.5, 1.6

Grade 1 Science and Technology

Understanding Matter and Energy:
Energy in Our Lives

Overall Expectation 3: demonstrate an understanding that energy is something that is needed to make things happen, and that the sun is the principal source of energy for the earth; SE: 3.2, 3.4, 3.5

Cars and Bikes – Can They Share the Road?

Grade 4-6 Language

Reading Comprehension

Overall Expectation 1: Read and demonstrate an understanding of a variety of literary, graphic, and informational texts, using a range of strategies to construct meaning; SE: 1.3, 1.4, 1.5, 1.6, 1.7

Grade 4 Social Studies

People and Environments: Political and Physical Regions of Canada

Overall Expectation B.2: use the social studies inquiry process to investigate some issues and challenges associated with balancing human needs/wants and activities with environmental stewardship in one or more of the political and/or physical regions of Canada; SE: B2.1

Grade 5 Social Studies

People and Environments: The Role of Government and Responsible Citizenship

Overall Expectation B1: Assess responses of governments in Canada to some significant issues, and develop plans of action for governments and citizens to address social and environmental issues; SE : B1.3

Grade 7-8 Language Curriculum Links

Reading Comprehension

Overall Expectation 1: Read and demonstrate an understanding of a variety of literary, graphic, and informational texts, using a range of strategies to construct meaning; SE: 1.3, 1.4, 1.6

LEARNING ACTIVITY

9-12

OVERVIEW: ENVIRONMENTAL EDUCATION OPPORTUNITIES IN GRADE 12 PHYSICS

Energy can be transformed from one form to another; however, systems involving energy transformations are never 100 percent efficient. The different processes used to generate usable energy vary in efficiency, as well as in the amount of GHGs they produce. As a result, different energy sources (e.g., coal, petroleum, natural gas, hydro, nuclear) and their resulting energy transformations affect the environment in different ways.

Curriculum Expectations

- **Energy Transformations:** E1, E2, E3, E3.4, E3.5
- **Electricity and Electronics:** D1

The learning activity can be modified and adapted to meet curriculum expectations in the Grade 9 Physics strand, the Grade 11 Physics and Environmental Science courses, as well as the Grade 12 Physics University Preparation course.

GUIDING QUESTIONS

QUESTIONS	LEARNING CONCEPTS
How can we reduce or eliminate GHG emission levels when we generate useable energy? What are energy alternatives? How can efficiency be increased?	Measure energy efficiency in terms of the energy released per unit C (as a gas). Less efficient processes produce high levels of carbon compounds, and more efficient processes produce lower levels of gaseous carbon. Increased efficiency is a factor in reducing the production of GHGs. In today's fossil fuel-based world, a device's efficiency can be measured in terms of the size of its "carbon footprint." Determine "energy equivalency" by converting kJ into kg of carbon.
ONTARIO ecoschools écoécoles de l'ONTARIO	**Links to EcoSchools - Energy Conservation** Compare the efficiency of various energy sources, as well as the relative amounts of GHGs that are released from each. Identify the main sources of energy for the school and monitor/track the school's energy usage over the course of the year. Explain how reducing energy consumption within the school relates directly to GHG emissions.
How much "green" energy do various jurisdictions use? What price would you or your parents be willing to pay for a hybrid car (e.g., a Toyota Prius)? How did you arrive at that figure?	Different energy sources (e.g., coal, petroleum, natural gas, hydro, wind, nuclear) produce differing amounts of gaseous carbon compounds. Some energy sources (e.g., hydro, nuclear, and wind) do not produce GHGs, although they have other environmental impacts. As people make fuel choices, they also make CO_2 choices.

EFFICIENCY AND VEHICLE EMISSIONS
Physics Grade 12 College Preparation

Curriculum Expectations

- **Energy Transformations:** E1, E1.1

Overview

This activity involves the collection and analysis of real-world data to explore vehicle efficiency and how that translates into CO_2 emissions. It complements the Energy Transformations & Motion sections of the curriculum.

TEACHING AND LEARNING STRATEGIES

Prior Learning

This activity requires an understanding of the factors that affect motion and energy transformations related to the efficiency of the internal combustion engine.

Fundamental Skills

Students need to be able to collect quantitative data, analyze that data and make connections to real world problems.

Systems Analysis

Students need to be able to identify parts of a system and connections between or among systems. In particular, students need to be able to make connections to how a system (internal combustion engine) works (its efficiency) in relation to outside factors (weight of car) acting on it.

Time Requirement

- Homework or 1/2 Computer Period – to access the internet and gather the required data
- 1 Class Period – for calculations and whole-class discussions

Learning Activity

Homework or 1/2 Computer Period

1. Using their family car, have students fill in the information needed on the 'Vehicle Information Chart' before working on this activity in class.
   - This information is essential to the activity and is found on the following website: http://oee.nrcan.gc.ca/transportation/tools/fuelratings/ratings-search.cfm
   - If the student does not have a family car, tell them to pick their dream car.
   - Work with students to calculate or estimate the ratio of highway to city driving in their commute.

