

# Polar Melt Down



This activity center is part of the **Water Protection** theme.

## What's the purpose of this activity?

Students will explore global warming and its effect on the Earth's polar ice caps and how this can affect ocean levels. Directed with the help of questions, students discuss these impacts and consider changes humans can make to create a positive change.

## Key messages:

- The North Pole and the South Pole are very different in terms of composition. The North Pole is on a floating ice cap whereas the South Pole is located on top of a landmass that is covered with a sheet of ice.
- Global Warming is like a greenhouse effect, causing the average temperatures of the Earth to increase.
- Global Warming causes melting of glaciers, including the Earth's Polar Ice Caps.
- Melting of the Polar Ice Caps will result in coastal flooding
- Humans can make a positive difference by decreasing the amount of fossil fuels we burn.

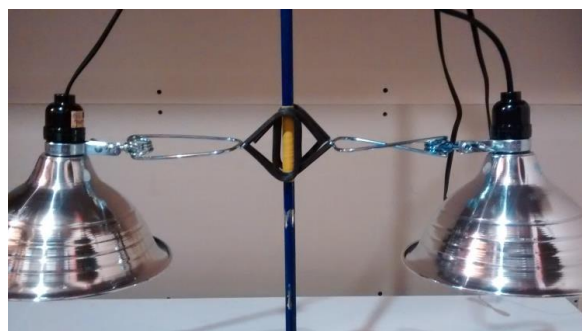
## Materials

- Metal stand
- 2, clamp on reflection lamps
- 2, light bulbs (150 W basking lights)
- Power Bar
- Extension cord
- 3, 4 cup pyrex dishes (glass)
- 2, clay "Antarctic" mounds (inside 2 pyrex dishes)

- Measuring Scoops: 1 cup, 1/3 cup & ¼ cup
- Ice cooler
- Ice cubes
- Cloth bag
- Wooden mallet
- Grease pencils
- Coloured tape
- Bucket/jug of water
- Plastic polar bear, seal, penguins
- Poster board with Velcro
- Arctic & Antarctic habitat laminate pictures (to be Velcroed to poster board)
- Penguin timer
- Laminated posters:
  - World Map or Globe
  - Greenhouse Effect/Map of Coastal Communities at Risk of Flooding
  - Impacts of Global Warming
  - Pictures of Polar Bear & Penguins with diminishing habitat

## Set up:

- Set metal stand on table
- Put light bulbs into reflection lamps
- Clamp reflection lamps onto metal stand at the taped mark (see photo below)
  - Clamp the lamp clamps on top of each other so the lamps are equal distance from table (see photo below)
- Put light cords up the metal stand so they are not touching any part of the reflection lamps
  - Run the cords to the top of the metal stand and set them in the top clamp



- Plug into power cord & extension cord ... plug into wall socket
- Fill bucket with water
- Make sure clay mounds look like this



- Place each clay mound into a pyrex dish making sure that the sides are not touching the sides of the pyrex dish (2 “Antarctica models to rotate with each group)

- Make sure the ice cooler is filled with ice cubes ... keep lid closed!
- Place cloth bag and hammer/mallet on a sturdy table, separate from the light set up
  - You will be pounding ice to crush it so you don't want to damage the lights!
- Decide which side of the light set up will be the North Pole and South Pole
  - Velcro Antarctica habitat photo and label to poster board on the side that will be representing the South Pole
    - Place a few plastic penguins in front of South Pole on table (not under lights!)
  - Velcro Arctic habitat photo and label to poster board on the side that will be representing the North Pole
    - Place a plastic polar bear and seal in front of North Pole on table (not under lights!)



## What will I be doing?

When students arrive ... Explain that this station is about ice melting!

- Ask the students: “**Can you think of where on our Earth large areas of ice are found?**”
  - Glaciers ... which are found in many areas of the world
    - About 10% of our world is covered by glaciers!
    - Almost every continent has glaciers ... even Africa!
      - On Mount Kilimanjaro and Mount Kenya
  - **Today we are going to focus on our polar ice caps! ... where are these?**
    - South Pole which is in Antarctica (**show on map/globe**)
    - North Pole Arctic, found in the high Arctic (**show on map/globe**)

### Preparing the Poles!

#### North Pole:

- Add 1 & 1/3 cup of water to the empty glass container
  - Now add **1 ice cube** and explain to the students that this represents the **Northern Polar ice cap (North Pole) in the Arctic**
  - Mark water level with grease pencil or coloured tape
  - Put aside ... but don't put under heat lamps yet!

