

The Greenhouse Effect

by Louise Comeau and Tim Grant



About half of the radiant energy that comes from the sun is reflected back into space after striking reflective surfaces such as particles in the atmosphere or snow at ground level. The rest is absorbed at the Earth's surface and released as infrared, or heat, energy. As this heat radiates upwards, some escapes into space and some is absorbed and emitted back to Earth by gases, such as water vapor, carbon dioxide, nitrous oxide and methane, which occur naturally in the atmosphere. This natural "greenhouse" effect is what makes the Earth's surface warm enough to support life. Without greenhouse gases, the average temperature on Earth would be about -18°C (0.4°F).

As long as the energy entering the system is balanced by the energy leaving, average temperatures remain relatively stable. But a rise in levels of greenhouse gases has the potential to upset this equilibrium by increasing the amount of heat that gets trapped near the Earth's surface. For most of the last 10,000 years, the concentration of the most abundant greenhouse gas, carbon dioxide, remained fairly steady at 280 parts per million (280 molecules of carbon dioxide for every million molecules of air). During that period, there existed a balance between sources of carbon dioxide such as respiration, decomposition and forest fires, and processes that remove it from the atmosphere such as photosynthesis and absorption by oceans.

Since the Industrial Revolution began in the 1750s, humans have affected the carbon dioxide balance in two ways. We have added large quantities of carbon dioxide to the atmosphere by burning carbon-rich fossil fuels such as coal, oil and natural gas. At the same time, we have cut down nearly half of the world's forests,¹ releasing the carbon stored in the trees and reducing the

Earth's ability to absorb carbon dioxide through photosynthesis. In the past decade, almost seven billion tonnes of carbon were released every year by the burning of fossil fuels and destruction of forests. About half of it dissolved in the oceans or was taken up by plants; the other half, about 3.5 billion tonnes of carbon, was added to the atmosphere and will remain there for 50 to 200 years. So far, the global concentration of CO_2 has increased by 31% from pre-industrial levels and is estimated to be increasing at the rate of 0.4% per year. Methane levels have increased by 151% and nitrous oxide

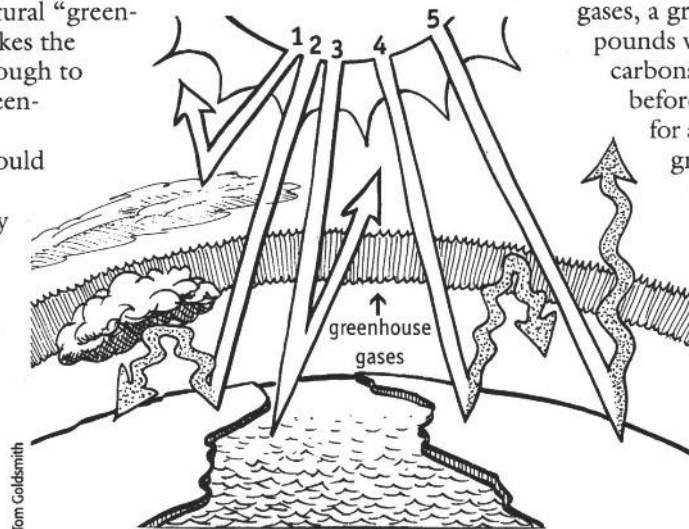
by 17%. The most potent of greenhouse gases, a group of human-made compounds which includes chlorofluorocarbons (CFCs), did not even exist before the 1930s, but they account for about 12% of today's enhanced greenhouse effect.² All of these greenhouse gases are destroyed over time by atmospheric chemistry, but the process can take decades to centuries.

What can we expect?

