

LESSON 3 Climate Of Our Past

Lesson at a Glance

Students examine the role of greenhouse gases in our atmosphere. Students then look at ways scientists determine what climate was like millions of years ago and if there were historical changes in climate. Students conduct library and online searches to learn about ice cores, tree rings, coral reef cores, and glaciers, then develop a class presentation.

Lesson Duration

Two 45-minute periods

Essential Question(s)

What evidence is there of historical changes in Hawaii’s climate?

How is the atmosphere affected by an abundance of greenhouse gases?

Key Concepts

- Energy from the sun is reflected, refracted, and absorbed in our atmosphere.
- There is evidence of climate differences in several forms, including tree ring data, the advance and retreat of glaciers, shoreline changes and ice cores showing CO₂ changes over time.
- By comparing past climate data with present monitoring of greenhouse gases like carbon dioxide, scientists are able to see that humans are contributing to the increase in carbon dioxide in the atmosphere.

Instructional Objectives

- I can show what happens to solar radiation in the atmosphere as it interacts with greenhouse gases.
- I can identify evidence of historical changes in climate.
- I can present the information I research to my peers.

Related HCPSIII Benchmark(s):

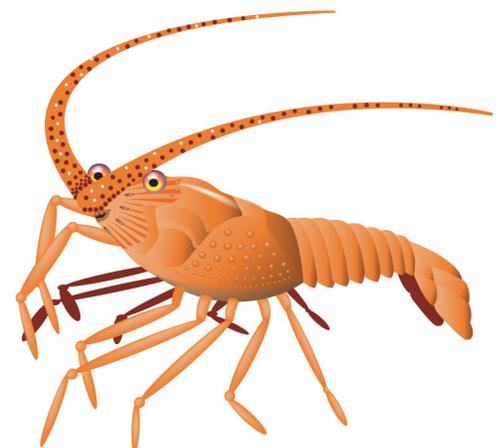
Science SC 5.6.3
Compare what happens to light when it is reflected, refracted, and absorbed.

Language Arts LA 5.1.2
Use a variety of grade–appropriate print and online resources to research a topic.

Language Arts LA 5.4.1
Write in a variety of grade–appropriate formats for a variety of purposes and audiences, such as note summarizing what they have read or heard.

Language Arts LA 5.6.1
Use speaking and listening skills to fill a prescribed role in group activities.

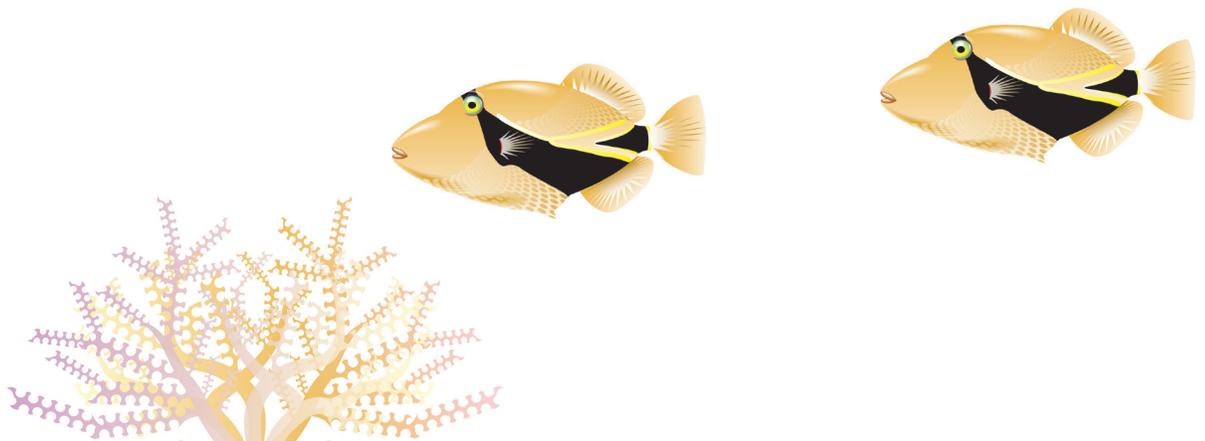
Language Arts LA 5.6.2
Give informal presentations or reports to inform



Assessment Tools

Benchmark Rubric:

