Climate Champions: Energy Revealed

Energy Education Activities
Grades 9-12

The binder and kit are made possible through the generous support of TD Friends of the Environment Foundation

TD Friends of the Environment Foundation

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Introduction

The ***Climate Champions: Energy Education Activities for Grades 9-12*** is designed to be used in combination with the ***Climate Champions: Energy Revealed Education Kit*.**

The following activities were selected from over 30 lessons in GreenLearning's award-winning Energy Revealed program, which explores ways to make energy visible in schools and at home. This program features a suite of free activities, videos and digital tools to turn your learners into future energy managers!

Whether learners are using installed energy metering technology, plug-in energy metering technology, such as handheld watt meters, or no technology at all, Energy Revealed will help learners become energy efficiency experts. After completing the following activities with your learners, we encourage you to register for GreenLearning's Energy Revealed Challenge. This challenge tasks students with hosting and tracking the impact of a Lights Out event. Educators can submit the actions from their learner's Lights Out event for their chance to win up to $1,000 in the Energy Revealed Challenge and be recognized for their work on GreenLearning's website.

For more free lessons, videos and digital tools relating to energy efficiency and climate action, please visit https://programs.greenlearning.ca/energy-revealed-seniors.

If you have any questions throughout your learning, please do not hesitate to contact us by email.

We look forward to seeing your work in the Energy Revealed Challenge,

The GreenLearning Team
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Educator Guide

The following binder outlines 6 activities, complete with **lesson plans, backgrounders and handouts** you can use to guide students through their energy learning. The watt meters provided in the Climate Champions: Energy Revealed Education Kit can be used in addition to or in place of energy metering technology throughout the activities.

In addition to the lessons provided, you can check out over 30 activities available for grades 9-12 at https://programs.greenlearning.ca/energy-revealed-seniors. Once you have completed the learning, we encourage you to take our environmental challenge: Energy Revealed and host either an **Energy Out Event or complete an Energy Investigation.**

Make sure to check out https://greenlearning.ca/webinars-events to keep up to date on all of our free, virtual professional development opportunities. There, you can also view recordings of past energy sessions, which are available anytime.

As part of the Climate Champions program you may have signed up to participate in one of our live "Speak for the Trees" workshops. If you are using this binder outside of that program and would like to begin exploring energy efficiency with your learners, you can visit https://greenlearning.ca/webinars-events to participate in a free, pre-recorded classroom workshop titled "Speak for the Trees." This session can be used to kick off your energy unit by guiding you and your learners through key energy concepts and terms in a fun, engaging and interactive 45-minute session.

All materials in this binder are available in digital format at greenlearning.ca.

What are you waiting for? Let's conserve energy!

Activity 1:
Knowing Energy: Stair Climb

Objectives: GreenLearning collaborated with Know Energy (https://www.knowenergy.com/) to create a series of activities with accompanying videos that explore the fundamentals of energy. These activities can be done in the order they appear on our website to guide learners progressively to learn everything about energy basics! The following activity is the first in the series, if you would like to further explore the activities within the Knowing Energy Video Series, please visit https://programs.greenlearning.ca/energy-revealed-seniors.

This activity and the associated video introduces learners to energy and power and their associated units and terms. It allows learners to experiment with these concepts as they record themselves climbing stairs.

Learning Outcomes: By the end of this activity, learners will:

- Understand the concepts of energy and power and their associated units and terms
- Complete a stair climbing experiment to test and measure you own energy and power
- Practice utilizing equations to answer basic energy questions in their worksheet

Materials:

- General Overview Guide
- Stair Climb Learner Worksheet
- Stair Climb Learner Worksheet Answer Key
- Stairs you can easily measure
- Timer
- Scale to weigh yourself

Activity 1: Knowing Energy: Stair Climb

Curriculum Connections: https://programs.greenlearning.ca/canada-curriculum-connections

Time: 1 hour

Activity

Step 1:

- Review the General Overview Guide to understand how the Knowing Energy Video Series works with its associated activities.

Step 2:

- Before learners get started on this activity, be sure to introduce them to the first two Knowing Energy videos in the series:
  - Introduction Video: https://vimeo.com/578161240 (1:28 minutes)
  - Energy Basics Video: https://vimeo.com/578164405 (8:56 minutes)

The Energy Basics Video introduces learners to the concepts of energy and power and their associated similarities and differences, as well as the units that define them. Learners are encouraged to take notes during the video to help complete the worksheet later on.

Step 3:

1. Allow learners to view the Stair Climb Experiment Video: https://vimeo.com/578166879 (2:17 minutes) and hand out the Stair Climb Learner Worksheet. Depending on the learner's grade level, direct them to complete either or all of levels 1-4.
2. The video itself will direct learners on what to do, so allowing them to re-watch, or to go over their task as a class is vital for their understanding. The experiment itself can be done in pairs.
3. Be sure to remind learners of the equations, and conversions that were introduced to them in the activities video. These concepts can be further discussed as a class before learner tackle this worksheet.

Step 4:

- Be sure to go over as a class the answers to the worksheet and refer to the Stair Climb learners Worksheet Answer Key for any confusion.

Teaching Tips

Level 1

- The basic equation to find Watts developed is Watts = Joules x Time (s). • Joules = (Weight in kg x 9.8m/s2) x height of stairs in metres. The 9.8 comes from the force required to overcome the force of gravity, which is 9.8m/s2.

Level 2

- The number of Watts generated at a faster speed should be higher than the original calculation. The Watts generated at a slower speed should be lower. Time is a very important variable; this applies to many things in energy. For example, a microwave clock typically uses more energy than the microwave while cooking since the time is far greater.

Level 3

- Smaller people will develop less power than larger people at the same speed, this is fairly intuitive but often misunderstood. In order to calculate horsepower (hp), the Watts generated should be the Watts you generated divided by 746 W.

