Canadian Centre for Energy Information

DRIVE – THE WAY LIFE moves

Drive – The Way Life Moves booklet and teacher guide are part of an integrated education program distributed nationally by the Canadian Centre for Energy Information (Centre for Energy). The purpose of this series of current and practical petroleum industry learning resources is to increase students', teachers' and parents' understanding of petroleum and its importance to all Canadians.

This resource uses the popular theme of transportation – and motor vehicles in particular – to provide real-life examples of the use and impact of petroleum resources in our daily lives. The activities explore petroleum's role in a motor vehicle's full life cycle and provide students with opportunities to investigate how science and technology are applied in vehicle design, production and operation. The resource also encourages students to identify and weigh the personal, social, economic and environmental costs and benefits of motor vehicle use, and to explore alternatives to personal vehicles.

Drive – The Way Life Moves is intended for students who are at or near driving age. Text and graphic treatments that attract aspiring young drivers and encourage them to explore the publication's content were identified with help from students in grades 9 to 12 who participated in focus group tests. The bold photos and headlines in *Drive – The Way Life Moves* reflect the interests and attitudes of this age group. The content is well-researched and has been reviewed by students, teachers and industry representatives for accuracy and balance.

With this resource, the Centre for Energy hopes to develop a greater awareness of the pros and cons of driving, while fostering a greater understanding of the role petroleum plays in transportation and in the rest of our lives.

April 2006 **LEARNING RESOURCE SERIES**

Canadian Centre
for Energy Information

Your Resource Source

The Canadian Centre for Energy Information (Centre for Energy) is a non-profit organization created in 2002 to meet a growing demand for balanced, credible information about the Canadian energy sector. On January 1, 2003, the Petroleum Communication Foundation (PCF) became part of the Centre for Energy. Our educational materials will build on the excellent resources published by the PCF and, over time, cover all parts of the Canadian energy sector from oil, natural gas, coal, thermal and hydropower to nuclear, solar, wind, fuel cell and other alternative sources of energy.

The Centre for Energy does not take positions on issues. The Learning Resource Series was developed using a multi-stakeholder review process with the aim of creating fact-based, balanced documents. Educators helped ensure that the educational materials are interesting and applicable to students in schools across Canada.

Canadian Centre for Energy Information
Tel: (403) 263-7722
Facsimile: (403) 237-6286
E-mail: infoservices@centreforenergy.com

To order publications and educational materials, call toll free: 1-877-606-4636

To find out more about the Canadian Centre for Energy Information or to find up-to-date information on petroleum issues, statistics or Centre for Energy education resources, please visit the Centre for Energy's portal at: **www.centreforenergy.com.**

Printed in Canada
Revised April 2006

Background Information

TEACHING TIPS

Most of the student activities appear in *Drive – The Way Life Moves;* their location in the booklet is indicated by a page number reference. Additional activities, as well as extensions to the activities, are described in this teacher guide.

Teachers may wish to act as facilitator while the whole class works through the activities, or have students complete the activities in groups or individually as enrichment or independent studies.

Did You Know text blocks offer additional information, which teachers can use to provide a more complete understanding of the concepts or encourage students to explore further. *Hints* provide the teacher with ideas to guide students as they think through some of the questions and problems posed in the activities. *Hints* can be shared with students as needed. *Tips* offer suggestions for facilitating the activities.

For a greater understanding of the topic, teachers are encouraged to review the Centre for Energy background information on petroleum and petroleum-based products prior to introducing these activities. This information is available at **www.centreforenergy.com** in the Education and Bookstore sections. Centre for Energy classroom materials are available free to Canadian teachers (some restrictions apply). Please visit the Centre for Energy portal at **www.centreforenergy.com** for product descriptions and ordering information.

For more information on petroleum and petroleum-based products, visit the following websites:

- Background information on Canada's energy resources from Natural Resources Canada's Petroleum Resources Branch: **www.nrcan.gc.ca**
- Statistical Review of the Wor ld Energ y from BP: **www.bp.com/centres/energy/index.asp**
- Background information on the production and use of plastics from the Canadian Plastics Industry Association: **www.plastics.ca**
- Descriptions of plastic car components from the American Plastics Council: **www.plastics-car.com**

For more information on vehicles and transportation visit:

- Canadian Automobile Association: **www.caa.ca**
- Transpor tation in Canada 2004 Annual Repor t from Transport Canada: **www.tc.gc.ca/pol/en/report/anre2004/toc_e.htm**
- Fuel economy information from the U.S. Department of Energy/U.S. Environmental Protection Agency: **www.fueleconomy.gov**
- Personal Vehicles Initiative (Natural Resources Canada): **www.oee.nrcan.gc.ca/transportation/personal-vehicles-initiative.cfm?attr+0**

For more information on the health effects from vehicle emissions, visit these websites:

- Environment Canada Clean Air: **www.ec.gc.ca/envhome.html**
- Health Canada: **www.hc-sc.gc.ca/ewh-semt/air/index_e.html**
- U.S. Environmental Protection Agency Air Now: **www.airnow.gov**

Curriculum Links and Learning Outcomes

The activities in Drive – The Way Life Moves are designed to fit within the following Alberta curricula and learning outcomes.