#### South Pole:

- **At the same time as the North Pole is being prepared, your partner will crush 1 ice cube in the cloth bag with hammer/mallet and scoop out with 1/4 cup scoop**
- Once the North Pole is “prepared”, take the other glass container with the clay mound and add 1/4 cup of water in the glass container (pour alongside, not on top of clay mound) ... **this can be done ahead of time by your partner so that it is ready!**
  - There is a permanent marking on

the bowl at this level holding the clay "Antarctica" ... if not, then mark water level with grease pencil or coloured tape

- Using the ¼ cup scoop, place all the crushed ice carefully on top of the clay "Antarctica"
  - Spread out the crushed ice so that it is contained on the top of the clay mound and no ice is falling over the sides or out of the runoff area
  - **Explain to the students that this represents the Southern Ice Cap (South Pole) in Antarctica**
- Preparing the Poles should be done as quickly as possible, to avoid "extra" melting and keep the melting period relatively the same ... but do so carefully!
- At the same time, place both bowls under their respective heat lamp (North Pole on Arctic side and South Pole on Antarctica side).
  - Turn heat lamps on using the power bar
- Ask the students:
  - **What do you think is going to happen as the ice melts?**
    - They will probably answer that the water level in the bowls will increase.
- Place "Habitat" poster board in front of light system (not too close to the lamps!)
  - This is to help demonstrate the different habitats but also to shield the students from staring at the lights
  - **Ask students what animals live in the Arctic?** ... polar bears!
    - Place Polar Bear & Seal in front of the North Pole/Arctic
  - **Ask students what animals live in Antarctica?** ... penguins!
    - Place Penguins in front of the South Pole/Antarctica
- Set Penguin timer for 10 minutes



**While we wait for the ice to melt ...**

Ask the following questions:

1. **Why did we put an ice cube in the North Pole and crushed ice on top of a clay mound in the South Pole?**
  - The North Pole is a floating ice cap.
  - The ice at the South Pole is mostly in the form of an ice sheet on top of a continent, which is land. This is Antarctica.
2. **What causes ice to melt?** ... warmth
3. **What creates warmth for the Earth?** ... the Sun
  - In fact, the sun is very important and without it, it would be too cold for us to live on Earth! ... for any living creatures to live on Earth!
4. **Have you heard of Global Warming?**
  - **Who can explain what that is?**
    - Global warming is the rise in the average temperature on Earth.
      - It has to do with the overall temperature rather than the temperature on any given day.
5. **Does anyone know how this "heating up" happens?**
  - There are a few things that have an impact on the Earth's temperature, global warming:
    - Natural temperature fluctuations of the planet
    - Volcanic eruptions
    - Increased solar activity
    - Greenhouse gases
6. **What are greenhouse gases? ... let students answer**
  - Greenhouse gases are naturally occurring gases which are found in very small amounts in our atmosphere (**use Greenhouse Effect poster to**



***use to explain!***

- The most common greenhouse gases are water vapor, carbon dioxide, and methane.
  - ... along with oxygen and nitrogen these make up the majority of gases in our atmosphere
- Greenhouse gases trap the sun's heat and warm the Earth (***use Greenhouse Effect poster to explain***)
  - Without these gases the Earth's heat would escape into space and the Earth would be too cold to support life ... we and all living things need these gases!
  - Our atmosphere has a natural balance of gases that help maintain the Earth's temperature in a certain range ... and that allows the Earth to support life!

**7. So, what's the problem? ...Greenhouse gases are good, right?**

- The problem is that we are producing an increasing amount of Greenhouse gases ... too many!
- **How are we doing this?**
  - By burning fossil fuels such as oil, natural gas and coal
- We are overloading our atmosphere and the result is that more heat is retained around the Earth, increasing the average temperature of the Earth causing Global warming!

**8. What problems can Global warming cause?**

- Global warming is responsible for climate change which includes:
  - Changes in temperatures
  - Extreme weather events like coastal storms, hurricanes, tornadoes, draughts, heat waves
  - AND it is causing our glaciers to melt!
    - Including our Polar Ice Caps!

***Let's look at our Polar Ice Caps ... take down the habitat "screen", turn off lights (using power bar) and bring focus to the "Ice Caps"***

***(don't move the dishes to allow the students to see the water levels compared to the tape lines clearly)***

**1. What has happened to the ice of our polar ice caps?**

- It has or is melting!

**2. What do you think this is doing to the habitat for the wildlife that depends on those frozen landscapes?**

- It's gone! (***Show photos of polar bears & penguins with diminishing habitat***)

**3. Has the water level risen in any of the containers?**

- Yes ... the South Pole water level has increased!