Adding more greenhouse gases to the atmosphere than can be disposed of naturally is like adding an extra blanket to your bed: things are going to heat up. According to climate scientists, mean surface temperatures will likely rise between 1.4 and 5.8°C by 2100.³ Warming will not be the same the world over. Because of the way wind and ocean currents transfer energy from the equator to the

poles, and as snow and ice melt, the region north of 50°N is expected to warm more than the global average. Summer temperatures could increase by as much as 7°C in Canada's Mackenzie Basin, with increases of up to 9°C in April and May.⁴

Because heat is what drives the climate system, we can expect an increase in extreme weather. Among the many impacts of climate change that scientists now predict are: a rise in sea level and changes in currents; changes in precipitation patterns; shifts of temperature zones; an increase in the frequency and intensity of storms; more heat waves and droughts; and a higher incidence of forest fires.



Pathways of solar radiation:

1. Light strikes particles in the atmosphere and is reflected back to space.
2. Light is absorbed at the surface and released as heat; then absorbed by clouds and emitted back to Earth.
3. Light strikes water and is reflected back to space.
4. Light is absorbed at the surface and released as heat; then absorbed by greenhouse gases and emitted back to Earth.
5. Light is absorbed at the surface and released as heat; the heat escapes directly into space.

We are already seeing these effects in North America. Karl et al reported in the February 1996 *Bulletin of the American Meteorological Society* that there is less than a one in 1,000 chance that the observed increase in extreme one-day precipitation events in the United States could be a naturally occurring event. In the north, the Mackenzie Basin has warmed by an average of 1.5°C over the last 100 years,⁵ more than double the global rate (0.6°C). Alaska and eastern Siberia have warmed at similar rates.

What can be done?

To slow the pace of climate change, we will have to reduce overall greenhouse gas emissions from many sources, but especially carbon emissions associated with fossil fuel consumption and the clearing of tropical rainforests. In North America, most analysts agree that we need to eliminate subsidies to the oil, gas and coal industries while promoting energy efficiency, renewable energy technologies, and the development of transportation systems that allow people to leave their cars at home. Many argue for "carbon taxes" on the use of fossil fuels that would encourage more resource-efficient activities. Much research has shown that taking steps to reduce carbon emissions actually enhances economic development. In a 1996 study, the Sierra Club of Canada found that stabilizing and reducing greenhouse

gas emissions in Canada could create up to 1.5 million person-years of work, far in excess of the job creation potential of the current oil sands expansion in northern Alberta.

To reduce carbon dioxide emissions in the short term, the single most effective measure, and the least disruptive economically, would be to raise the fuel efficiency standards of new cars and trucks which have remained unchanged for almost a decade. On an individual level, planting trees, favoring public transit and bicycles over cars, making our homes more energy-efficient, reusing and recycling materials, and eating locally-grown foods are actions that everyone can take to help reduce emissions of greenhouse gases. ♻

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Notes

- ¹ Lester R. Brown, et al., *State of the World 1999* (Washington, DC: Worldwatch Institute, 1999), p. 60.
- ² Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2001: The Scientific Basis, Summary for Policymakers*, World Meteorological Organization/United Nations Environmental Programme, p. 7.
- ³ IPCC, p. 13.
- ⁴ Janet Brotton and Geoffrey Wall, "The Possible Effect of Climate Change on the Sport Hunting of Bathurst Caribou of the NWT," Mackenzie Basin Impact Study, Interim Report #2, 1994.
- ⁵ Environment Canada, *The State of Canada's Climate: Monitoring Variability and Change*, 1995.

The Major Greenhouse Gases

Gas	Contribution to the greenhouse effect	Increase since 1750	Heat-trapping ability (in relation to CO ₂)	Lifespan in atmosphere (years)	Sources
Carbon dioxide (CO ₂)	53%	31%	1	50-200	Respiration; decomposition; forest fires; evaporation from oceans; burning of fossil fuels.
Methane (CH ₄)	17%	151%	25	10	Underground deposits (natural gas is mostly methane); respiration by anaerobic decomposers living in wetlands, rice paddies and the digestive tracts of ruminant animals and termites; garbage dumps.
Nitrous oxide (N ₂ O)	5%	17%	200	150	Microbes that break down organic matter in soils; nitrogen fertilizers; burning of fossil fuels and wood.
Ground-level ozone (O ₃)	13%	36%	2,000	weeks	Very small amounts naturally present in atmosphere; formed photochemically when nitrogen oxides and volatile organic compounds in automobile exhaust react in sunlight.
Halocarbons (CFCs)	12%	none in 1750	up to 10,000	60-100	Human-made compounds used in refrigerators, air conditioners, foam products, aerosol sprays. There are no natural sources.