SCIENCE 14: INVESTIGATING PROPERTIES OF MATTER

- Outline the steps in separating the components of mechanical mixtures and solutions on the basis of their properties (e.g., distillation of solutions such as crude oil).
- Differentiate among metals, non-metals and metalloids on the basis of properties (e.g. luster, conductivity, malleability, brittleness, state of matter).
- Design an experiment and identify major variables.

SCIENCE 14: INVESTIGATING MATTER AND ENERGY IN THE ENVIRONMENT

- Assess the costs and benefits of technological developments that produce materials the ecosystem cannot recycle (e.g., disposable plastics).
- Identify and assess the needs and interests of society that have led to technologies with unforeseen environmental consequences (e.g., impact of driving a car on atmospheric conditions).
- Compile and display data, by hand or computer, in a variety of formats, including diagrams, flow charts, tables, bar graphs, line graphs and scatterplots.

SCIENCE 20: CHANGES IN MOTION

- Understand that the motion of objects is described in terms of displacement, time, velocity and acceleration.
- Learn how Newton's laws of motion relate force to the motion of objects.

SCIENCE 30: ENERGY AND THE ENVIRONMENT

- Understand that the global demand for energy must be reconciled with the need to maintain a viable biosphere.
- Analyze energy consumption by various sectors.

PHYSICS 20: KINEMATICS AND DYNAMICS

- Assess the design and use of injury prevention devices in cars and sports in terms of the principle of inertia and Newton's laws.

MATH 14: NUMBER (NUMBER OPERATIONS)

- Estimate and calculate percentages.
- Express rates and ratios in equivalent forms to solve problems.

MATH 14: SHAPE AND SPACE (MEASUREMENT)

- Convert between SI and Imperial systems of measure, using a conversion table or calculator.
- Develop a sense of approximate conversions between SI and Imperial units through investigations.

MATH 14: STATISTICS AND PROBABILITY (DATA ANALYSIS)

- Display data by hand or computer in a variety of ways, including circle graphs.

MATH 24: NUMBER (NUMBER OPERATIONS)

- Modify a spreadsheet template to allow users to input their own variables.

MATH 24: STATISTICS AND PROBABILITY (DATA ANALYSIS)

- Read and interpret given data.
- Draw and validate inferences, including interpolations and extrapolations, from graphical and tabular data.
- Discuss how collected data are affected by the nature of the sample, the method of collection, the sample size and biases.
- Discuss issues to be addressed when collecting data; e.g., appropriate language, ethics, cost, privacy, cultural sensitivity.
- Select, defend and use appropriate methods of collecting data: designing and using questionnaires, interviews, experiments, research.
- Design different ways of presenting data and analyzing results, by focusing on the truthful display of data and the clarity of presentation.

INFORMATION AND COMMUNICATIONS TECHNOLOGY 10 AND 11

- *P2:* Organize and manipulate data.
- *C1:* Access, use and communicate information from a variety of technologies.
- *C6:* Use technology to investigate and/or solve problems.
- *C7:* Use electronic research techniques to construct personal knowledge and meaning.

NOTE

This set of activities is designed to support the curriculum strands listed, but is not a complete unit of study designed to meet all the learning requirements for each curriculum. Rather, the resource is intended as a supplement for extension to the broader lessons included in the curriculum and therefore covers only selected learning outcomes.

Pan-Canadian Science Links

The activities in *Drive – The Way Life Moves* fit within the grade 10 to 12 general learning outcomes from the Pan-Canadian Common Framework for Science listed below.

- *#114:* Describe disciplinary and interdisciplinary processes used to enable us to understand natural phenomena and develop technological solutions.
- *#115:* Distinguish between science and technology in terms of their respective goals, products and values, and describe the development of scientific theories and technologies over time.
- *#116:* Analyze and explain how science and technology interact with and advance one another.
- *#117:* Analyze how individuals, society and the environment are interdependent with scientific and technological endeavours.
- *#118:* Evaluate social issues related to the applications and limitations of science and technology, and explain decisions in terms of advantages and disadvantages for sustainability, considering a variety of perspectives.
- *#214:* Analyze data and apply mathematical and conceptual models to develop and assess possible explanations.
- *#319:* Identify and explain the diversity of organic compounds and their impact on the environment.
- *#325:* Analyze and describe relationships between force and motion.
- #326: Analyze interactions within systems, using the laws of conservation of energy and momentum.