Level 4

- The energy required to climb one stair at a time or two should be the same at a given time since the power generated is the sum of all stairs. If you could jump up all stairs at once it would be the same. A bike will not increase your ability to generate more power however it can decrease the power required since a bike can build momentum (gliding).
- The bonus question requires learners to find the intersection between two equations, one for the 100 lbs person and 1 for the 150 lbs person (tip lbs must be converted to kg).

Knowing Energy: General Overview Guide

General Tips & Guidelines

1) *Learners should complete all activity parts in the previous levels as well as their level activities. So, a learner in level 4 should do level 1-4 activities.*

2) Level 1 activities are designed for learners with basic mathematical skills (addition, subtraction, multiplication and division).

3) Subsequent levels increase in difficulty up to a senior high school level for level 4. The higher-level activities require more thought rather than super complex math.

4) Activities with only levels 1 and 2 can be divided into primary school (up to grade 8) for level 1 and high school for level 2.

5) Learners are required to watch all videos that correspond to the activity. Sometimes the information to complete the tasks is not all in one video.

6) Encourage learners to research questions they have on their own before asking for help from the educator.

Activity 1:
Knowing Energy: Stair Climb

Worksheet

Name:

Reminder:

- 2.2 pounds = 1 kilogram
- 9.8m/s^2 = force of gravity

Level 1 Questions/Activities:

1. How many Kilograms do you weigh? (Multiply this number by 9.8 m/s^2)

_____

_____

2. What is the height of the stairs?

_____

3. How many seconds does it take you to run up the stairs? (Must be in seconds)

_____

4. How many Watts do you develop to climb the stairs?
(hint: Watts (W) = $\frac{weight\ (N) \times height\ (m)}{time\ (s)}$, remember weight here is in Newtons, where Newtons (N) = 9.8 m/s^2 x your own weight (kg))

_____

_____

Level 2 Questions/Activities:

- ***Note:*** Complete level 1 questions/activities first if you haven't already done so.

1. Climb the stairs in double the time and see how many Watts you develop.

2. Run the stairs in half the time (if possible, to see how many Watts you develop).

3. Does the number of Watts required change with your time, explain how you can understand this with a real-world example?

Level 3 Questions/Activities:

- ***Note:*** Complete levels 1-2 questions/activities first if you haven't already done so.

1. If a larger and smaller person runs up the stairs at the same time, who do you think develops the most power? Explain your thinking.

2. If one horsepower = 746 Watts, how much horsepower do you develop climbing the stairs?

Level 4 Questions/Activities:

- ***Note:*** Complete levels 1-3 questions/activities first if you haven't already done so.

1. Does it require more or less power (W) and energy (kWh) to climb the stairs one at a time or two at a time?

2. If it was possible, would riding a bike allow you to develop more power?

3. BONUS: How much faster would a person weighing 100 lbs have to run up the stairs to exert the same amount of power as someone weighing 150 lbs given the larger person climbs the stairs in 10 seconds?

Activity 1:
Knowing Energy: Stair Climb

Answer Key

Reminder:

- 2.2 pounds = 1 kilogram
- 9.8m/s^2 = force of gravity

Level 1 Questions/Activities:

1. How many Kilograms do you weigh? (Multiply this number by 9.8 m/s^2)
Assume a weight of 50kg for solutions.

2. What is the height of the stairs?
10 feet or 3 m assumed.

3. How many seconds does it take you to run up the stairs? (Must be in seconds)
10 seconds assumed.

4. How many Watts do you develop to climb the stairs?
(hint: Watts (W) = $\frac{weight\ (N) \times height\ (m)}{time\ (s)}$, remember weight here is in Newtons, where Newtons (N) = 9.8 m/s^2 x your own weight (kg))

$$\text{Watts (W)} = \frac{(9.8\ \text{m/s}^2 \times 50\ \text{kg}) \times 3\ \text{m}}{10\ \text{seconds}}$$

$$\text{Watts (W)} = 147\ \text{Watts}$$

***This may not match the video numbers exactly, round numbers used here.**

Level 2 Questions/Activities:

- ***Note:*** Complete level 1 questions/activities first if you haven't already done so.

1. Climb the stairs in double the time and see how many Watts you develop.

$$\text{Watts (W)} = \frac{(9.8\ \text{m/s}^2 \times 50\ \text{kg}) \times 3\ \text{m}}{20\ \text{seconds}} = 73.5\ \text{Watts}$$

2. Run the stairs in half the time (if possible, to see how many Watts you develop).

$$\text{Watts (W)} = \frac{(9.8\ \text{m/s}^2 \times 50\ \text{kg}) \times 3\ \text{m}}{5\ \text{seconds}} = 294\ \text{Watts}$$

3. Does the number of Watts required change with your time, explain how you can understand this with a real-world example?

Yes, it changes in a linear manner, this is intuitive through perceived effort doing the activity (i.e., higher heart rate).

Level 3 Questions/Activities:

- ***Note:*** Complete levels 1-2 questions/activities first if you haven't already done so.

1. If a larger and smaller person runs up the stairs at the same time, who do you think develops the most power? Explain your thinking.

$$\text{Watts (W)} = \frac{(9.8\ \text{m/s}^2 \times 75\ \text{kg}) \times 3\ \text{m}}{10\ \text{seconds}} = 220.5\ \text{Watts}$$

Compared to a 50 kg person who only generates 147 Watts.

2. If one horsepower = 746 Watts, how much horsepower do you develop climbing the stairs?

Using the original 147 Watts, hp = 147/746 = 0.20 HP

Level 4 Questions/Activities:

- ***Note:*** Complete levels 1-3 questions/activities first if you haven't already done so.

1. Does it require more or less power (W) and energy (kWh) to climb the stairs one at a time or two at a time?

It is the same, there is no number in the equation to say how the stairs are climbed. Therefore, the calculation is a sum of the total height, which is 10 m.

