



Greenhouse Gas Guzzlers

The atmosphere is changing as more and more gases are added to it. How can we help the atmosphere return to a state that will help to prevent global climate change?

Activity Time:

40 minutes

Setting:

Outdoors or gymnasium

Materials:

Included

- Cones
- Balls
- Tokens e.g. buttons, cards, popsicle sticks
- Greenhouse Gas Guzzler Cards

Not included

- Mats (varying sizes)
- Collection Bags

Grade Level:

Grade 4-10

Subject Areas:

Chemistry, ecology, geography, science and technology, social studies

Group Size:

24+

Keywords:

Atmosphere, carbon dioxide, emissions, greenhouse gases, sink, source

* Source: Clean Air Shuffle
ffl.nbed.nb.ca/



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Summary

This is a race and teamwork exercise in which students will learn appropriate actions to remove greenhouse gases from the atmosphere.

Objectives

Students will:

- Determine how personal choices and actions have environmental consequences
- Describe potential environmental impacts of using living and non-living resources
- Analyze potential environmental impacts between renewable and non-renewable methods of producing electrical energy
- Evaluate human impacts on ecosystems and requirements for sustaining healthy ecosystems
- Use models to describe how systems operate
- Describe factors that affect productivity and species distribution in aquatic environments

Materials

- One pair of mats for each team. Mats should be of various sizes if available and

large enough for six to eight students to stand on but light enough to be carried overhead.

- Grade 4-7: 50 balls to represent CO₂, doesn't matter what colour(s) and 32 emission tokens
- Grade 8-10: 50 Balls of 3 different colours to represent GHG emissions in the following ratio (carbon dioxide 30: methane 10: nitrous oxide and halocarbons 10). Carbon dioxide emissions from the 'vehicle' mat represented by emission tokens.
- Set of laminated cards with pictures that represent actions taken to reduce greenhouse gases (the cards also indicate how many balls can be collected for each action).
- Bags to hold collected balls and tokens.

Making Connections

The news is full of stories about climate change caused by changes in the earth's atmosphere. Human activities are creating greenhouse gas emissions on a scale never seen before. However, if we can create the problem, then we can take steps to solve it. In this activity



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students learn what activities can be taken to remove carbon from the atmosphere and store it through natural processes or to prevent excessive carbon emissions, thus reducing the amount of greenhouse gases in the atmosphere and helping to slow climate change.

Background

The Climate Change Primer provides a detailed explanation of carbon sinks and carbon sources. You will need to be familiar with this information. You will also need to be familiar with actions that can be taken to remove carbon from the atmosphere or to prevent further emissions.

For this activity you will need to compare the carbon emissions between small, mid-sized and

large vehicles. The following information was taken from the **Natural Resources Canada** Website.

In general, the conversion factor is 2.4 Kg of CO₂/Litre of gasoline. This may change with the type of fuel used or the age or condition of the vehicle.

Nitrous oxide emissions are mostly caused by industrial agricultural practices. When nitrogen compounds (fertilizers) are added to the soil, bacterial action is stimulated, and nitrous oxide emissions generally increase. Adding excess nitrogen to the soil also enriches ground and surface waters, such as rivers and streams, which generate indirect emissions of nitrous oxide.

The second-largest source of human-made (anthropogenic)

nitrous oxide emissions is a byproduct of fuel combustion in transportation and from commercial, residential, industrial fossil fuel generated electricity.

Source: US Energy Information Administration

Procedure:

For grades 4-7

Follow procedure 1 through 8. Use Action Cards for grades 4-7, the number of balls refers to the number of CO₂ removed.

For grades 8-10

Follow procedure 1 through 8 and the wrap-up. Focus on the different types of GHG. Use Action Cards for grades 8-10.

Vehicle Models and Emissions

Vehicle Model	Litres to Travel 100Km	CO2 Emissions per Year
Toyota Prius (hybrid)	4L	1968 Kg
Mini Cooper	8.4L	3504 Kg
Mazda 6	12.5 L	5136 Kg
Jeep Cherokee	19.1 L	8112 Kg

Extensive vehicle emission information can be found at the Natural Resources Canada website. On the site you can compare years, models and sized of vehicles across a range of categories. Go to the Office of Energy Efficiency at <http://oee.nrcan.gc.ca/transportation/tools/fuelratings/ratings-search.cfm?attr=8>

Carbon Sinks and Sources

Greenhouse Gases GHGs	Pre-industrial concentration 1860	Concentration in 2000	Average lifespan in atmosphere	Global warming potential over 100 years	Anthropogenic sources and current share of overall Climate Change
Carbon Dioxide CO ₂	288 ppm	370 ppm	50 -200 years	1	Fossil fuel combustion 75% Deforestation, poor forest and soil management 24% CO ₂ current share of overall climate change is about 52%
Methane CH ₄	750 ppb	1750 ppb	12 years	23	Fossil fuel extraction and processing Livestock digestion process Rice paddies Landfills Animal waste/slurry
Nitrous Oxide N ₂ O	285 ppb	312 ppb	120 years	296	Poor soil management Fossil fuel combustion Industrial and animal farming processes
Halocarbons CFCs HFCs PFCs, etc.	0	From 5 ppt to 533 ppt	From 1 year to thousands of years	From 5 000 to 22 000	Liquid coolants used in air conditioning units and refrigerators Some foam insulation

Table adapted from Stormy Weather: 101 Solutions to Climate Change by Guy Dauncey
 ** ppm (parts per million of molecules), ppb (parts per billion of molecules), ppt (parts per trillion of molecules)
 * The global warming potential is in relation to carbon dioxide

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Warm Up

1. Ensure that students understand the concept of sinks and sources prior to the start of the game.

2. In the game the collected balls represent the various greenhouse gas emissions reduced with each action.

Students will need to know why a certain action reduces carbon emissions or carbon as a greenhouse gas as they will have to explain it during the debrief activity in order to keep the balls they have collected.