STUDENT ACTIVITY 1 **SCIENCE 14, ICT 10**

Petroleum Inside Out

Learning Outcomes

- *SCIENCE 14:* Outline the steps in separating the components of mechanical mixtures and solutions on the basis of their properties (e.g., distillation of solutions such as crude oil).
- *SCIENCE 14:* Differentiate among metals, non-metals and metalloids on the basis of properties (e.g., luster, conductivity, malleability, brittleness, state of matter).
- *SCIENCE 14:* Design an experiment and identify major variables.
- *ICT 10:* Organize and manipulate data.
- *ICT 10:* Use electronic research techniques to construct personal knowledge and meaning.

Activity

Begin this activity with a class discussion on how to identify products made from metals, non-metals or metalloids. Students may suggest testing for conductivity, malleability, hardness, luster etc. Explain that many non-metal materials often used today are made from petroleum or petrochemicals, like plastic and foam. Ask students how they could determine if a product is made with petroleum or petrochemicals. Students might suggest that petrochemical products may be lightweight, stretchy, soft, slippery, etc.

Explain that each pair is going to examine the interior and exterior of their friend's vehicle, and make a list of all the components they can see that are made with petroleum or petrochemicals. Before they go outside to the car, pairs should gather any tools they will require, such as notepaper, magnet, etc.

Back in the classroom, students should add to their list all the petroleum-based components that are in the engine, like fluids and parts. When they think they have completed their list, students should use the Internet to research any other petroleum-related vehicle products they may have missed.

Have student pairs share their final lists with the rest of the class. Ask: Why do you think so many vehicle components are made with petrochemicals?

TIP

Prior to beginning this activity, have students form pairs. Have each pair receive permission to use a friend's car for the activity.

Did you know?

A European study found that using 100kg of plastic material in modern cars replaces between 200 and 300 kg of other materials. This reduces fuel consumption by 750 litres over the average life span of a car.

Source: Environment and Plastics Industry Council

TIP

The following table lists some of the automobile components made from petroleum and petrochemicals.

Interior	Exterior	Engine
Air bags	Bumpers	Antifreeze
Arm rests	Car body	Brake fluid
Carpets	Headlights	Fan belt
Children's car seats	Protective door strips	Gasoline
Dashboard	Roof racks and containers	Hoses
Door panels	Running boards	Motor oil
Foam seat cushions	Tail lights	Oil filter
Head rests	Tires	Power steering fluid
Radio and CD player buttons	Bumper stickers	Protective caps
Seat belts		Windshield cleaner
Seat covers		
Steering wheel		
Upholstery		

NOTE

Some of these items, like upholstery and seat covers, may or may not be made from petroleum.

Extension

Explain that gasoline and other petrochemical products are produced from naphtha, one of the lightest distillates of crude oil. A distillate is a liquid product condensed from vapour during distillation, the process of purifying a liquid by successive evaporation and condensation. Have students study a model of a fractional distillation tower (see *Our Petroleum Challenge* or visit **www.centreforenergy.com**) to find out what other distillates come from crude oil. Have them identify three or four products made from each type of distillate. Students could put their data into a table like this:

Distillate	**Product**
Naphtha	Gasoline Dashboards Vinyl upholstery Tail lights Antifreeze
Kerosene	Jet fuel Stove oil
Light gas oils	Jet fuel Diesel fuel Furnace fuel
Heavy gas oils	Further refined to make naphtha
Residue	Refinery fuel oil Waxes Greases Asphalt

STUDENT ACTIVITY 2 **SCIENCE 14, SCIENCE 30, ICT 10**

Our Automobile Economy

Learning Outcomes

- *SCIENCE 14:* Assess the costs and benefits of technological developments that produce materials the ecosystem cannot recycle (e.g., disposable plastics).
- *SCIENCE 14:* Identify and assess the needs and interests of society that have led to technologies with unforeseen environmental consequences (e.g., impact of driving a car on atmospheric conditions).
- *SCIENCE 14:* Compile and display data, by hand or computer, in a variety of formats, including diagrams, flow charts, tables, bar graphs, line graphs and scatterplots.
- *SCIENCE 30:* Understand that the global demand for energy must be reconciled with the need to maintain a viable biosphere.
- *SCIENCE 30:* Analyze energy consumption by various sectors.
- *ICT 10:* Organize and manipulate data.
- *ICT 10:* Access, use and communicate information from a variety of technologies.

Activity

Form students into small groups. Ask them to make a web diagram to illustrate all the goods and services connected directly or indirectly to motor vehicles in Canada. Have them consider resource extraction, refining, manufacturing, distribution, insurance, roads and highways, parking, maintenance, disposal, safety, recreation, environment and any other categories they can think of. When they are finished, they should compare their web with that of another team to find anything they may have missed. Ask them to identify which of the goods or services they listed produce materials that cannot be recycled.

TIP

A F.A.I.R analysis includes arguments For, arguments Against, and any other Interesting Remarks.

Describe the following scenario to students: Imagine a new environmental law is being proposed in our community. This law would ban the use of motorized vehicles (cars, trucks, motorcycles, etc.) except for emergency use. That means any other transportation needs would have to be filled via public transit or non-motorized vehicles.

