

Appendix C –

Adapted Ecological Macro Model – Keeping the Earth Warm

Adapted from Tom Puk's Ecological Consciousness: Stop Peeing into the Drinking Water (2017)

Part 1 – Natural Greenhouse Effect: Life Giving

Objective:

Understand and appreciate the wonder of the natural greenhouse effect through embodied experience.

Concepts:

Greenhouse gases (GHG), natural greenhouse effect, anthropogenic greenhouse effect

Key Definitions:

- **Atmosphere** – the layer of gases, that we know as air that surrounds the planet Earth and is held there by the Earth's gravity. There are 7 layers.
- **Troposphere** – the lowest layer of the atmosphere, extending from the Earth's surface up 6 – 10kms. This air is where all of the Earth's weather occurs. It is mostly made up of nitrogen and oxygen.
- **Entropy** – heat energy that escapes from Earth into the atmosphere.
- **Photon (Light Rays)** – the energy created when the sun converts particles into both heat and light.
- **Infrared Light (Heat)** – a type of radiant energy that's invisible to the human eye but that we can feel as heat.
- **Greenhouse Gases** – Gases that contribute to the Earth's greenhouse effect by absorbing infrared radiation.
- **Water Vapour (H₂O)** – invisible gaseous phase of water. It is the most abundant GHG in the air (89%). These gases are short lived as they are constantly being circulated back to Earth through the water cycle.
- **Carbon Dioxide (CO₂)** – a colourless gas that makes up 7.5% of GHG in the air. It naturally occurs through respiration and volcano eruptions. Humans emit CO₂ through burning fossil fuels, deforestation, land use,
- **Methane (CH₄)** – a flammable gas that makes up a small % of GHG in the air, although it is a more powerful GHG than carbon. Methane is formed through the decay of waste in landfills, agriculture, rice cultivation, and cow digestion.
- **Anthropogenic** –emissions or pollution coming from human activity

Equipment (for a group of 20):

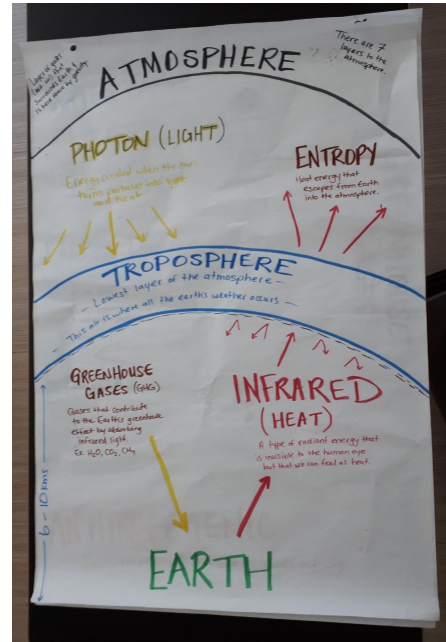
*** These ratios will need to change for groups larger or smaller than 20*

- ✓ Coloured Cloth
 - 7 blue (water vapour – H₂O)
 - 1 black (carbon dioxide – CO₂)
 - 12 yellow (photons – light)
 - 12 red (infrared – heat)
- ✓ Rope (x 2)


- ✓ Tarp
- ✓ Whistle
- ✓ Poker chips (2 colours)
- ✓ Rocks
- ✓ Buckets (x 5)
- ✓ Prepare flipchart(s) of key definitions (see end of activity)

Play Area Set-up:

- The play area should be large enough for players to be able to run around (e.g. approx. half of a soccer field, a gym, etc.)
- At one end of the play area, set out the tarp, and two buckets. This represents **Earth**. One of these buckets should be filled with rocks.
- In the middle of the play area, set up both ropes parallel to each other, about 6 feet apart. This represents the **troposphere**. Place a bucket filled with red poker chips.
- On the other end of playing area, place a bucket filled with green poker chips and another empty bucket. This represents the **atmosphere**.
- Prepare a flipchart with key definitions written out.



Activity Sequence:

- Give all participants a either a yellow and red band OR a blue or black coloured cloth (according the ratios in the equipment section) and have them stand in their starting positions. 
- When you use a new term, use the definition sheet to help define it.
- Begin with the following explanation:
 - This game is going to simulate the Earth's natural greenhouse effect.
 - There are three areas in the game: the atmosphere, the troposphere, and the Earth.
 - There are two key roles in the game: natural greenhouse gases (GHG) and light/heat.
- Explain the role of the greenhouse gases:
 - The blue bandanas represent water vapour.
 - The black bandana represents carbon dioxide (CO2).
 - The GHGs are only allowed to move within the troposphere throughout the game.

