

# Ice Under Fire

A Live Science Demonstration about Polar Science & Global Warming  
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A twenty-minute demonstration for children and adults developed by Alice Altair Gift Enevoldsen

## Credits

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## Demonstration Description

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A twenty minute live science stage demonstration requiring one demonstrator.

The demonstrator will lead the audience through an exploration of how ice contributes to knowledge of global warming. The demonstration will use research from polar science to examine global warming, ending by empowering people to make changes in their life choices to combat global warming.

## Learning Objectives

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After watching this demonstration audience members will be able to:

- Describe one way in which ice is important in understanding global warming;
- Describe one difference between carbon dioxide and non-greenhouse gases;
- Increase in motivation to make life choices that contribute to solving global warming.

## Educational Standards Addressed

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### General National Science Education Standards (National Research Council 1996)

These are standards addressed, but not taught thoroughly in this demonstration.

Physical Science

- Properties and changes of properties in matter (5-8)
- Transfer of Energy (5-8)
- Interactions of energy and matter (9-12)

Science in Personal and Social Perspectives

- Changes in environments (K-4)
- Environmental quality (9-12)
- Natural and human-induced hazards (9-12)
- Science and technology in local, national, and global challenges (9-12)

## Outline of Demonstration

Activity	Key Concepts	Transition to next section
<b>Introduction</b>		
Introduce yourself & theme of demonstration.	Welcome!	
Set up earth model showing ocean rise.	Ice, water, and land are all part of the earth	You already know about ice.
<b>Ice: Polar scientists examine ice bubbles.</b>		
Make ice with liquid nitrogen.		This is too cold to touch, let's look at regular ice first.
Observe "regular" ice.	Ice has bubbles full of air.	Let's look at different ice.
Observe ice made with LN <sub>2</sub> .	The air in the bubbles is from the time the ice was frozen. Bubbles in ice are time capsules.	That ice was very white.
Demonstrate the concept of albedo/reflection.	White reflects better. Our poles reflect sunlight.	Bonnie, a polar scientist studies reflection.
Show a model ice core.	Ice can be really old.	Other polar scientists study what's inside the bubbles.
<b>Fire: Polar scientists examine the air trapped in ice bubbles.</b>		
Establish content of earth's atmosphere.	CO <sub>2</sub> exists.	
Extinguish a flame with CO <sub>2</sub> .	CO <sub>2</sub> behaves differently from O <sub>2</sub> .	Here's why scientists are interested in CO <sub>2</sub> .
Show models of molecules responding to heat.	CO <sub>2</sub> does the greenhouse gas jiggle – it traps heat.	If there's CO <sub>2</sub> in the atmosphere ...
Demonstrate CO <sub>2</sub> build-up with Sun-Earth feltboard.	Global warming is a positive feedback loop	What has happened to our earth model throughout the demonstration?
Torch ice in earth model of ocean-rise.	With global warming oceans rise.	Humans have made this problem. And humans can solve it. But a solution won't drop from the sky.
<b>Conclusion</b>		
Reveal solutions & demonstrate how each action improves the situation.	Using the tools of science and working together, we can solve this problem.	Thank you!
Thanks!	Music	

## Individual Activity Descriptions:

### Earth Model Showing Ocean Rise

#### Set up:

- Fill a large graduated cylinder with water and blue food coloring. Put graduated cylinder under a ring stand.
- Place funnel in the graduated cylinder
- Place the wire mesh cone in the ring.
- Position ocean/land image behind graduated cylinder.
- Place torch to the side.

#### DURING DEMONSTRATION:

- add three handfuls of ice in the mesh cone.
- Mark ocean level on graduated cylinder with bright tape.

**How to torch the ice:**

Place tape at the top of the "ocean water"  
Torch the ice by pointing the torch flame through the mesh.  
Move the torch around so no one area of the mesh becomes red hot.

**Safety:**

Do not point the torch at anything that hasn't been approved.  
Wear goggles.  
Follow torch instructions.  
Don't melt the laminated image with the torch.