Reflection page

Questions:

1- Using your own words can you describe the phenomena know as the Greenhouse effect?

2- What are some of the solutions that are suggested in the article to help reduce Carbon Dioxide?

3- On an individual level, what are some things that could you do to help reduce the emissions of greenhouse gas?



Blindfold Nature Games- Part 1



Objectives-

- To make connections to important ecological concepts such as adaptation, diversity, predator-prey relationships
Adaptation: all living things have evolved to fit how and where they live
Diversity: differences in living things allow for the success of all life
Predator-prey relationships: studying the interactions between two species and the interdependence to one other
- To open the eyes of the learner to the natural environment; especially heightened adaptations of the senses
- To engage and develop skills of the learner: knowledge of local flora and fauna, observation and listening skills

Materials- Blindfolds, scarfs

“Deer Ears Activity”

Method-

- 1- Explain the importance of a deer’s hearing in survival- (to listen for danger and the on-coming of predators).
- 2- Have the students cup their hands around their ears to continue to listen while you speak in order to demonstrate how ear cups or flaps help to capture sound and improve hearing dramatically.
- 3- Note that many animals have these large ear flaps or cups to enhance their sense of hearing to locate predators and prey in order to best survive.
- 4- Choose a quiet location to play Deer Ears
- 5- Have one person be the deer. They will wear a blindfold (or simply close their eyes) and place a scarf in their back pocket (tail).
- 6- Be sure that the student wearing a blindfold has their ears exposed for better listening.
- 7- Have student(s) who will be the predator (Wolf/Cougar/Coyote/Lynx etc.,) to stand 10 meters away.
- 8- The adult or leader will act as the game warden or referee to judge the “starve” calls.

Rules:

- Predators sneak up quietly to the Deer and try to grab the scarf (tail) from the students back pocket.
- Deer can stop a predator from advancing by pointing in the specific direction of the predator and say “Starve”
- If the Deer points with 2 or 3 degrees of the correct direction then the predator must freeze, stop advancing and sit quietly. If they miss the predator, then they may continue to stalk and sneak up to snatch the deer’s tail.
- The Game Warden can then give the “go ahead to continue stalking for those predators still in the game.
- Each Deer can have a limit to the number of “Starves” they can use to call out (for starters use 5 -10 starves and then reduce the amount as the game is re-played).
- The first predator to reach the deer without being starved wins and become the next deer.
- Deer cannot move off their spot. They can only rotate. Predators can only walk.

Variations

- Change the number of starves available to a Deer
- Change the number of predators

- Have 2 Deer working together at the same time; both blindfolded, both with a limited number of starves and 3-4 predators
- One on One version- one predator/one prey (limited number of starves)
- Increase the starting distance that the predator begins the hunt

Conclusion: Following this activity take time to discuss other adaptations deer have to avoid predation including: long necks, eyes at the side of their heads, large nose, white tail, long legs, fast runners and jumpers, light brown fur, etc.

Also discuss the importance that predators have in keeping populations healthy by increasing the strength of a prey population when feeding on old, sick or injured prey. Predators also help keep a healthy balance of individuals and prevent over population which enable prey to have a steady food supply. Other animals also benefit from prey being eaten when there are left overs. Eagles, fox, and many other scavengers depend upon the predator-prey relationship for left over animal carcasses.