Ask students to think about how the law would affect their own lives, as well as their community as a whole. Have them use the F.A.I.R. model to identify the important issues to consider if the law were imposed.

Once they have had a chance to consider all the F.A.I.R. aspects, have the class conduct a democratic vote on the proposed law.

Extensions

1. Have students write an essay describing our society's economic reliance on the automobile.

2. Ask students to use the web diagram to identify one or two automobile- or petroleum- related careers that might interest them. Have them do some research to find out what education and skills are required for the position.

Descriptions of automobile-related careers can be found on the following websites:

- DTI Automotive Directorate: **www.autoindustry.co.uk/education/careers/index.html**
- Vocational Information Centre: **www.khake.com/page12.html**

3. Have students conduct a cost-benefit analysis of a modern car to weigh the economic, social and environmental costs of personal automobiles against the benefits in the same categories. Explain that in simpler terms, they are just going to list the pros and cons of automobiles. Have students display their information in a table like the one below to help them analyze all the benefits (pros) and costs (cons) at once. Ask students the following questions: What does your cost-benefit analysis tell you? How might the benefits of automobiles be increased while their social and environmental costs are reduced?

HINT

Detailed descriptions of petroleum industry careers can be found on the Centre for Energy portal at **www.centreforenergy.com** or at **www.careersinoilandgas.com**

Source: Statistics Canada, 2006

	Pros	**Cons**
Economic		
Social		
Environmental		

STUDENT ACTIVITY 3 **SCIENCE 14, ICT 10**

So Exhausting

CAUTION

This activity should only be undertaken with adult supervision. The vehicle engine should not be running during the experiment.

Learning Outcomes

- *SCIENCE 14:* Identify and assess the needs and interests of society that have led to technologies with unforeseen environmental consequences (e.g., impact of driving a car on atmospheric conditions).
- *SCIENCE 14:* Compile and display data, by hand or computer, in a variety of formats, including diagrams, flow charts, tables, bar graphs, line graphs and scatterplots.
- *ICT 10:* Organize and manipulate data.
- *ICT 10*: Access, use and communicate information from a variety of technologies.

Materials

- Cotton swabs
- Notepaper
- Tape
- Variety of motor vehicles

Procedure

Form students into pairs. Have each pair choose a motor vehicle from the school's outdoor parking lot and ask the owner if they may test the vehicle's particulate emissions. Have pairs set up a chart like this sample to compare their chosen vehicle with others:

Make	Model	Engine	Year	Amount of Particulate Matter
Chevrolet	Cheyenne Truck	C-20	1972	High

Have student pairs follow these steps to conduct the experiment:

1. Use your cotton swab to swipe the inside of the vehicle's tailpipe a few times. Be careful! Only conduct this experiment outside. Exercise caution as the tailpipe may be hot, especially if the vehicle has just arrived in the parking lot. Be careful not to touch it with your hand or clothing.

2. Tape your cotton swab to your notepaper. Look carefully at everyone's cotton swab and notes. What do you think caused the blackness on the swabs? Are some blacker than others? If so, which ones? Try to find reasons for lower or higher levels of particulate matter, based on the type and age of each vehicle and the fuel type used. You will likely want to question the vehicle owner regarding fuel, maintenance, driving habits, etc.

3. Write a short summary on the experiment and your findings.

Extensions

1. Some areas in Canada have programs to decrease the emissions from cars, especially older models. But not everyone can afford a brand new car. Sometimes people have to drive older, less wellmaintained cars, even though they would prefer a newer vehicle that runs more smoothly. Ask students to brainstorm answers to these questions: How might an effective vehicle emission reduction program avoid penalizing people who simply can't afford to fix their car or buy a newer model? How can we all help reduce the emissions from our vehicles?

2. The internal combustion engine produces a number of environmentally-unfriendly emissions, such as carbon dioxide (CO2) and nitrogen oxides (NOX) which are considered greenhouse gases. Ask students to research the answers to the following questions: What impacts do vehicle emissions have on people and the environment? What are the human-caused and natural sources of greenhouse gases? Have students create a pie graph to illustrate the breakdown of greenhouse gases emitted by an average passenger vehicle.

HINT

Refer to vehicle emission information posted at:

- Environment Canada Air Quality: **www.ec.gc.ca/cleanair-airpur/**
- Clean Air Handbook: **www.cleanair.ca/handbook.html**
- Air Head: **www.airhead.org/AirPollution/**
- US Environmental Protection Agency: **www.epa.gov/oar/oaqps/cleanair.html**

Did you know?

Passenger cars and trucks fueled by gasoline are responsible for the highest percentage of greenhouse gases emitted in road transportation in Canada (35.2% and 29.9% respectively).