**Make Ice with Liquid Nitrogen**

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**Set up:**

¼-dewar of LN<sub>2</sub>  
Large Styrofoam cooler  
Fill silicon ice-cube tray holes 2/3 full of water. Do not fill the last row of ice-cube holes to give yourself a handle for the tongs.  
Fill a shoe-box sized plastic container 1/3 full of room-temperature to lukewarm water  
Gather tongs, gloves, goggles, and LN<sub>2</sub>-temperature signs

**How to:**

Place the ice-cube tray in the bottom of the cooler.  
Using appropriate safety precautions pour enough LN<sub>2</sub> into the cooler to float the ice-cube tray.  
Pour the LN<sub>2</sub> towards one end of the cooler: attempt not to pour directly on the ice-cube tray, this causes the water to splash out of the holes.  
Using tongs, hold ice-cube tray down, but keep moving it around so it doesn't freeze to the bottom of the cooler in any spilled water.  
Using tongs, remove the tray from the cooler by pinching the unfilled end of the ice-cube tray.  
Place the ice-cube tray right-side-up in the Tupperware of water.

**Safety:**

Follow your institution's safety protocol for LN<sub>2</sub>.  
Realize that the ice is the same temperature as LN<sub>2</sub> to begin with, don't touch it until it is melting, or begins to melt immediately when you touch it.

**Clean up:**

Dispose of LN<sub>2</sub> left in cooler appropriately.

**Observe "Regular" Ice**

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**Set up:**

Have six cups set out.  
During the demonstration put 2-3 ice cubes from the café in each cup.

**How to:**

Call up six volunteers to the stage.  
Give each volunteer instructions to make sure everyone in the audience sees the ice.  
Ask for audience observations of ice.  
When done ask that all cups be placed at the end of the front row, or on the stage (pick one location).

**Safety:**

Plastic cups can break and make semi-sharp pieces.

**Observe Ice Made With Liquid Nitrogen**

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**Set up:**

Have six cups set out.  
When the LN<sub>2</sub>-ized ice is warm enough to melt, place one cube in each cup.

**How to:**

Call up six volunteers to the rope.  
Give each volunteer instructions to make sure everyone in the audience sees the ice.  
Ask for audience observations of ice.

When done ask that all cups be placed at the end of the front row, or on the stage (pick one location).

**Safety:**

Plastic cups can break and make semi-sharp pieces.

LN<sub>2</sub>-ized ice that doesn't melt in your hand is **TOO COLD and can cold-burn visitors.**

**Demonstrate Albedo/Reflection**

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**Set up:**

Sheet of paper or a sign that is half black & half white.  
working flashlight

**How to:**

Hold up black/white sintra.  
Point the flashlight at the middle so it shines on both colors.

**Safety:**

I recommend against shining the light directly into your eye for an extended period of time.

**Clean up:**

If storing for more than two weeks remove the batteries from the flashlight.

**Ice Core**

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**Set up:**

Have the ice core.

**How to:**

Hold up the ice core.

**Safety:**

Don't whack people with the ice core.

**Existence of Carbon Dioxide – Extinguishing Flame**

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**Set up:**

Put 2 tablespoons of baking soda in a large flask.  
Prepare a small graduated cylinder with 60 mL of vinegar and one drop of red food coloring (let sit, it will mix itself).  
Put votive candles in a beaker with a wide mouth (about 10 cm).  
Set out a box of matches.  
Set out combustion tongs.  
Have goggles.

**How to:**

Light the two candles (use tongs and a match)  
Pour the red vinegar into the baking soda flask.  
Wait for the reaction to calm down.  
Pour the resulting carbon dioxide (gas in the flask) into the beaker, slowly and carefully. Do not pour the liquid. The candles will go out.  
Attempt to relight the candles: your match will gutter before reaching the candles.

**Safety:**

Exercise appropriate caution with matches and candles.  
Don't drop glassware.