2. If it was possible, would riding a bike allow you to develop more power?

A bike will not allow you to generate more power although it may allow for great efficiency since a bicycle can glide, even up a hill.

3. BONUS: How much faster would a person weighing 100 lbs have to run up the stairs to exert the same amount of power as someone weighing 150 lbs given the larger person climbs the stairs in 10 seconds?

Convert the weights 100 lbs = 45 kg, 150 lbs = 68 kg
Calculate the energy (Watts) produced by the larger person:

$$\text{Watts (W)} = \frac{(9.8\ \text{m/s}^2 \times 68\ \text{kg}) \times 3\ \text{m}}{10\ \text{seconds}} = 199.92\ \text{W}$$

We know it takes 199.92 W of energy for the larger person; we can now find the time required for the smaller person (at the same amount of energy exerted):

$$199.92\ \text{W} = \frac{(9.8\ \text{m/s}^2 \times 45\ \text{kg}) \times 3\ \text{m}}{\text{time (s)}}\text{, rearrange for time}$$

$$\text{Time (s)} = \frac{1{,}323\ \text{Nm}}{199.92\ \text{W}} = 6.62\ \text{seconds}$$

Therefore, it would take the smaller person to move up the stairs in 6.62 seconds to exert the same amount of energy as the larger person (meaning they would have to move up the stairs 3.38 seconds faster than the larger person).

Activity 2:
Extra Energy Investigation

Objective: Learners will investigate the energy usage of an identified device in their school they don't normally think about.

Note: if you are using circuit level energy metering technology you will need to make sure it is monitoring the desired device for this activity.

Learning Outcomes:
By the end of this activity, learners will:

- Use circuit level metering technology to understand the energy usage of a device in their school they don't normally think about.
- Understand what would be considered an energy efficient example of the object of their choice.
- Understand the energy use of their chosen device as well as the and life cycle impact, and environmental impact.

Materials:

- Installed Energy Metering Technology

Curriculum Connections: https://programs.greenlearning.ca/canada-curriculum-connections

Time: 2 - 3 hours

Activity

Step 1:

- Log into the energy metering technology software and discuss the energy being used in that area.
- Have learners think about the different types of energy being used in the monitored areas that you don't normally think about and create a list of these things to increase energy use awareness.
    - For example, think of the hand dryers in the bathrooms, vending machines, etc.

Step 2:

- Take a look at the list of the items the class brainstormed and see which ones are being monitored by the technology. Discuss as a class which one you would like to investigate.

Step 3:

- Discuss how you want to investigate the chosen electrical device's energy use.
- Then, decide how you are going to test the electrical device.
    - For example, are you going to look at the device's use throughout a day, week etc.?

Step 4:

- Research that electrical device and come up with some ideas for what would be considered an energy efficient example of the identified electrical device.
    - For example, what would be considered an energy efficient vending machine?
- Record the data as discussed to get an idea of the energy use of the device.

Note: When you are recording the data make sure your graph is at a scale where you can see the difference in energy.

Extension Activities:

- Research the difference between electric hand dryers and paper towel. Which ones do you think are the most energy efficient (take into consideration the energy it takes to produce the paper towels)?
- Senior level learners can research life cycle impacts of products, highlighting concepts like embedded energy (energy going into production of a good) and environmental impacts, such as the impact of paper towel waste on land use.

Activity 2:
Extra Energy Investigation

Assessment Rubric

Category	Level 4	Level 3	Level 2	Level 1
Data Collection	Data was collected several times. It was summarized independently, in a way that clearly describes what was discovered.	Data was collected more than one time. It was summarized, independently, in a way that clearly describes what was discovered.	Data was collected more than one time. Adult assistance was needed to clearly summarize what was discovered.	Data was collected only once and adult assistance was needed to clearly summarize what was discovered.
Description of Procedure	Procedures were outlined in a step-by-step fashion that could be followed by anyone without additional explanations. No adult help was needed to accomplish this.	Procedures were outlined in a step-by-step fashion that could be followed by anyone without additional explanations. Some adult help was needed to accomplish this.	Procedures were outlined in a step-by-step fashion, but had 1 or 2 gaps that require explanation even after adult feedback had been given.	Procedures that were outlined were seriously incomplete or not sequential, even after adult feedback had been given.
Variables	Independently identified and clearly defined which variables were going to be changed (independent variables) and which were going to be measured (dependent variables)	Independently identified which variables were going to be changed (independent variables) and which were going to be measured (dependent variables). Some feedback was needed to clearly define the variables.	With adult help, identified and clearly defined which variables were going to be changed (independent variables) and which were going to be measured (dependent variables)	Adult help needed to identify and define almost all the variables.
Conclusion/ Summary	Learner provided a detailed conclusion clearly based on the data and related to previous research findings and the hypothesis statement(s).	Learner provided a somewhat detailed conclusion clearly based on the data and related to the hypothesis statement(s)	Learner provided conclusion with some reference to the data and the hypothesis statement(s)	No conclusion was apparent OR important details were overlooked.
Display	Each element in the display had a function and clearly served to illustrate some aspect of the experiment. All items, 6, graphs etc. were neatly and correctly labeled	Each element had a function and clearly served to illustrate some aspect of the experiment. Most items, 6, graphs etc. were neatly and correctly labeled.	Each element had a function and clearly served to illustrate some aspect of the experiment. Most items, 6, graphs etc. were correctly labeled.	The display seemed incomplete or chaotic with no clear plan. Many labels were missing or incorrect.
Idea	Independently identified a question which was interesting to the learner and which could be investigated.	Identified, with adult help, a question which was interesting to the learner and which could be investigated.	Identified, with adult help, a question which could be investigated.	Identified a question that could not be tested/investigated or one that did not merit investigation.

Activity 3:
Total Energy vs Total Cost

Objective: Learners will calculate how much energy an identified object expends.