Nature Trivia Questions – Part 5

“Survival Edition”



(Please note: Answer page can be found on a separate attachment)

Instructions: This is an activity that can be used for group decision making, or done for individual interest. Here are 10 questions concerning personal survival in a wilderness setting. Your first task is to individually select the best answer out of three possible choices given to each situation. Try to imagine yourself in each situation provided. Assume you are alone and have a minimum of equipment, unless specified. The season is fall. The days are warm and dry, but the nights are cold.

After you have completed the questions individually, you will again consider each question as a member of a small team made up of other students, family members, friends, etc. Your team will have the challenge of deciding by consensus, the best choice alternative for each question. Do not change your individual answers, even if you change your mind in the group discussion. Both individual and group answers' will later be compared with the correct answers provided by a group of survival experts.

#1- You have strayed off from your group in dense forest. You have no special signaling equipment, cell phone or even reception. The best way to attempt to contact your friends is to:

- a) Call “Help” loudly but in a low register.
- b) Yell or scream as loud as you can.
- c) Whistle loudly and shrilly.

Answer _____

Your Group's Answer _____

#2 – The day becomes hot. You have a 1-liter water bottle full of water. You should

- a) Ration your water- about 1 cup a day
- b) Do not drink until you stop for the night, then drink what you think you need
- c) Drink as much as you need when you need it

Answer _____

Your Group's Answer _____

#3- Your water is now gone and you become very thirsty. You finally come to a dried up stream. Your best chance of finding water is to:

- a) Dig anywhere in the dried up stream bed
- b) Dig up plants and roots near the stream bank
- c) Dig in the stream bed at the outside edge of a curve or corner

Your Answer _____

Your Group's Answer _____

#4- You decide to walk out of the wilderness country by following a series of ravines where a water supply is available. Night is soon approaching. The best place to camp is:

- a) Beside the water supply in the ravine
- b) High up on a ridge of the hill side
- c) Midway up the hill side

Your Answer_____

Your Group's Answer_____

#5- Your flashlight glows dimly and your batteries show signs of losing power, just as you are about to make your way back to your campsite after a searching for firewood. Darkness can come quickly in the woods and the surroundings can all look the same. You should:

- a) Head back at once, keeping the flashlight on, hoping the light will glow enough for you to make out familiar landmarks as you find your way back
- b) Put the batteries under your armpits to warm them up, and then replace them in your flashlight. Stop along the way, and continue the process of warming them and replacing in your flashlight as needs be
- c) Shine your light for a few seconds and try to get the scene in your mind. Turn your flashlight off and then move out in the darkness, repeat the process until you arrive at camp

Your Answer_____

Your Group's Answer_____

#6- You must cross a small river that has a strong current with large rocks and some white water rapids. After carefully selecting the safest place to go across, you should:

- a) Leave your hiking boots and back pack on
- b) Take your boots and pack off
- c) Take off your backpack, but leave your boots on

Your Answer_____

Your Group's Answer_____

#7 – Which way should you face while wearing a back pack and crossing the current of a stream:

- a) Upstream
- b) Across the stream
- c) Downstream

Your Answer_____

Your Group's Answer_____

#8- Unarmed and unsuspecting, you surprise a large bear prowling around your campsite. As the bear moves toward you and is approximately 10 meters away, you should:

- a) Run as fast as you can
- b) Climb up the nearest tree
- c) Freeze, but be ready to back away slowly

Your Answer_____

Your Group's Answer_____

#9- What do you think is the number #1 most important survival element from these 3 choices:

- a) Food
- b) Fire
- c) Signaling device

Your Answer_____

Your Group's Answer_____

#10- When you are packing your clothes for a wilderness trip and cold weather is expected, you should:

- a) Pack several layers of lightweight clothing for your upper and lower body
- b) Pack a thick heavy jacket and heavy lined pants to prepare for the cold weather
- c) Pack a stereo headset to keep your ears warm and your spirits up

Your Answer_____

Your Group's Answer_____



Nature Trivia Questions– Part 5

Rational and Answers

“Survival Edition”



#1- You have stayed off from your group in dense forest. You have no special signaling equipment, cell phone or even reception. The best way to attempt to contact your friends is to:

- a) Call “Help” loudly but in a low register.
- b) Yell or scream as loud as you can.
- c) Whistle loudly and shrilly.