**• Why hasn't the North Pole?**

- The North Pole, as we said is a floating mass of ice ... therefore as the floating ice melts in the water (in the ocean) the space the ice took up is replaced by the water
  - Once ice now water!
  - Therefore no change in level!

- But the South Pole is a sheet of ice on top of a landmass, Antarctica. When the ice melts off of this, it does cause a rise in the water level ... the ocean level!

- The land mass is still taking up space in the ocean therefore the ice that once sat on top, melts off and adds volume to the surrounding ocean.

- Greenland is similar; it is ice on top of land. (***can show on map/globe***)

- Some scientists believe that if all the ice at the Poles melted, sea levels would increase by at least 200 feet (~ 61 meters) and this would be entirely due to the ice of the South Pole

- Imagine if Greenland also





melted!

4. **How do you think this will affect people around the world?** ... think about all the communities that live on the coast, by the ocean? (*show map of coastal communities*)
- Even a small rise in sea levels will cause flooding of these areas.
  - It is estimated that 1 in 10 people (approximately 634 million people) in the world live in areas that are at risk of this type of flooding

### Debrief:

1. **What can we do?**
- Use less fossil fuels
  - Use renewable energies: hydro, solar, wind
  - Switch to energy-saving lightbulbs
  - Walk or ride your bike instead of using the car for short distances
  - Turn off electrical items when you are not using them
  - Recycle and reduce your food waste.

### Resetting the Activity

- Use other clay “Antarctic” model for the next activity
  - The clay gets warm and soft during the “melt down” and will deform if touched right away
    - Any changes in the form of the clay may have an effect on the melting time and run off
  - By rotating the dishes, the clay has a chance to cool down so it is easier to empty the water
- Just before next round, gently hold the clay mound in the dish by holding the flat top of the mound with your fingers and pour off the water into the water bucket
- This water can be reused to fill the models

### Additional Background Information:

The North Pole is in the middle of the Arctic Ocean which is surrounded by the land masses of North America, Europe and Asia so there is a land connection to the south meaning that land animals can more easily reach the Arctic unlike Antarctica where animals must be able to swim or fly across hundreds of miles of frigid and storm-prone ocean even at the narrowest point.

### Climate Change

Climate change is any significant long-term change in the expected patterns of average weather of a region (or the whole Earth) over a significant period of time. Climate change is about abnormal variations to the climate, and the effects of these variations on other parts of the Earth.

- The Earth's climate appears to be changing very quickly, something that has not happened since the end of the last ice age, 10,000 years ago.
- The Earth has warmed by an average of 1°C in the last 100 years, which may not sound like a lot but this “small” change causes a great shift in our climate which affects the global environment
- Although natural volcanic eruptions can affect Climate change it is human activities that has the most significant affect
  - Natural Cause – Volcanic eruptions are sporadic and have relatively short-term effects.
  - Human Causes – Burning of fossil fuels and conversion of land for forestry and agriculture purposes are the main causes of climate change.
- Since the beginning of the Industrial Revolution, human influences on the climate system have increase substantially
- Carbon dioxide is the main cause of human-induced climate change and global warming
  - Burning fossil fuels (oil and gas) produces carbon dioxide.
  - Carbon dioxide is a very long-lived “greenhouse gas” which means that it stays in our atmosphere for a very long time and produces a “greenhouse effect” on Earth
  - The greenhouse effect makes the

earth warmer by allowing the sun's energy in, but not allowing the heat to escape ... therefore the Earth warms and the result is global warming

- Global warming, the rise in the Earth's temperature and causes more extreme and unpredictable weather

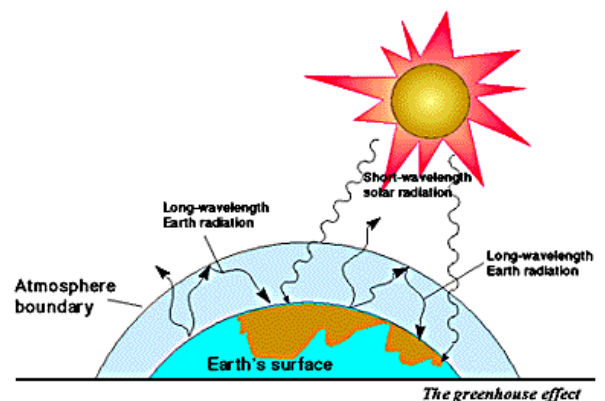
### **Why is global warming important?**