Learning Outcomes:
By the end of this activity, learners will:

- Calculate the kilowatt hours used by a particular device in one year, the cost of electricity in one year, and the amount of GHGs produced in one year.
- Investigate and describe relationships between humans and their environments, and identify related issues and scientific questions.
- Analyze personal and public decisions that involve consideration of environmental impacts, and identify needs for scientific knowledge that can inform those decisions.

Materials:

- Laptop
- Plug in or Circuit level Energy Metering Technology
- Copies of the 'Total Energy vs Total Cost' Learner Worksheet
- Marking Rubric

Curriculum Connections: https://programs.greenlearning.ca/canada-curriculum-connections

Time: 2-3 hours

Activity

Step 1:

- Think about an area in the school with electrical devices that you would like your learners to focus on. If you have circuit level energy metering technology an area that is being monitored would be ideal.
- Once you have identified the space ask your learners to make a list of the electrical devices in that chosen area.
- Have learners take a look at their list and decide which one specific device they would like to focus on.

Step 2:

- Have learners determine the number of watts their device uses, this can be done using your circuit level energy meter technology, or by using plug in energy meters. Alternatively, learners can look up the wattage online.

Step 3:

- Next, calculate the device's watt hours.
  - Watt: the SI unit of power, equivalent to one joule per second, corresponding to the power in an electric circuit in which the potential difference is one volt and the current one ampere.

  - Watt hours: Watt Hours are the units used to measure energy used. By measuring the Watts an appliance uses with your energy meter, you are measuring the rate at which it uses electrical energy. We like to compare power (W) to speed (km/h) and energy (Wh) to distance (km).
    - Example: if a laptop uses energy at a rate of 26W, it will use 26 Wh in an hour, 52 Wh in two hours, and 13Wh in half an hour.
- To do this, the learners will want to multiply the unit's wattage by the number of hours they use it. By doing this they will find the watt-hours of energy used each day.

E.g. A typical laptop uses 50 watts when in use. If you use it for 5 hours a day the total number of watt hours is 250. (50 watts x 5 hours = 250 watt hours).

Step 4:

- The next step is to convert the watt hours to kilowatt hours. To do this, simply divide the watt hours by 1000.

E.g. 250/1000 = 0.25 kWh per day.

Step 5:

- Now they will want to calculate usage over a month to find out the cost (since electric bills are based on monthly usage). Simply take the kWh per day and multiply them by 20 school days in a month.

For our example, that would be 0.25 kWh per day x 20 days = 5 kWh per month.

Step 6:

- The last step is to figure out the cost. To do this you will have to figure out how much the school is being charged a kWh. This will depend on your energy provider, but for this example let's say its 9.79 cents/kWh (based on Enmax's fixed rate for 2024). To get the cost, you take your total and multiply it by the energy cost.

For our example that would be 5kWh x $0.0979 = $0.49

Step 7:

- The last step is to figure out the cost. To do this you will have to figure out how much the school is being charged a kWh. This will depend on your energy provider, but for this example let's say its 6.414 cents/kWh (based on Enmax's rate for October 2018). To get the cost, you take your total and multiply it by the energy cost.

For our example that would be 5kWh x $0.06414 = $0.32

Note – You can also use GreenLearning's Electrical Energy Calculator to help calculate the kilowatt hours used in one year, the cost of electricity in one year, and the amount of GHGs produced in one year for all provinces and territories.

Activity 3:
Total Energy vs Total Cost

Worksheet

Name: _____

Observed Device

My chosen device to investigate:

_____

Watts my device uses:

_____

# of watt-hours my device uses:

_____

# of kWh my device uses:

_____

# of kWh per month my devise uses:

_____

# of kgs GHGs my device produces:

_____

Activity 4:
Exploring Our Energy Ethics

Objective: Through an interactive group activity, learners take a position on several environmental issues based on their own personal ethics. They consider the different opinions of their classmates and weigh the importance of factual evidence. As learners hear other perspectives and learn new information, they discover that their own views and values may change.

Learning Outcomes:
By the end of this activity, learners will:

- Understand different perspectives on energy and environment issues
- Share views related to statements that deal with ethical issues about energy and the environment
- Consider the opinions of classmates
- Reflect on their own ethics related to choices about energy and the environment

Materials:

- Energy and the Environment: The Impacts of Our Energy Use Backgrounder (referenced in Activity 3)
- Five sheets of poster board to use as signs. Write one of the following phrases on each sheet: Strongly Agree, Agree, Don't Know, Disagree, Strongly Disagree.
- Tape to mark places on a large circle on the classroom floor for the change-your-place lead-in activity. You need as many places as you have learners

Curriculum Connections: https://programs.greenlearning.ca/canada-curriculum-connections

Activity 4: Exploring Our Energy Ethics

Time: 1.5 hours

Activity

Step 1: Change Your Place

- Ask learners to form a circle so that each person is standing on a place marker. You stand in the middle of the circle and explain that this activity is called “Change Your Place.” Explain that the person in the middle of the circle will make a change-your-place statement that is true about themselves. Everyone standing on a place marker for whom that statement is also true must then move and find another place on the circle. The person in the middle must try to find a place on one of the markers too. The person who does not find a place on the circle markers is left in the middle and will start another round by making a new statement.
- Demonstrate how it works by making the first true statement. For example, you might say “Change your place if you are the youngest person in your family” or “Change your place if you are wearing blue socks.” Everyone, you included, who is “the youngest person” or “wearing blue socks” must now move to find a new place in the circle. One person will be left in the middle.
- The person in the middle starts again, “Change your place if…” Continue until at least 4 or 5 learners have had a turn in the middle.
- Take a few minutes to debrief by asking learners for their comments on the activity

Step 2: Take a Stand

- Explain that the class will now do a similar activity, one that requires each person to “Take A Stand.” This time, learners listen to a statement and make decisions about where they stand on it.
- Place the five signs in different places in the classroom — in a line or in different corners of the room. Tell the learners that you will read an opinion statement to them. After you read the statement, learners must stand in front of the sign that most closely represents their view on the statement: either Strongly Agree, Agree, Don’t Know, Disagree, or Strongly Disagree. Tell learners that they must be prepared to explain why they chose to stand where they do.
- Select from the opinion statements included at the end of this lesson plan or create your own. After you read a statement, ask learners to stand in front of a sign, and then ask individuals (or groups of learners standing in the same place) to explain why they are standing where they are. Give equal time to representatives of different sides of the issue, and allow many learners to speak.