Topic		Waves	
Benchmark SC.5.6.3		Compare what happens to light when it is reflected, refracted, and absorbed	
Rubric			
Advanced	Proficient	Partially Proficient	Novice
Compare and give examples of the ways light can be reflected, refracted, and absorbed	Compare what happens to light when it is reflected, refracted, and absorbed	Describe that light is reflected, refracted, and absorbed	Provide examples of the reflection, refraction, or absorption of light
Topic		Locating Sources/ Gathering Information	
Benchmark LA.5.1.2		Use a variety of grade-appropriate print and online resources to research a topic	
Rubric			
Advanced	Proficient	Partially Proficient	Novice
Use substantive information from an extensive variety of grade-appropriate print and online resources to thoroughly research a topic	Use relevant information from a variety of grade-appropriate print and online resources to research a topic	Use some relevant information from a few grade-appropriate print and online resources to research a topic	Use very little relevant information from grade-appropriate print and online resources to research a topic
Topic		Range of Writing	
Benchmark LA.5.4.1		Write in a variety of grade-appropriate formats for a variety of purposes and audiences.	
Rubric			
Advanced	Proficient	Partially Proficient	Novice
Insightfully adapt writing to grade-appropriate formats for a variety of purposes and audiences	Adapt writing to grade-appropriate formats for a variety of purposes and audiences	Write with some adaptation to grade-appropriate formats for a variety of purposes and audiences	Write with little adaptation to grade-appropriate formats for a variety of purposes and audiences



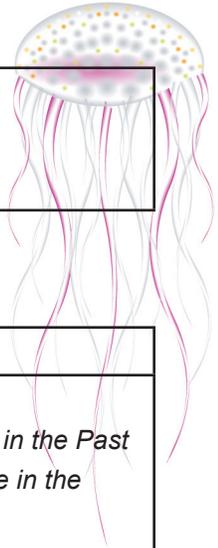
Topic		Discussion and Presentation	
Benchmark LA.5.6.1		Use speaking and listening skills to fill a prescribed role in group activities	
Rubric			
Advanced	Proficient	Partially Proficient	Novice
Use speaking and listening skills to fill a prescribed role in group activities, in a highly effective way	Use speaking and listening skills to fill a prescribed role in group activities	Use some speaking and listening skills that assist in filling a prescribed role in group activities, in a limited way	Use irrelevant speaking and listening skills that do not relate to a prescribed role in group activities

Topic		Discussion and Presentation	
Benchmark LA.5.6.2		Give informal presentations or reports to inform	
Rubric			
Advanced	Proficient	Partially Proficient	Novice
Give highly effective informal presentations or reports that clearly inform	Give effective informal presentations or reports to inform	Give marginal informal presentations or reports that somewhat inform	Give ineffective informal presentations or reports that do not inform

Assessment/Evidence Pieces

Lesson

- Student Worksheet: *Greenhouse Gases*
- Student Worksheet: *Evidence of Climate in the Past*



Materials Needed

Teacher	Class	Group	Student
<ul style="list-style-type: none"> • Method to project PowerPoint 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • Student Worksheet: <i>Greenhouse Gases</i> • Student Worksheet: <i>Evidence of Climate in the Past</i> • Student Worksheets: <i>Evidence of Climate in the Past Task Cards</i>



Instructional Resources

PowerPoint Presentation: *Our Atmosphere – the Greenhouse Effect*

PowerPoint Presentation: *Recording Earth's Climate*

Teacher Reading: *Evidence of Climate in the Past*

Student Worksheet: *Greenhouse Gases*

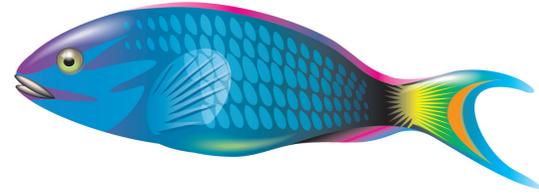
Teacher Answer Key: *Greenhouse Gases*

Student Worksheet: *Evidence of Climate in the Past*

Student Worksheets: *Evidence of Climate in the Past Task Cards (#1-4)*

Video: *The Greenhouse Effect*

Video: *Sea Level Rise*



Student Vocabulary Words

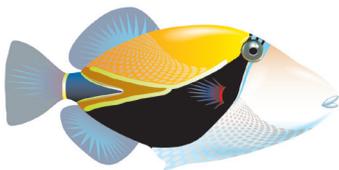
climate: the long-term average of conditions in the atmosphere (weather), ocean, ice sheets on land and sea ice.

climate model: computer-based programs that use data compiled from weather instruments and others over many years to project climate patterns into the future; predictions are based on varying certain parameters of the data.

climatology: the study of the climate and climatic processes.

ice ages: periods in the Earth's history when temperatures were significantly reduced, resulting in the expansion of ice sheets and glaciers on the Earth's surface.

interglacial (period): periods in between glacial periods when the glaciers and ice sheets covering the Earth receded due to warmer temperatures.