- Even small variations of the planet's average temperature can have a large impact on the environment
  - For example, the ice ages that occurred generally involved a reduction in the global temperature of around 5°C.
- Here are some things that may happen and in some cases, are happening, as the temperature rises:
  - **Melting Glaciers:** Many glaciers are already melting and shrinking throughout the world. If the temperature increases they will continue to melt.
  - **Rising Ocean Levels** - As glaciers melt, ocean levels will rise. This could cause flooding in cities located near the coast.
  - **Migration of animals** - Animals will migrate to cooler spots as their old habitats get too warm. This could upset the food chain and put some species in danger of extinction.
  - **Extreme Weather** - More powerful hurricanes, more droughts and more flooding in different areas of the world.
  - **Change in ecosystems** - Cold weather biomes such as the tundra will shrink, while deserts will continue to expand.

### **Greenhouse Effect ... Global Warming**

- Greenhouse gases are natural occurring gases which are found in very small amounts in our atmosphere (along with the oxygen and nitrogen which is the majority of gases out there)
  - Water vapour, Carbon dioxide, Methane

- Greenhouse gases trap the sun's heat and warm the earth
  - Without these gases the earth's heat would escape into space and the Earth would be too cold to support life
  - Our atmosphere has a natural balance of gases that help maintain the Earth's temperature in a certain range so that the Earth can support life!
- So, what's the problem then?
  - The problem today is that we are producing an increasing amount of GHG's, mainly by burning fossil fuels such as oil, natural gas and coal
    - Burning of fossil fuels accounts for 80%-85% of the carbon dioxide emissions
- The result ... more heat is retained around the earth and this is what we call global warming
  - This warming of the earth is responsible for climate change which not only includes temperature changes but extreme weather events such as coastal storms, hurricanes, tornadoes, draughts, heat waves etc.



### **What can impact global warming?**

1. **Natural Fluctuations**
  - The average temperature of the Earth has changed throughout history. Some of this is due to natural changes in temperature that occur over time due to a large number of variables.
  - Even slight changes in nutrient cycles

such as the carbon cycle, the oxygen cycle, and the water cycle have likely had an impact on the climate over time.

## 2. Greenhouse Gases

The reason the Earth isn't a ball of frozen ice is because of greenhouse gases. Greenhouse gases act like insulation to keep the Earth warm. However, as more and more greenhouse gases get into the atmosphere, the Earth grows warmer. The main greenhouse gases that keeps the Earth warm are water vapor, carbon dioxide, and methane.

- In the past 100 years, humans have been the cause of a significant increase in greenhouse gases in the atmosphere, especially carbon dioxide.
- Every time we drive our cars or use electricity, more carbon dioxide is released into the air.

## 3. Sun Activity

- All the energy and heat on Earth comes from the sun therefore the sun's activity will have an effect on the temperature of the Earth. The activity of the sun is actually different over time, which can change how much energy hits the Earth.

## 4. Volcanoes

- When volcanoes erupt they can change the temperature of the entire Earth for a short period of time.
- Their eruptions send large amounts of ash and particles into the atmosphere which blocks some of the sun's rays from hitting the Earth, causing the Earth to cool.
- At the same time, volcanic eruptions emit large amounts of carbon dioxide into the atmosphere.

### ***What can we do about it Global Warming?***

We can't do much about the Earth's natural fluctuations, volcanic eruptions, or the sun's activity, but we can impact the amount of greenhouse gases that are emitted into the air!

- Try to cut down on the amount of electricity you use.

- Reduce the amount of driving you (or your parents) do.
  - Don't idle cars! ... Turn the engine off!
  - Carpool to events
- Plant trees can help.
  - Plants and trees take in carbon dioxide!
- We should use clean renewable energy sources such as hydropower, solar energy and wind energy.
  - These sources produce much less pollution as well.

Since 1990, worldwide carbon dioxide emissions have risen by over 20 percent.

The United Nations formed a group called the International Panel on Climate Change to investigate global warming.

### **Clean Up Procedures:**

Make sure the lights are off (turn off by power bar) and unplugged from wall.

Let the clay models cool down before emptying the water.

Empty all water back into buckets.

If this is the first day of the festival, you can leave the activity set up.

If this is the last day of the festival:

- Take all laminated photos off of the poster board and place into bin.
- Put all materials back into the bin, including laminated posters
- If anything is still wet/damp, for example the clay models and dishes, leave open and do not put any lids on.
- Leave the light bulbs in the lamp shields and leave on the metal post.
- Unplug lights from power cord and roll up with extension cord and place into bin.