- Ask learners if their positions have changed after hearing different views on an issue. Invite them to move to a different sign if and when their opinions change. If learners move, ask volunteers to explain why they changed their opinion.
- To encourage discussion, read one of the facts that accompanies a statement. You can read the fact aloud, or have a learner do so. Ask if any learners want to change their place after hearing the new information, and then ask for volunteers to explain how the information influenced their view.

Step 3: Conclusion

- After exploring three or four take-a-stand statements, debrief the activity with discussion questions:
  - Which statements were most challenging to take a stand on? Why?
  - What influences your position on a statement?
  - How do our views determine our actions?
  - How do our views have environmental consequences?
  - What are effective ways to communicate our views on issues?
  - How might your perspective differ from that of people from other cultures, of different ages, places and times?
- Ask learners to reflect individually on what they learned through this activity. Have them write in their journals or create drawings about their energy ethics. Ask them to reflect on the statements, facts and different perspectives and to express their own ethics about energy and the environment.

Teaching Tips

This activity asks learners to express their opinions on challenging and sometimes controversial issues. Ensure that a safe learning environment exists so that all learners feel free to express their views. Remind learners that there is no right or wrong opinion: what is important is that they listen and respect one another's views. Explain that the process of understanding and reflecting on our views and values is a process of formulating our ethics.

.Extension Ideas

- **Invite learners to research an opinion statement.** Ask learners to select a statement or create their own upon which to do some additional work. Encourage them to research the arguments on both sides and write an article, create an image or make a presentation about the different perspectives and their own view as well.

- **Work with learner-generated statements.** Ask learners to write their own opinion statements, incorporating local issues and debates, and then complete the activity again. Learners could also provide the statements for another class to use.
- **Defend a position.** Assign learners a position on an energy and environment statement that they must defend. Stage a debate or have learners write a convincing speech on the statement.
- **Conduct interviews.** Ask learners to interview other learners, teachers, parents and/or community members using opinion statements from the list provided or statements that learners generate themselves. Encourage learners to track the number of people who agreed and disagreed with the statements and why.

Opinion Statements & Related Facts

1) Everyone is responsible for protecting the environment.

2) Automobile makers should be required to make all vehicles as fuel-efficient as possible.

- Facts:
  - About 60% of the oil that the world consumes is used to power transportation vehicles, and half goes to passenger cars and light trucks. If we continue to consume as much oil as we are now, the U.S. Department of Energy says that the world will run out of conventional oil in 40 years.
  - The average fuel efficiency of new vehicles has gotten worse by 13% in the last 10 years, largely due to the popularity of the SUV.

3) Communities across Canada should use only renewable sources, such as wind, solar or micro-hydro to meet their energy needs.

- Facts:
  - If your family could use only renewable energy for all of your energy needs, you could help reduce the amount of emissions in the air each year by 20,000 pounds of carbon dioxide, 70 pounds of sulphur dioxide and 50 pounds of nitrogen oxide.
  - Fossil fuels still account for more than 85% of the world's primary energy consumption. The most significant greenhouse gas is carbon dioxide, which comes mainly from burning fossil fuels — coal, oil, natural gas — to generate energy.

4) Jobs are more important than the environment.

- Fact:
  - Conventional energy projects like oil and gas development or large-scale hydroelectric projects do not create that many jobs: only seven jobs for every million dollars invested. For the same investment, renewable energy projects created 60% more jobs.

5) No matter what kind of energy we use, we must conserve energy.

6) Science and technology will solve many of our energy and environmental problems.

- Facts:
  - By using the "off the shelf" energy-efficient technologies that are available today, we could cut the cost of heating, cooling and lighting our homes and workplaces by up to 80%.
  - Albert Einstein said, "We can't solve problems by using the same kind of thinking we used when we created them."

7) To reduce the energy used to produce and transport food, grocery stores should sell only locally grown foods.

- Facts:
  - The average fruit or vegetable travels more than 1,500 miles before it gets to your plate. Buying locally means food does not have to travel as far, which means less greenhouse gas emissions, and less of a contribution to global warming.
  - Buying locally often costs more money because food is produced on a smaller scale. However, buying locally supports local farmers and the local economy.

8) There should be a law that states that all household appliances must be as energy efficient as possible.

- Facts:
  - Compact fluorescent lamps use 75% less energy than incandescent lamps for the same amount of light, and they last up to eight times longer.
  - An ENERGY STAR® refrigerator is at least 10% more efficient than the minimum government energy efficiency standards.
  - Refrigerators are twice as efficient (or 200% more efficient) than they were 25 years ago; dishwashers are 62% more efficient, and washing machines are 56% more efficient. Clothes dryers are about the same as they were.