- Their role is to tag the infrared light (heat) as they are trying to escape from earth into the atmosphere OR to try and get as many of the red poker chips onto the Earth.
- Explain the role of the light/heat waves:
 - Everyone with a yellow cloth represents a photon. They are to start in the atmosphere with a green poker chip, which represents light coming from the sun.
 - When the game begins, the photons will run through the troposphere to get to earth.
 - When they reach earth, they place their green chip on the tarp and take a rock out of the bucket; they now represent heat (red cloth).
 - As heat, these players now try to pass back through the GHGs in the troposphere to get back to the atmosphere.
 - If a player is NOT tagged, place the rock in the empty bucket (which represent entropy) and start again as a photon (green poker chip).
 - If they ARE tagged, they must take a red poker chip (representing heat) from the bucket in the troposphere and return it to the empty bucket on earth. Still holding their rock, they now try again to get through the troposphere. Every time they are tagged with a rock in their hand, they must put another heat chip in the bucket and repeat.
- NOTE: *Greenhouse gases can tag light waves as they try to get to earth, however nothing happens to this person, they just get to keep trying. This represents the fact that 30% of the suns rays are reflected and sent back into space before making it to earth.*
- Begin the game by saying that the whistle will represent the start of play and the stop. When you here it, stop where you are.
- Let the game play out until you think everyone has the gist of the movement.
- Blow the whistle. When everyone stops, explain that this enacts a part of the water cycle. When you blow the whistle again, play resumes, but all the water vapour must run and touch the tarp and then go back to the troposphere and continue their regular role.
- Allow the game to play for another moment or two.
- Blow the whistle to stop the game. Ask participants to count all the red poker chips on earth and all the rocks in the atmosphere.
 - Q1: What do the poker chips represent? (heat trapped on Earth)
 - Q2: What do the rocks represent? (entropy, the heat that escaped into the atmosphere)
- Final Round:
 - Empty the buckets of red poker chips on Earth and rocks in the atmosphere.
 - Ask all the greenhouse gases to leave the troposphere.

- Allow light to play one more round until they are all back in the atmosphere.
- Re-count the number of rocks in the atmosphere and the number of red poker chips on earth.
- This demonstrates what happens when there is no greenhouse effect.

Part 1 Debrief:

- What did you observe?
- How many poker chips did the earth collect when the greenhouse gases were in effect?
- What caused the Earth to heat up?
- How many poker chips did the Earth collect when there were no greenhouse gases playing?
- What would happen if there was no greenhouse effect?

Part 3 – Anthropogenic Greenhouse Effect: Life Threatening

Objective:

Understand the anthropogenic greenhouse effect through embodied experience.

Concepts:


What are the main anthropogenic greenhouse gases, how do anthropogenic greenhouse gases influence the natural greenhouse effect

Equipment (for a group of 20):

*** These ratios will need to change for groups larger or smaller than 20*



- ✓ Coloured Bandanas
 - 7 black (Carbon dioxide – CO₂)
 - 2 green (Methane – CH₄)
 - 1 brown (other GHGs)
 - 10 yellow (photons – light)
 - 10 red (infrared – heat)
 - 7 blue (water vapour – H₂O)
- ✓ Rope (x 2)
- ✓ Tarp
- ✓ Whistle
- ✓ Poker chips (2 colours)
- ✓ Rocks
- ✓ Buckets (x 5)

Play Area Set-up:

- Same as Part 1, except in the troposphere spread out the blue clothes (water vapour). 

Activity Sequence:

- For a group of 20, the game will begin with 10 yellow's, 7 black's, 2 green's, and 1 brown.
- Explain that this game is going to simulate the effect of anthropogenic GHG on the Earth's greenhouse effect, which is leading to global warming. This round we will observe what happens as more GHG's are emitted into the troposphere.
- Ask anyone who is not a yellow/red cloth to go stand in the troposphere – they are the GHGs this round. Ask the group:
 - What does the black cloth represent? (Carbon dioxide)
 - How is CO₂ released? (burning fossil fuels, deforestation, land use changes)

- What does the green cloth represent? (Methane)
 - How is CH₄ released? (decomposition of waste in landfills, agriculture, rice cultivation, cow digestion, etc.)
 - What does the brown cloth represent? (other GHGs like nitrous oxide and chloroflourocarbons, which are potent GHGs, but are much less present than water vapour, carbon, and methane)
 - How are they released? (soil cultivation, industry, etc.)
- Explain to the group that the same rules apply for Part 3 as they did for Part 1 (see above). The only difference is that no one will act as water vapour; these are already in the troposphere.
 - Every few minutes, the game facilitator will blow the whistle and give a new instruction. When you hear the whistle, stop where you are.
 - Allow the first round to play out for a few moments.
- First whistle:
 - Count how many red poker chips (heat) are on the Earth and record for Round 1.
 - Change the ratio to 8 yellow and 12 GHGs (add in 2 carbon)
 -  Have players start from the beginning.
- Second whistle:
 - Count how many red poker chips (heat) are on the Earth and record for Round 2.
 - Change the ratio to 6 yellow and 14 GHGs (add in 3 carbon and 1 methane)
 -  Have players start from the beginning.
- Third whistle:
 - Count how many red poker chips (heat) are on the Earth and record for Round 3.
 - End of the game.

Part 3 Debrief:

- What did you observe?
- What happened when more GHG's were added to the troposphere?
- If the red poker chips represent temperature increase, what happened to the Earth by the end of the game?
- As human beings, what can we do to lessen the amount of greenhouse gases?