BROKEN LINK? *Google* "Natural Resources Canada" → Energy → Energy Efficiency → Cars and Light Trucks → Fuel Consumption Ratings

Class Time

1. Start with discussion of energy transformations, internal combustion engines, factors that affect efficiency of vehicles and carbon dioxide emissions (CO_2) from cars.
2. **Calculate:** Using 'Table 1', calculate the amount of CO_2 emissions that your car produces during a round trip commute to school.
   a. Ensure students estimate the relative proportions of city driving and highway driving.
3. **Calculate:** Have the entire class choose either city or highway driving (depending on where your school is located) and calculate the amount of CO_2 their car produces for a 10 km drive.
4. **Create a Graph:** Have each student share their information about how much CO_2 is produced during a 10 km drive with 7 other classmates. Create a graph comparing the cars and CO_2 produced from driving 10 km.
   a. If necessary, add examples for car types that are not represented in the class (i.e. large vs. small cars, newer vs. older cars, etc.).
5. **Calculate:** Choose the most efficient car on your graph and calculate how much CO_2 would be produced by a year's commute (choose your average commute time as a class and assume 196 days of school).
6. **Repeat the Calculation:** Using the least efficient car on your graph.
7. **Calculate:** The amount of trees needed to offset your yearly commute.
   a. According to the UNEP an average tree absorbs 12 kg CO_2 per year.
   b. Follow the example in Table 2.

Whole Class Discussion

Why are some cars more efficient than others?

- Look at the graph you just produced, what do the least and most efficient cars have in common
- From this discussion, highlight the differences between these cars that might impact efficiency

Why are there differences in efficiency between highway driving and city driving?

What is the difference between the yearly CO_2 produced from an efficient car vs. an inefficient car?

- Why do consumers continue to buy inefficient cars? What advantages do they have over efficient vehicles that keep them on the market?
- Brainstorm ways that an inefficient car could be made more efficient

Extension

Calculate the price of gas for a yearly commute. How many trees would be needed for your entire class' commute? For your school's commute?

Find your vehicle information here:
http://oee.nrcan.gc.ca/transportation/tools/fuelratings/ratings-search.cfm
(Select model year and click "Submit Year" BEFORE selecting the model!)

Sample Vehicle Information taken from the website

Year: 2003 View Legend

Make/Model	Class	Eng. Size /Cyl	Tran # gear	Fuel Consumption					Rank		CO_2 kg per year
				Typ	$/yr	L/yr	L/100km City	L/100km Hwy	Class	All	
MAZDA PROTEGE	C	1.6/4	E4+	X	$1101	1644	9.3	6.9	39	66	3880

Vehicle Information Chart

Car Details		
Make	*Mazda*	
Model	*Protégé*	
Class	*C – Compact*	
Year it was made	*2003*	
Fuel Consumption Found on the website listed below enter your vehicle information to find specifics		
City	*9.3 L/100km*	
Highway	*6.9 L/100km*	
CO_2 kg / year (assuming 20,000 km driven at 2.3 kg of CO_2)	*3880 kg of CO_2 / year*	
Home-School Commute Use Google Maps (http://maps.google.com)		
Km driven to school	*10 km*	
Km driven to school and back	*20 km*	
Type of Commute Estimate % of highway driving (fast, consistent) vs. city driving (slow, stop & go)		
% Highway	*20%*	
% City	*80%*	

Table 1

Explanation	Example
Calculate the mass (in kg) of CO_2 produced by 1 L of fuel. Inputs (from website, using the 2003 Mazda Protégé as an example): • Fuel Consumption = 1644 L/ year • Emissions = 3880 kg of CO_2 / year	$\frac{1644\ L\ of\ Fuel}{1\ Year} = \frac{3880\ kg\ of\ CO_2}{1\ Year}$ 1644 L of Fuel = 3880 kg of CO_2 $\frac{1644\ L\ of\ Fuel}{1644} = \frac{3880\ kg\ of\ CO_2}{1644}$ **1 L of Fuel = 2.360 kg of CO_2**
Determine the proportion of city and highway driving. Example inputs: • Round-trip commute = 20 km • 20% highway & 80% city driving	Highway commute = 20 % of 20 km = 20 * 0.2 **= 4 km** City commute = 80% of 20 km =20 *0.8 **= 16 km**
Calculate the fuel consumption of the commute. Inputs (from website, using the 2003 Mazda Protégé as an example): Fuel Efficiency: • 6.9 L /100km–Hwy driving • 9.3 L /100 km–City driving	**Highway commute** $\frac{6.9\ L\ of\ Fuel}{100\ km}$ $\frac{0.069\ L\ of\ Fuel}{1\ km}$ $\frac{0.069\ L\ of\ Fuel}{km}$ = *4 km =0.276 L of fuel **City commute** $\frac{9.3\ L\ of\ Fuel}{100\ km}$ $\frac{0.093\ L\ of\ Fuel}{1\ km}$ $\frac{0.093\ L\ of\ Fuel}{km}$ = *16 km =1.488 L of fuel Total Fuel Used: = Highway commute + City commute = 0.276 + 1.488 **= 1.764 L of Fuel**
Calculate the mass (in kg) of CO_2 produced during the daily commute	Total L of fuel used * kg of CO_2/ L of Fuel = Total Emissions 1.764 L of Fuel * 2.360 kg of CO_2/ 1 L of Fuel **= 4.163 kg of CO_2 emissions produced during the daily commute**

Table 2

Calculate the mass of CO_2 (kg) produced from your yearly commute Example Input: • 196 days in a school year • 4.163 kg of CO_2 produced during the daily commute (from previous example)	= 196 days/school year *4.163 kg of CO_2/day **= 816 kg of CO_2/school year**
Calculate the amount trees needed to offset your yearly commute. Inputs • An average tree absorb 12 kg CO_2 per year as per UNEP • Emissions produced: 816 kg of CO_2 produced during a year's commute	$\frac{816\ kg\ of\ CO_2\ produced\ during\ yearly\ commute}{12\ kg\ of\ CO_2\ absorbed\ by\ one\ tree\ per\ year}$ = **68 average trees** are needed to absorb the emissions from your commute.