Activity 4:
Exploring Our Energy Ethics

Assessment Rubric

Thinking	Level 4	Level 3	Level 2	Level 1
Demonstrates an understanding of appropriate listening behaviour by adapting active listening strategies to suit a variety of situations, including work in groups	Demonstrates a highly developed understanding of appropriate listening behaviour by adapting a wide variety of listening strategies	Demonstrates a well-developed understanding of appropriate listening behaviour by adapting a variety of listening strategies	Demonstrates some understanding of appropriate listening behaviour by adapting up to two listening strategies	Demonstrates limited understanding of appropriate listening behaviour
Demonstrates an understanding of appropriate speaking behaviour in a variety of situations, including paired sharing and small- and large-group	Demonstrates a highly developed understanding of appropriate speaking behaviour	Demonstrates a well-developed understanding of appropriate speaking behaviour	Demonstrates some understanding of appropriate speaking behaviour	Demonstrates a limited understanding of appropriate speaking behaviour
Communicates orally in a clear, coherent manner, presenting ideas, opinions and information in a readily understandable form	High degree of effectiveness; communicates with a wide variety of supporting details	Considerable effectiveness; communicates with a variety of supporting details and ideas	Some effectiveness; communicates with a few supporting details and new ideas	Limited effectiveness; communicates in a simple and understandable form
Application	**Level 4**	**Level 3**	**Level 2**	**Level 1**
Analyzes human use of energy and natural resources and the impact of this use on society and the environment	Demonstrates a high degree of application skills by extensive analysis	Demonstrates effective use of application skills by a complete analysis	Demonstrates limited effective use of application skills by partial analysis	Demonstrates limited effective use of application skills by unfinished analysis

Activity 5:
Walk a Mile

Objective: By exploring the concept of an ecological footprint, learners learn that simple lifestyle choices have a meaningful impact on the planet. Learners create a paper foot of their own Carbon Critter. After answering a series of questions about its energy use, they calculate its ecological footprint online to see the impact of its lifestyle choices and energy use on the environment.

Learning Outcomes:
By the end of this activity, learners will:

- Understand the concept of an ecological footprint
- Explore the relationship between everyday lifestyle choices and energy consumption
- Consider the impact of our own lifestyle choices and energy consumption on the planet

Materials:

- Internet-enabled device
- Energy and the Environment: The Impacts of Our Energy Use Backgrounder
- What are Carbon Critters Driving? Handout
- A paper foot of a Carbon Critter as an example for learners
- Heavy paper or card stock
- Coloured markers

Activity 5: Walk a Mile

Curriculum Connections: https://programs.greenlearning.ca/canada-curriculum-connections

Time: 2 hours

Activity

Step 1: What Even is an Ecological Footprint?

- Introduce the idea that even when we do not know the definition of something, we can usually make a good guess at its meaning by looking at individual words and parts of words.
- Have learners write the words and phrases that they think are related to ecological footprint.
- Ask learners to work in small groups to exchange their ideas and develop a one-line definition.
- Provide learners with a definition from another source for comparison. For example, your ecological footprint is an estimate of how much productive land and water is needed to support the way you live. For other definitions, see the backgrounder, Energy and the Environment: The Impacts of Our Energy Use.
- Guide a discussion about the similarities and differences between the definitions to establish a shared understanding.
- Record questions and key points that come up during the discussion so that you can refer to them throughout the lesson.

Step 2: Make Carbon Critters

- Explain that learners will be creating a creature, called a Carbon Critter, and imagining what it would be like to live like that creature (i.e., that they will be exploring what it would be like to walk a mile in someone else's shoes).
- Hand out paper and have each learner draw an outline of a foot and ankle for their critter. Provide an example of a cut-out foot and ankle for their reference.
- Ask learners to imagine the lifestyle of their critter. Review the meaning of each of the lifestyle categories: food, shelter, goods and services, and mobility. Ask them questions to prompt them to think about the various possibilities.
- Ask learners to give their critter a name that relates to its lifestyle and its views on energy and the environment. Tell them to write the name on the ankle of the critter's foot (e.g., Gizmo Guy, Power Pit).

- Have learners summarize their critter's lifestyle, including what food they eat and products they buy, how they get around, and what their homes are like. They can record their descriptions on the paper foot below the critter's name, under the following headings:
  - FOOD: How often does your critter eat animal-based products (e.g., meat, fish, dairy) each week? In a week, how often is the food your critter eats processed, packaged and imported?
  - SHELTER: What is the size of your critter's home? (Use units of square metres or substitute with something learners are familiar with, such as a classroom). What type of home is it (detached, apartment, environmentally designed, etc.)? Does it have electricity or not?
  - GOODS & SERVICES: How much waste does your critter produce compared to others? How many kilograms of garbage does your critter produce per week?
  - MOBILITY: How does your critter get from place to place? How much does your critter travel by public transit, motorbike, car, bicycle, plane and on foot? How often does your critter drive alone versus with someone else? How many litres of gasoline does the critter's vehicle use for every 100 kilometres driven? (Refer to the handout, "What are Carbon Critters Driving?" at the end of this lesson).
- Have learners visit https://www.footprintcalculator.org/ to calculate the ecological footprint for their critter. They enter basic information about their critter's lifestyle, and the site calculates its ecological footprint. Learners learn how many more planet Earths we would need if everyone lived like their Carbon Critter. Tell learners to record that number (the number of Earths) upside down on the back of their critter's foot.
- Tell learners to also record the results, by category, from the online ecological footprint summary page onto their critter's foot.
- As a class, review the significance of the results. Discuss how the categories used to calculate an ecological footprint relates to our own lifestyles.

Step 3: Conclusion

- To help learners form conclusions about the connections between lifestyle, energy, impacts on the environment and the role of daily choices, lead a class discussion using some of the following questions:
  - What did you think about the size of the ecological footprint of your Carbon Critter?
  - How does this compare to the amount of land that is actually available for each person on Earth?

- How do you feel about the number of Earths required to support the lifestyle of your Carbon Critter (if everyone in the world lived that way)?
- When you compare the ecological footprint of different Carbon Critters, what activities seem to cause the biggest increase to the footprint? How would you explain that?
- How are Carbon Critters similar to us?
- How do Carbon Critters impact our world?
- How could you explain why Carbon Critters aren't very concerned about their impact on the world?
- What advice would you give the people who make the laws that govern Carbon Critters?
- What message could you give to Carbon Critters that you think they would listen to?
- What do you think it will take for Carbon Critters to reverse their impact on the earth?
- How do the ideas in this activity relate to our energy uses and choices?