Source: Environment Canada, 2004

STUDENT ACTIVITY 4 **MATH 14, ICT 10**

Emissions Diet

Learning Outcomes

- *SCIENCE 14:* Identify and assess the needs and interests of society that have led to technologies with unforeseen environmental consequences (e.g., impact of driving a car on atmospheric conditions).
- *SCIENCE 14:* Compile and display data, by hand or computer, in a variety of formats, including diagrams, flow charts, tables, bar graphs, line graphs and scatterplots.
- *MATH 14:* Display data by hand or computer in a variety of ways, including circle graphs.
- *ICT 10:* Organize and manipulate data.
- *ICT 10:* Access, use and communicate information from a variety of technologies.
- *ICT 10:* Use technology to investigate and/or solve problems.

Activity

Explain that an "average vehicle" is driven approximately 24,000 kilometres per year. Ask students to find a friend or family member who drives an "average vehicle" and interview that person to find out how far they drive to work, on weekends and on vacation. Have students modify this sample table according to the data derived from that interview.

Sample Driving Days Per Year Calculation

240 commuting days @ 25 km each way	= 12,000 km
125 weekend and holiday days @ 64 km per day	= 8,000 km
Additional vacation and recreation driving	= 4,000 km
Total km driven per year	= 24,000 km

Have students create a pie graph to illustrate the amount of time their friend or relative spends driving to work, on weekends and on vacation.

Explain that an "average vehicle" emits about six tonnes of carbon dioxide, carbon monoxide, hydrocarbons and nitrogen oxides per year. Have students create a generic mathematical formula to calculate how much that would be per driving day or per average trip (see sample below). Using their kilograms per kilometre calculation, have students calculate how many kilograms of emissions their friend's or relative's car emits every year.

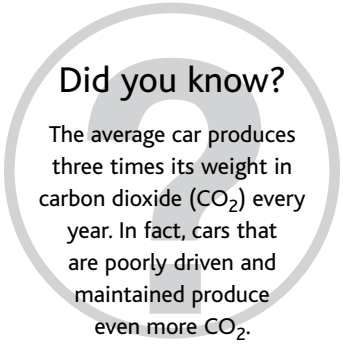
Sample Emissions Calculations

24,000 km	=	6 tonnes
4,000 km	=	1 tonne or 1,000 kg
400 km	=	100 kg
40 km	=	10 kg
4 km	=	1 kg

Using their graph, tables and notes, students can then identify a number of ways to reduce their friend's or relative's vehicle use. For example, the friend might be able to carpool to work one day a week, take the bus on his or her monthly visit to grandma's place in the next town and walk to a Tuesday night basketball game. Students should use their per day or per trip estimate to assign an emissions estimate to each reduction effort, and try to get their friend's or relative's vehicle to lose a full tonne of emissions during the next year.

Extension

For one week, ask the students to travel to and from school without riding in a personal vehicle, like a car, truck or van. They (and you!) might take the bus or train, ride a bike, in-line skate or walk. After the week is over, have students write a summary of their experiences, analyzing the positive and negative aspects of their alternative mode of transportation. In a class discussion, ask: What could you do to make your non-personal vehicle transportation easier, more efficient or more enjoyable? What might your community do to improve its system of alternative transportation?



Source: Natural Resources Canada

STUDENT ACTIVITY 5 **MATH 14, ICT 10**

Road Trip

Learning Outcomes

- *MATH 14:* Estimate and calculate percentages.
- *MATH 14:* Express rates and ratios in equivalent forms to solve problems.
- *MATH 14:* Convert between SI and Imperial systems of measure, using a conversion table or calculator.
- *MATH 14:* Develop a sense of approximate conversions between SI and Imperial units through investigations.
- *MATH 14:* Display data by hand or computer in a variety of ways, including circle graphs.
- *ICT 10:* Access, use and communicate information from a variety of technologies.
- *ICT 10:* Use technology to investigate and/or solve problems.

Activity

Ask students to imagine they are driving from their home to a destination of their choice in the United States. Have them research a route and then complete a table, similar to the one started below, to help plan their trip.

Sample Table: Road Trip from Calgary, Alberta to Phoenix, Arizona

Day	Start from	Destination	Distance (km)	Distance (miles)	Average driving speed (kph)	Average driving speed (mph)	Approx. driving time (hours)
1	Calgary, Alberta	Butte, Montana	772	482	88	55	8.75
2	Butte, Montana	Salt Lake City, Utah	672	420	88	55	7.60
3	Salt Lake City, Utah						

When they are finished, ask:

1. On average, how far would you travel on the highway in an hour? In a day?

2. If you drove on the highway at the speed limit of 100 kph, but your average speed is only 88 kph, what percentage of time are you likely driving on slower, non-highway roads each day? What if you drove at 110 kph, but still only averaged 88 kph?

Extension

Tell students the car they drove on their trip can run about 10 kilometres on one litre of gasoline. Ask them to add a column to their spreadsheet and calculate how much gasoline, in litres, they would need for each leg of their trip. Then have students convert 10 kilometres per litre into miles per gallon. Ask them to add one final column to their spreadsheet to show the number of U.S. gallons of gasoline needed for each leg of the journey.