Answer: a) Call “Help” loudly but in a low register.

Low tones carry farther, especially in dense woodland. There is a much better chance of being heard if you call loudly but in a low key. “Help” is a good word to use because it alerts others that you are in need of assistance. Yelling or screaming would not only be less effective, but also it might be passed off as a bird call or other people having fun yelling with excitement. Of course it would be best if you had a whistle with you since it is a universal signaling devise for distress when blown repeatedly, and it requires much less energy to use compared to calling out loudly.

#2 – The day becomes hot. You have a 1-liter water bottle full of water. You should

- a) Ration your water- about 1 cup a day
- b) Do not drink until you stop for the night, then drink what you think you need
- c) Drink as much as you need when you need it

Answer: c) Drink as much as you need when you need it.

The danger here is dehydration, and once the process starts, your liter of water will not do much to reverse it. Saving or rationing will not help, especially if you become unconscious or excessively weakened by lack of water. Lying unconscious somewhere due to sunstroke or dehydration could result if you are not drinking enough water. So use the water as you need it, and be aware of your need to find a water source as soon as possible.

#3- Your water is now gone and you become very thirsty. You finally come to a dried up stream. Your best chance of finding water is to:

- a) Dig anywhere in the dried up stream bed
- b) Dig up plants and roots near the stream bank
- c) Dig in the stream bed at the outside edge of a curve or corner

Answer: c) Dig in the stream bed at the outside edge of a curve or corner.

This is the part of the stream or river that flows the fastest, deepest, is less silted with scum or foam, and the last part to go dry.

#4- You decide to walk out of the wilderness country by following a series of ravines where a water supply is available. Night is soon approaching. The best place to camp is:

- a) Beside the water supply in the ravine
- b) High up on a ridge of the hill side
- c) Midway up the hill side

Answer: c) Midway up the hill side.

A sudden rain storm might turn the ravine into a rushing current of water. If heavy rain occurs, then your camp could easily become flooded when you are situated in a ravine. This has happened to many campers and hikers before they have a chance to escape. On the other hand, high up on a ridge of a hill increases your exposure to rain, wind and lightning should a storm break. The best location for protection and shelter would be Midway up the hill side.

#5- Your flashlight glows dimly and your batteries show signs of losing power, just as you are about to make your way back to your campsite after a searching for firewood. Darkness can come quickly in the woods and the surroundings can all look the same. You should:

- a) Head back at once, keeping the flashlight on, hoping the light will glow enough for you to make out familiar landmarks as you find your way back
- b) Put the batteries under your armpits to warm them up, and then replace them in your flashlight. Stop along the way, and continue the process of warming them and replacing in your flashlight as needs be
- c) Shine your light for a few seconds, try to get the scene in your mind, move out in the darkness, repeat the process until you arrive at camp

Answer: b) Put the batteries under your armpits to warm them up, and then replace them in the flashlight. Stop along the way, and continue the process of warming them and replacing in your flashlight as needs be.

Flashlight batteries lose much of their power in the cold. Well used or weak batteries run down even faster in the cold. Warming the batteries can restore them for a while. You would normally avoid night travel, of course, unless you were in open country where you could use the stars for navigation and see the open terrain. In the forest there are too many obstacles of logs, branches, uneven ground, etc. that could injure you with a broken leg, injured eye, or twisted ankle. Any injury coupled with being lost could drastically increase risks and worsen your situation. Once sun sets, darkness falls quickly in the forest areas, so it is best to stay at your campsite.

#6- You must cross a small river that has a strong current with large rocks and some white water rapids. After carefully selecting the safest place to go across, you should:

- a) Leave your hiking boots and back pack on
- b) Take your boots and pack off
- c) Take off your backpack, but leave your boots on

Answer: a) Leave your hiking boots and back pack on.