Teaching Tips

To familiarize yourself with the concept of an ecological footprint, explore this learner-friendly website: http://basecampearth.org/exp2/index.htm

Calculate your own ecological footprint using this online calculator: https://www.footprintcalculator.org/ It won't take much time: you simply answer 13 questions about your energy use, and then you can see your footprint and learn about its implications. For other links and more information about ecological footprints, refer to the backgrounder, Energy and the Environment: The Impacts of Our Energy Use.

Extension Ideas

- **Use an online Lead In.** Working alone or in pairs, have learners explore the concept of an ecological footprint at the Base Camp Earth website, http://basecampearth.org/exp2/. This learner-friendly site reflects the work of four secondary school learners who spent four days studying ecological footprints via the e-community. You may want to direct your learners with a focus question.
- **Expand the Main Activity.** Let learners make informed decisions about what their Carbon Critters drive by sending them to the Natural Resources Canada website where they can choose from a list of more than 1,000 car models: https://fcr-ccc.nrcan-rncan.gc.ca/en.

Did You Know?

To support their current lifestyle, the average Canadian requires 8.17 hectares of productive earth; the average American requires 8.22 hectares. Based on the current human population and bio-productive space, nature can provide and sustain only about two hectares of land for every person in the world. If everyone lived like people in North America, we would need about four more planets!

Activity 5:
Walk a Mile

Learner Handout

What are carbon critters driving?

Top Picks for CARBON CRITTERS with BIG Feet

Make/Model	Type of Vehicle	Consumption of fuel L/100km	Emission of CO2 (kg per yr.)*
Bugatti Chiron	Two-seater	21	9,660
Lamborghini Aventador	Two-seater	21	9,660
Ferrari GTC4Lusso	Minicompact	18	8,280
Ford Shelby GT500 Mustang	Sub-compact	16	7,360
Rolls-Royce Dawn	Compact	16	7,360
Rolls-Royce Wraith	Mid-sized	16	7,360
Buick Regal TourX	Small station wagon	10	4,600
Ram 1500 TRX	Pick-up	19.8	9,108
GMC Sierra	Pick-up	15	6,900
Mercedes-Benz AMG G65	SUV	20	9,200

*We are assuming these cars are driving 20,000 km per year at a rate of 2.3 kg of CO2 per litre of gasoline consumed.

Top Picks for CARBON CRITTERS with SMALL Feet

Make/Model	Type of Vehicle	Consumption of fuel L/100km	Emission of CO_2 (kg per yr.)*
Mazda MX-5	Two-seater	8	3,680
Polestar 1 (PHEV)	Two-seater	5	2,300
BMW i4 (EV)	Sub-compact	2	0
Tesla Model 3 (EV)	Mid-sized	1.8	0
Volvo V90	Station wagon	9.5	4,370
Volkswagen Golf	Compact	8.7	4,002
Mitsubishi Mirage	Sub-compact	6	2,760
Hyundai Elantra	Compact	6	2,760
GMC Sierra 1500 Crew Cab	Pick-up	10	4,600
Toyota Prius	SUV	4.8	2,280

*We are assuming these cars are driving 20,000 km per year at a rate of 2.3 kg of CO_2 per litre of gasoline consumed.

*EV Cars don't emit CO_2, but according to a study the manufacturing of the battery emits around 17.5 tons of CO_2.

Activity 5:
Walk a Mile

Assessment Rubric

Knowledge & Understanding	Level 4	Level 3	Level 2	Level 1
Demonstrate an understanding of the importance of being physically active, and apply physical fitness concepts and practices that contribute to healthy, active living	Demonstrates thorough understanding of content	Demonstrates considerable understanding of content	Demonstrates some understanding of content	Demonstrates limited understanding of content
Thinking & Investigation	**Level 4**	**Level 3**	**Level 2**	**Level 1**
Evaluate the effects both beneficial and harmful of various technologies on human body systems	Uses critical/creative thinking processes, skills, and strategies with a high degree of effectiveness	Uses critical/creative thinking processes, skills, and strategies with considerable effectiveness	Uses critical/creative thinking processes, skills, and strategies with some effectiveness	Uses critical/creative thinking processes, skills, and strategies with limited effectiveness
Communication	**Level 4**	**Level 3**	**Level 2**	**Level 1**
Communicate orally in a clear, coherent manner, presenting ideas, opinions, and information in a readily understandable form	Communicates for different audiences and purposes with a high degree of effectiveness	Communicates for different audiences and purposes with considerable effectiveness	Communicates for different audiences and purposes with some effectiveness	Communicates for different audiences and purposes with limited effectiveness

Activity 6: Can You Observe How To Conserve?

Objective: Learners will research a chosen topic on how conserving energy will impact the school.

Learning Outcomes:
By the end of this activity, learners will:

- Utilize GreenLearning's Spiral Inquiry Model to answer the question: How can conserving energy impact your school?
- Collaborate amongst peers to develop their own focus question(s) and inquiry plan

Materials:

- Pen and paper
- Energy Metering Technology (Optional)

Curriculum Connections: https://programs.greenlearning.ca/canada-curriculum-connections

Time: 7-10 hours

Activity

Step 1: Spark (A Learner Investigation)

- Begin by getting familiar with GreenLearning's Spiral Inquiry Model found here: https://programs.greenlearning.ca/course/spiral-inquiry-model

- Pose the question “How can conserving energy impact your school?”
  - We all know we should turn the lights off in a room that we aren’t using, but why? If you took the time to save as much energy as possible, what impact would that have?
  - Here, learners will focus on researching one way their school can conserve energy.
- Working with a partner, have learners brainstorm ideas as to simple ways everyone can conserve energy (think of at school, at home, in and around the community).
  - For example:
    - Turning off lights when not in use
    - Using energy in off-peak hours
    - Plugging in electricity only when needed
- Next, discuss why conserving energy is important:
  - Saves GHG’s from being emitted
  - Cost savings, etc.
- Using the above discussions, have the learners share their ideas and discuss different ways the school can save energy.
  - Post the ideas around the room. Add any ideas that come out of the discussion.