STUDENT ACTIVITY 6 **SCIENCE 30, ICT 11**

Charging Around Town

Learning Outcomes

- *SCIENCE 30:* Understand that the global demand for energy must be reconciled with the need to maintain a viable biosphere.
- *ICT 11:* Organize and manipulate data.
- *ICT 11:* Access, use and communicate information from a variety of technologies.
- *ICT 11:* Use technology to investigate and/or solve problems.
- *ICT 11:* Use electronic research techniques to construct personal knowledge and meaning.

Activity

Explain to the class that electric cars are considered zero-emission vehicles, although some emissions may be created while manufacturing the car and from the generation of electricity needed to power it. Because they run on a charged battery, these cars don't go very far. A modern electric vehicle (or EV for short) runs from 90 to 150 km on a single charge, depending on road conditions, traffic and driving style. To help EV drivers get where they need to go, EV producers install battery charging facilities in locations around town, including malls, restaurants, workplaces, airports, parks and beaches.

Ask students: If you were launching an EV company in your community, where would you locate the first 10 of your charging facilities? Form students into small groups. Have them plot their chosen battery charging facility locations on a municipal or regional map. Ensure they consider:

- Major driving routes.
- Traffic patterns: weekday rush hours, weekend getaways, etc.
- Road conditions: gravel versus paved, number of stops, etc.
- Local geography: downtown core, hills, etc.
- Popular and important destinations: hospitals, schools, airport, shopping malls, etc.
- Any other important factors.

Once they have completed their map, have the groups write an explanation of why they chose each of their 10 battery recharging sites.

TIP

There are a number of web sites with information on electronic vehicles, such as EV World magazine at **www.evworld.com**

STUDENT ACTIVITY 7 **SCIENCE 20, PHYSICS 20, ICT 11**

From Zero to Sixty

Learning Outcomes

- *SCIENCE 20:* Understand that the motion of objects is described in terms of displacement, time, velocity and acceleration.
- *SCIENCE 20:* Learn how Newton's laws of motion relate force to the motion of objects.
- *PHYSICS 20:* Assess the design and use of injury prevention devices in cars and sports in terms of the principle of inertia and Newton's laws.
- *ICT 11:* Access, use and communicate information from a variety of technologies.
- *ICT 11*: Use technology to investigate and/or solve problems.
- *ICT 11:* Use electronic research techniques to construct personal knowledge and meaning.

Newton's Laws of Motion

1. An object at rest tends to stay at rest and an object in motion tends to stay in motion with the same speed and in the same direction, unless acted upon by an unbalanced force.
2. The acceleration of an object as produced by a net force is directly proportional to the magnitude of the net force, in the same direction as the net force, and inversely proportional to the mass of the object. Or in other words, acceleration equals force divided by mass.
3. For every action, there is an equal and opposite reaction.

Inertia: A descriptive term for the tendency of a body to resist acceleration; the tendency of a body at rest to remain at rest or of a body in straight line motion to stay in motion in a straight line unless acted on by an outside force.

Source: **www.dictionary.com**

TIP

A number of websites introduce and explore Isaac Newton's Laws of Motion:

- **www.glenbrook.k12.il.us/gbssci/phys/Class/newtlaws/newtltoc.html**
- **www.physicsclassroom.com/class/newtlaws/newtltoc.html**
- **http://en.wikipedia.org/wiki/Newton's_laws_of_motion**

Activity

Explain that seat belts, air bags and baby car seats are three automobile safety features that are made with petroleum and other materials. Form students into pairs or small groups. Ask students to choose one of these safety features and:

- Suggest reasons why this safety feature was introduced.
- Describe when the feature was invented and how it has evolved over the years.
- Research some statistics that illustrate what happens in a collision when this feature is not used.
- Describe how the safety feature is tested and what regulations apply to its design and use.
- Explain how the safety feature works, using Newton's Laws of Motion and the principle of inertia.

HINT

To see what happens in a collision when the driver is not wearing a seatbelt, visit Multimedia Physics Studios at: **www.physicsclassroom.com/mmedia/newtlaws/cci.html**

Did you know?

In all types of crashes, lap-shoulder seat belts reduce fatalities in passenger cars by about 45% and reduce fatalities in light trucks by about 60%.

Safety belts can also reduce the risk of serious injury to the head, chest and extremities by an estimated 50% to 83%.

Airbags alone are 10% effective in reducing deaths, whereas airbags and lap-shoulder belts together reduce the risk of death by 50% in front seats.