3. Using the information provided in the primer, discuss with

students the importance of carbon dioxide as a greenhouse gas and how human activity has increased greenhouse gas emissions. Brainstorm ways to reverse those emissions. Use the action cards to guide discussion if necessary.

List of Human Activities to Reduce Various Greenhouse Gases

Sustainable transportation – bike, carpool, transit, walk	All reduce burning of fossil fuels.
Eating locally grown	Think about how far your food travels and how much fossil fuels are burnt to get it to your plate.
Eat organic	Does not deplete the soil, no need to use nitrogen fertilizers. No tilling therefore less carbon dioxide released.
Eat red meat only once a week	Reduces CO ₂ because less forest needs to be cleared for cattle ranching, reduces methane due to digestive process and nitrous oxide due to disposal of animal waste.
Clothing – cotton	Cotton is a very fertilizer and pesticide intensive crop. It takes energy to make anything. Might as well use the energy to make something that lasts.
Clothing – synthetics	Most synthetic fibre are made from fossil fuels.
Waste reduction	
Plastic	Use cloth bags. Buy products that have less packaging. All plastics are petroleum based products. Carbon dioxide, methane and nitrous oxides are produced at the various stages of oil extraction, refining and transformation into plastics.
Styrofoam	Use travel mugs, reusable containers. Styrofoam is also made from fossil fuels.
Compost	Reduces methane due to anaerobic decomposition of organic matter in landfills.
Recycle	It takes less energy and resources to reuse than to make from new.
Reduce electricity consumption	Though most of BC energy is hydroelectricity which doesn't produce greenhouse gases, government may choose to develop coal, natural gas, or lift the moratorium on offshore oil and gas development to satisfy our increasing demand for cheap energy.

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The Activity

1. Establish a rectangular playing area with the start and finish lines along the shorter sides. **Divide participants** into equal teams of six to eight players.

2. Each team receives two mats of identical size. The mats represent the vehicle they are driving in. A small mat may represent a compact car - less room but also fewer emissions. A large mat may represent an SUV or a pickup truck. It means more comfort and faster movement but also more emissions.

3. Scatter the balls and tokens throughout the playing area. This represents the atmosphere filled with various greenhouse gases. Explain to the students that the balls represent carbon dioxide (and other greenhouse gases for grades 8-10) emitted into the atmosphere. The tokens represent vehicle emissions.

4. Scatter the grade appropriate laminated action cards throughout the playing area. Explain that as the teams work their way across the playing area, they will need to collect as many of these cards as they can. They will also need to collect the number of balls indicated on the card.

5. Each team also has to make up for the emissions that their vehicle puts out. Large vehicles (mats) will have to collect 10 tokens, medium sized vehicles will have to collect 5 and small vehicles will have to collect 2. If all teams are on mats of the same size, all will need to collect the same number of tokens as determined by the teacher.

6. Each team begins by standing on one mat at the start line - with the other mat directly in front of the mat they are standing on. When the activity begins, all members of each team will step on to the new mat (heading towards the finish). Once on the second mat, they must pick up the first mat, lift it over their heads, place it in front of them and continue the process towards the finish line. This will appear similar to a leapfrog activity. **All team members must be on a mat AT ALL TIMES!**

7. It may be necessary to set a **time limit** of 10 minutes for the activity and give a warning at the five, seven and nine minute marks.

8. **Grade 4-7:** Tally the number of emissions that have been reduced. Discuss the different types of actions and how they reduce emissions.

Grade 8-10:

The **team that collects the most balls and can match them to their action cards and the correct number of tokens for their vehicle emissions wins** the first part of the activity. **Balls can be won or lost in the wrap up section of the activity.**

Wrap Up

1. If you are using different sizes of mats for different teams, **ask the students what were the advantages and/or disadvantages of getting around in a small vehicle** versus a large vehicle.

2. Discuss the teamwork involved. What were the team's strengths? What was the most challenging thing to do? What strategies were developed as play went on?

3. Determine the final score. Check that each team has collected the correct number of tokens for their vehicle's emissions. If a team has not done so, they can still earn points (balls).

4. Teams show their action cards and corresponding balls. Each action reduces CO₂ and other GHGs in the atmosphere



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and students need to explain how in order to keep the balls they collected for that card. If the team cannot give a satisfactory explanation another team may attempt it and win the balls.

5. When all the cards have been addressed, **calculate the following:**

- Which team(s) collected enough tokens to cover their emissions while 'driving'
- Which team(s) collected enough balls to match their action cards

If a team has been successful in both of these activities they are the winners. If no team has succeeded at both activities, the one that is closest is the winner or it is a tie between all teams.

6. Discuss with the students how each person can help to reduce greenhouse gas emissions at home, at school and in the community.

Extensions:

Play it again with different teams and new action cards. Have students design the action cards for the second round.

Brainstorm actions that individuals can take to reduce greenhouse gas emissions.

Have each student commit to trying one action for a week. At the end of the week, assess how easy or hard it was for students to change their lifestyles.

Have students select another action and/or continue with the first.

Assessment:

Have students create an illustration showing the enhanced carbon cycle. Illustrations should include:

- Creation of emissions through human activity
- Build up of carbon in atmosphere
- Removal of carbon from the atmosphere through human activity
- Storage of carbon on earth in a natural form
- Prevention of further emissions through changes in human activity