Step 2: Hypothesize and Plan

- Focus:
  - Working as a class or in small groups, have learners decide on the focus of their inquiry. Use the Spark discussion and activities to help you decide. Revisit the brainstorming activity and class discussion and encourage learners to think about what they would like to investigate.
  - Here is a list of possible suggestions, but encourage learners to keep their own interest in mind and make sure to pursue something that interests them: lighting use, heating/cooling use, computer use.
    - Senior learners may want to investigate: weather stripping, insulation, renewable energies, energy efficient appliances.
    - If available, have learners think about how they can use the energy metering technology to help with their investigation.

Inquiry Question. The learners are now ready to move on to create the group's inquiry question or questions.

1. Have each group meet and discuss what they have taken away from the class brainstorming and discussions.
   a. What interests the group?
   b. What would be the most relevant to your school?
   c. What topics would help the group understand their findings?
2. The inquiry question needs to investigate both what energy conservation steps the school should take and what the impact will be.

It could be stated as a hypothesis using "If_____", then _____" language. For example, "If we turn the light off (in a determined space) then we can reduce the school's cost by x and save y GHGs"

- Remember! While you are conducting your inquiry, you may need to modify your question or hypothesis. Make it something that is testable and workable within the time you have.

Plan. Next, have each group plan each step of their inquiry.

Check In. Have the learners fill out part 1 of the learner worksheet.

Step 3: Explore and Research

Research. Have each group gather and review information needed to answer their question or to test their hypotheses.

Record. Record information and remember to remind them to keep track of their sources. If available, have learners create the appropriate reports in the energy metering technology software. Have each group **evaluate** the information they have collected:

- Does it answer their question or test their hypothesis? Does it raise more questions – of so, how can they be answered?

Reflect. Have learners reflect on and discuss their preliminary findings and observations to compare these to their previous knowledge. They may need to clarify and modify their focus question(s) and inquiry plan.

Check In. Have each group fill out the worksheet (check in #2) as a group and hand it in.

Step 4: Analyze and Check

- Have each group **compare**, sort and **classify** their information. Describe characteristics and note patterns.

Conclude. Have each group draw conclusions about their questions and hypotheses.

Check In. Have the learners fill out the worksheet (Check in #3) as a group and hand it in.

Step 5: Communicate

- Now the groups are ready to turn their knowledge into action.

Communicate

- Have each group communicate their inquiry findings to the class and other. They should think about what message they want to get across and tailor that message to the audience. Ideas include a YouTube video, PowerPoint presentation, research blog, web pages on school site, podcast, meme, rap (or other style poem or song), skit or play, poster or other artwork, infographics, etc.
- The audience does not have to be just the class. Have the learner think of other people who can benefit from learning what was discovered:
  - Junior learners- maybe in feeder schools
  - School council (possible with a small request for funding to help your action project)
  - Parents
  - Display in a local mall
  - Part of a school assembly for Earth Day or other occasions
  - Experts who helped your research
  - Share on social media

Act. Throughout the research, learners have probably come across many calls to action. They likely also have many ideas for what you and your class could do to inform your school or community about your school's energy use.

- There are many suggestions classes have for energy education including:
  - Campaign to stop idling in school parking lots
  - Meeting with local politicians/school boards about issues
  - Speaking at public meetings

- Awareness Fair
- Developing and passing around petitions
- Take part in organized learner action competitions

Plan. Developing a plan is a good way to start. We would love to see it!

Activity 6: Can You Observe How To Conserve?

Worksheet

Name (s) : _____

Part 1: Hypothesize and Plan

1. What is the general focus of your Inquiry?

_____

_____

_____

2. Why did your group choose this focus?

_____

_____

_____

3. What is your Inquiry Question? (Note: this can be modified later if necessary)

_____

_____

_____

4. What are your early thoughts on the next three steps of the Spiral Inquiry?

5. What additional help do you need from the educator?

Part 2: Explore and Research

1. What are three key facts about your Inquiry that you have discovered?

2. Does your group have a complete record of all your resources?

3. Does your Inquiry Question need to be modified?

4. What additional research is left?

5. What local experts are you thinking of consulting?

6. What additional help do you need from the educator?

Part 3: Analyze and Check

1. Have you sorted out your information?

2. What are the patterns you see when you analyze it (highlight two or three)?

3. What are one or more conclusions that you can draw from your data?

4. What are your early thoughts on the actions that can be taken in this area?

5. How would you encapsulate the message your research in one or two sentences?

6. What additional help do you need from the educator?

Energy Revealed Challenge

Congratulations on completing the Energy Revealed activities and learning about energy efficiency and climate action! Your learners are now ready to take real world action by hosting and tracking the impact of their **Energy Out Event or Energy Investigation.**

Register for GreenLearning's Energy Revealed Challenge at https://programs.greenlearning.ca/take-the-energy-revealed-challenge or scanning the QR code.

Once you register, click on the challenge package to get started!

Annual grand prizes for the challenge are:
1st Place: $1,000
2nd Place: $500
3rd Place: $250

All submissions for the challenge will be celebrated on GreenLearning's Challenge Showcase page. To view past submissions for the Energy Revealed Challenge visit https://programs.greenlearning.ca/submission-showcase.

If you have any questions about registering, completing or submitting for the challenge please contact GreenLearning at programs@greenlearning.ca.

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