Source: US Automotive Coalition for Traffic Safety, 2006

STUDENT ACTIVITY 8 **MATH 24, ICT 11**

Hitting the Target

Learning Outcomes

- *MATH 24:* Discuss how collected data are affected by the nature of the sample, the method of collection, the sample size and biases.
- *MATH 24:* Discuss issues to be addressed when collecting data; e.g., appropriate language, ethics, cost, privacy, cultural sensitivity.
- *MATH 24:* Select, defend and use appropriate methods of collecting data: designing and using questionnaires, interviews, experiments, research.
- *MATH 24:* Design different ways of presenting data and analyzing results, by focusing on the truthful display of data and the clarity of presentation.
- *ICT 10, 11:* Organize and manipulate data.
- *ICT 10, 11:* Access, use and communicate information from a variety of technologies.
- *ICT 10, 11:* Use electronic research techniques to construct personal knowledge and meaning.

Activity

Show students a variety of print or web-based photos of motor vehicles. Explain that automobile manufacturers design and sell vehicles that meet the needs and wants of certain people in the car-buying market.

Have students choose a car, truck, van or sport utility vehicle and research the features of that vehicle, using electronic and print information sources. Then have students look critically at the vehicle's features and develop a list of the probable needs and wants of the "typical" person in that vehicle's target market. Have students think about whether or not they share those same needs and wants. Ask students: Are the safety features an important aspect of your vehicle's feature list? If not, what other aspects, such as appearance or popularity, are emphasized with special features?

Now tell students they are going to devise an online questionnaire to help potential car buyers determine their needs. Lead a class discussion on survey design and distribution, such as using non-judgmental and culturally-sensitive language, protecting privacy, etc. If possible, share some sample surveys with the class.

Ask students to include questions in their surveys that address: purpose of the vehicle; expected distances to drive in town and on the highway; capacity required for passengers or cargo; safety concerns; climate and seasonal driving conditions; environmental impacts; budget; and any other considerations they can think of. Have students e-mail the questionnaire to a relative or friend, asking him or her to pilot test the questionnaire and suggest ways it might be improved.

Then have students e-mail their final questionnaire to three people of different ages and backgrounds, asking them to complete the survey as honestly as possible. When the surveys are returned, have the students analyze the results, and from them, identify one or two potential vehicles that might meet each respondent's needs. Have students create a clear electronic or print presentation of their data and recommendations.

When everyone is finished, lead a class discussion regarding any gaps in the individual surveys that hampered the data analysis and recommendations. Ask students if they would feel comfortable using their data to make sweeping statements about the vehicle-buying market. Why or why not?

Extension

Have students design a print or electronic ad for a motor vehicle. Ask them to write ad copy that addresses that vehicle's target market needs and wants.

HINT

All automakers have websites that detail the features of each of their current and older models. For a generic listing of vehicle safety features, and comparisons among several models, students can review the following websites:

- **www.safecarguide.com**
- **www.consumerreports.org/cro/cars.htm**

STUDENT ACTIVITY 9 **SCIENCE 30, MATH 24, ICT 11**

Home Town Options

Learning Outcomes

- *SCIENCE 30:* Understand that the global demand for energy must be reconciled with the need to maintain a viable biosphere.
- *MATH 24:* Select, defend and use appropriate methods of collecting data: designing and using questionnaires, interviews, experiments, research.
- *MATH 24:* Design different ways of presenting data and analyzing results, by focusing on the truthful display of data and the clarity of presentation.
- *ICT 11:* Organize and manipulate data.
- *ICT 11:* Access, use and communicate information from a variety of technologies.
- *ICT 11:* Use technology to investigate and/or solve problems.
- *ICT 11:* Use electronic research techniques to construct personal knowledge and meaning.

Activity

Form students into pairs. Ask them to find out what alternatives to individual driving their community offers. Have them investigate hometown options such as public transit, carpooling, car sharing, bike routes or other transportation alternatives or combinations. Have pairs create a spreadsheet that details their findings, filling in the blanks for each of the headings listed on the next page.

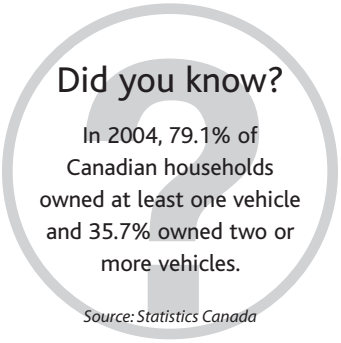
Transportation Option	Renewable or non-renewable	Cost	Availability	Convenience	Enjoyment	Environmental impacts
Public transit						
Carpooling						
Car sharing						
Bike routes						
Others?						

Ask students: What transportation options are not available in your hometown?

Extension

Tell students it is estimated that commuters spend about two years of their lives getting to and from work. Have students conduct a survey of three of their relatives, friends or neighbours to find out how they get to work every day and how long it takes them to make a round trip. Have students create a mathematical formula to calculate a lifetime's worth of the time each of the three people spend commuting every day. Ask students to create a clear electronic or print presentation of data and recommendations.

When they are finished, ask students to compare their formula and results with those of a friend from the class. Ask: How does your calculation compare to the two-year average estimated for a lifetime of commuting? What individual and community initiatives might reduce commuting time and costs? How would your survey participants prefer to spend the time they currently devote to commuting?