Having an accident while crossing a river and stream with water currents can lead to serious injuries or even be fatal. Sharp rocks or uneven footing require that you keep your boots on. If your pack is fairly balanced, then wearing it will provide you the most stability in swift current. A waterproof sealed backpack will often float even when loaded with normal camping gear. So if you step into a hole or deep spot with the water over your head, the back pack could act as a life jacket and help you float.

#7 – Which way should you face while wearing a back pack and crossing the current of a stream:

- a) Upstream
- b) Across the stream
- c) Downstream

Answer: b) Across the stream.

Errors in facing the wrong way while crossing a stream with moving water current are the cause of many drownings. Facing upstream is the worst alternative since the current could push you back and your pack would provide the unbalance to tip you over backwards. In this event you could knock your head up against rocks or even worse become submerged under water. If you are facing downstream then at least you could use your hands to break your fall should you lose your balance. You have the best stability while crossing the moving current by facing across the stream keeping an eye on the exit point of the opposite side.

#8- Unarmed and unsuspecting, you surprise a large bear prowling around your campsite. As the bear moves toward you and is approximately 10 meters away, you should:

- a) Run as fast as you can
- b) Climb up the nearest tree
- c) Freeze, but be ready to back away slowly

Answer: c) Freeze, but be ready to back away slowly.

If the bear is seeking some of your food, let him/her take what they want and hopefully it will be on its' way. Sudden movement can startle the bear a lot more than your presence, so freezing, keeping still while backing away slowly is the recommended action to take. Bears can climb trees very well so that is not a secure place to seek protection. Running away from a bear can also trigger the predator-prey instincts to start a chase with you being the prey. Some experts suggest to stand your ground and try to make yourself appear big. For example, stand up tall, standing together if you are more than one person, picking up large objects like a big log, hold up a back pack, spread open your arms, etc. and in a stern voice tell the bear to go away. The idea here is that you are not going to be easy prey and that the bear will have to endure a fight before being successful. If the bear perceives you as a difficult and challenging opponent, then it may think twice and leave. Some experts also suggest banging pots and making loud noises and shouting to make your presence known and discourage the bear from approaching.

#9- What do you think is the number #1 most important survival element from these 3 choices:

- a) Food
- b) Fire
- c) Signaling device

Answer: b) Fire

Fire is central to survival. It helps keep from freezing and can maintain a warm body temperature for the body's core which ranks as the most common cause of death when lost in the wild. You can survive a week without food and still remain healthy. The problems associated with no food are more psychological than physical. Fire is more important than food because it also provides comfort and security. The bright flame can also scare away potential predators and pests. The heat dries wet clothes. The heat kills parasites and can cook food to easier to chew and boil water for sterilizing for drinking and medical uses. The light and smoke of the fire can also serve as a signaling device. Smoke and fire can be seen over great distances to help you to be found by search and rescue teams.

#10- When you are packing your clothes for a wilderness trip and cold weather is expected, you should:

- a) Pack several layers of lightweight clothing for your upper and lower body
- b) Pack a thick heavy jacket and heavy lined pants to prepare for the cold weather
- c) Pack a stereo headset to keep your ears warm and your spirits up

Answer: a) Pack several layers of lightweight clothing for your upper and lower body

When packing clothes for a spring or fall wilderness trip where temperatures fluctuate, being prepared with 'layers' of clothing is best. Layering your clothing is the warmest way to dress when cooler temperatures are expected. For example, two lighter sweaters will be better than one very heavy sweater. If you get hot while hiking or if the temperature rises, then you can remove one of the light sweaters and yet still keep a warm piece of clothing on. If you are only prepared with one heavy layer of clothing your options for adjusting to the temperature outside as well as your changing body temperature is limited. Dressing in layers can therefore help you to prevent overheating, sweating and becoming chilled.