**Molecule Models**

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**Set up:**

Large models of O<sub>2</sub> and CO<sub>2</sub> molecules  
Have the Sun and Earth feltboard up already.

**How to:**

Demonstrate energy transfer and jiggling according to script using props and your body.

**Safety:**

Don't throw the molecules at the audience.

## Sun-Earth Feltboard – CO<sub>2</sub> Impact

### Set up:

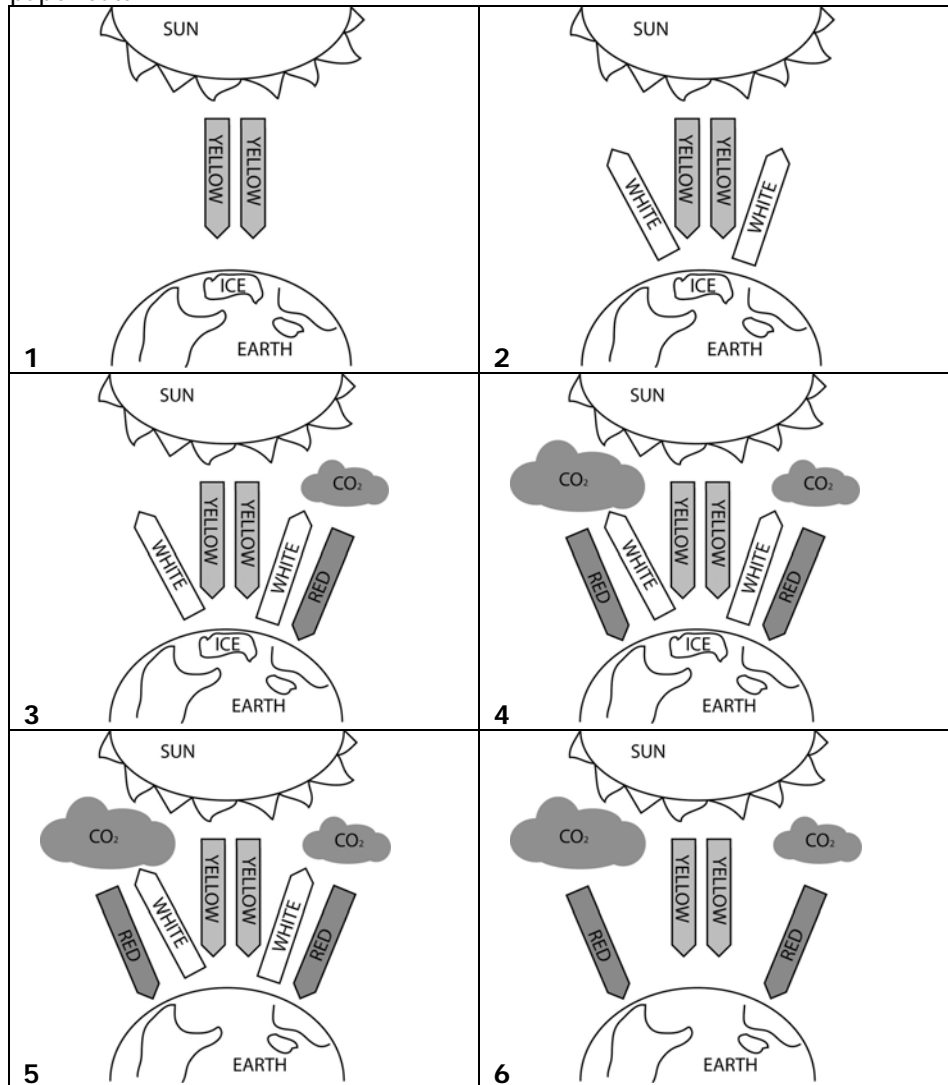
Have these signs available: Earth, ice cap, sun, two sun arrows, two ice-reflection arrows, two CO<sub>2</sub>s, and two CO<sub>2</sub> absorption arrows.

### How to:

Follow the script and diagram for the order of placing the signs on the board.

### Safety:

Watch for paper cuts



### Works Consulted

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