STUDENT ACTIVITY 10 **MATH 24, ICT 11**

New Versus Used

Learning Outcomes

- *MATH 24:* Modify a spreadsheet template to allow users to input their own variables.
- *MATH 24:* Read and interpret given data.
- *MATH 24:* Draw and validate inferences, including interpolations and extrapolations, from graphical and tabular data.
- *ICT 11:* Organize and manipulate data.
- *ICT 11:* Access, use and communicate information from a variety of technologies.

Activity

Explain to students there are two ways to calculate the depreciation of an asset like a car. The Straight Line Method assumes the vehicle depreciates by an equal percentage of its original value for each year it's used. The Declining Balance Method assumes the vehicle depreciates more in the earlier years and less later on.

The following table compares the depreciation using both calculation methods, for the following vehicle:

Original cost: $24,000
Expected to be driven for four years
After four years, expected to be sold for scrap $4000

Straight Line Method		
Year	Annual Depreciation	Year End Book Value
1	$20,000 x 25% = $5,000	$24,000-$5,000 = $19,000
2	$20,000 x 25% = $5,000	$19,000-$5,000 = $14,000
3	$20,000 x 25% = $5,000	$14,000-$5,000 = $9,000
4	$20,000 x 25% = $5,000	$9,000-$5,000 = $4,000
Declining Balance Method		
Year	Annual Depreciation	Year End Book Value
1	$24,000 x 40% = $9,600	$24,000-$9,600 = $14,400
2	$14,400 x 40% = $5,760	$14,400-$5,760 = $8,640
3	$8,640 x 40% = $3,456	$8640-$3,456 = $5,184
4	$5,184 x 40% = $2,073	$5,184-$2,073 = $3,111

Have students analyze the table to answer the following questions:

1. What is the total amount depreciated in the Straight Line Method? What is the total amount depreciated in the Declining Balance Method?

2. If you own a vehicle for business, you can use depreciation as a tax deduction. If this were your business vehicle and you wanted as big a tax deduction as possible, which method of depreciation would you use?

3. If you were shopping for a vehicle like this one, would you buy new or used?

4. If you wanted to buy this vehicle when it was three years old, which depreciation method would you prefer was used to calculate the selling price?

5. What do you think it means when people say "The price of a new car drops as soon as you drive it off the lot?"

6. How is the Straight Line Method calculated? How is the Declining Balance Method calculated?

Have students choose a new car and research its sticker price. Then ask them to modify this spreadsheet to calculate the depreciation for their chosen car, in both the Straight Line Method and the Declining Balance Method. Have students graph their data for both methods on one graph to compare the two methods of calculating depreciation.

Ask students to pair up and exchange spreadsheets and graphs. Have each student in the pair analyze their partner's data and answer questions #1 to #4 above.

TIP

The Straight Line Method annual depreciation is calculated as:

$$\frac{\text{Original cost} - \text{scrap value}}{\text{Expected life (years)}}$$

OR

$$\frac{\$24{,}000 - \$4{,}000}{4 \text{ years}}$$

Canadian Centre
for Energy Information

Drive – The Way Life Moves Resource Review

Please help us improve this resource by providing feedback on the following areas. You may complete and fax this review form to the Centre for Energy at (403) 237-6286, or by mail to 1600, 800 6th Avenue SW, Calgary, AB T2P 3G3. You may also e-mail your comments to infoservices@centreforenergy.com

Did you find Drive – The Way Life Moves useful for your class?

☐ Yes ☐ No

Would you use it again and/or recommend it to other teachers?

☐ Yes ☐ No

Which of the Drive – The Way Life Moves activities did you and your students complete?

- ☐ #1. Petroleum Inside Out
- ☐ #2. Our Automobile Economy
- ☐ #3. So Exhausting
- ☐ #4. Emissions Diet
- ☐ #5. Road Trip
- ☐ #6. Charging Around Town
- ☐ #7. From Zero to Sixty
- ☐ #8. Hitting the Target
- ☐ #9. Home Town Options
- ☐ #10. New Versus Used

Of the activities you completed, which ones did you and your students find the most interesting? Please list your top three:

TEACHER	*STUDENTS*
1	1
2	2
3	3

Please rate Drive – The Way Life Moves in the following categories:

Curriculum fit	☐ Good fit	☐ Some fit	☐ No fit
Age level	☐ Too old	☐ Too young	☐ Just right
Activities	☐ Too many	☐ Too few	☐ Just right
Time required for activities	☐ Too long	☐ Too short	☐ Just right

Please offer your suggestions for improving this resource. Feel free to expand on your responses given above and/or continue on a separate page if necessary.

Thank you! Your input is appreciated. We invite you to complete the following information so we can send you a token of our appreciation.

Name:

School:

Street address:

City:

Province:

Postal code:

Phone:

Fax:

E-mail:

Please indicate if you would like to be added to our mailing list

☐ Yes ☐ No