Lesson Plan

Lesson Preparation

- Review the Science Background provided in the Unit Overview and the Teacher Reading *Evidence of Climate in the Past*.
- Review the Teacher Answer Key: *Greenhouse Gases*.
- Preview the PowerPoint presentations *Our Atmosphere – the Greenhouse Effect and Recording Earth’s Climate*, and make arrangements to project them.
- Review and make copies of Student Worksheets *Greenhouse Gases*, *Evidence of Climate in the Past* and *Evidence of Climate in the Past Task Cards*, one per student.

I. *Greenhouse Gases and Climate Change*

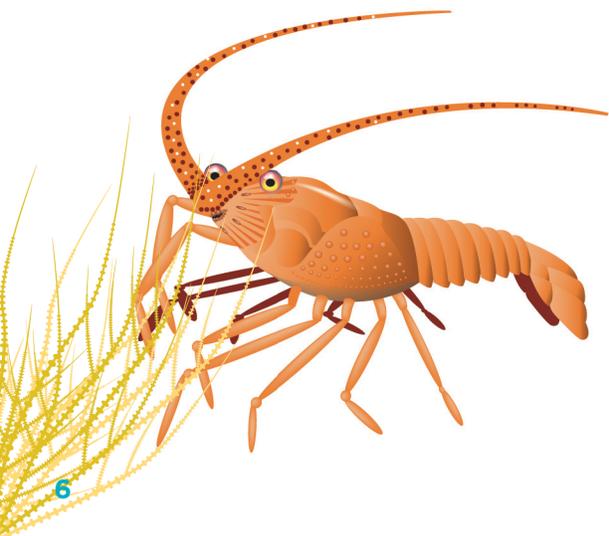
- A. Review the definition of climate and any related concept from the Word Wall.
- B. Write a K-W-L for “Greenhouse Gases” on the board and ask students what they know about greenhouse gases. Fill in the K and W columns.
- C. Introduce the lesson by telling students that scientists study lots of different phenomena to try to understand climate. NOAA scientists at Mauna Loa on the Big Island have been measuring the amount of carbon dioxide (CO₂) in the atmosphere for over 50 years.
- D. Open PowerPoint: *Our Atmosphere – the Greenhouse Effect* and do the step-by-step lesson with students. Make sure that students understand that greenhouse gases occur naturally in the atmosphere and that we, as humans, are contributing to the increase in the greenhouse gas carbon dioxide. The PowerPoint will discuss these points further as well as the effects on the Earth.
- E. Bring students back to the K-W-L chart for “Greenhouse Gases” and ask students what they have learned. Compare to the K and W.
- F. Pass out *Greenhouse Gases* worksheet to students as reinforcement or a quiz.

II. Introduce the Recording Earth's Climate

- A. Introduce the lesson by showing the PowerPoint *Recording Earth's Climate*.
- B. Cover the notes on the slides to lead class discussion.

III. Examine the Evidence of Climate in the Past

- A. Tell students that scientists have found evidence to show that global climate has undergone changes in the past. Explain that, in this lesson, they will work in *expert* groups to learn about one type of evidence, then describe and explain their evidence to the rest of the class (You may need to give students some ideas for their demonstrations. For example, they could model a glacier moving over the landscape with their bodies, or demonstrate how sediments are laid down over time, by shaking a sealed glass of water and sediment.).
- B. Divide students into *expert* groups of approximately three students. Distribute a task card to each group, and Student Worksheets *Evidence of Past Climate Change* and *Evidence of Past Climate Change Task Cards*, to each student. Give students time to work out how they want to present their piece of evidence. Students may also conduct library and internet research to enhance the information on their topic.
- C. Review the Student Worksheet, *Evidence of Past Climate Change*, with students. Ask them to record the key points for each piece of evidence when the other groups present their research.
- D. Have students present their piece of evidence of past climate change. Answers to all questions on the group worksheet must be shared with the rest of the class in some way.



LESSON 3 - Teacher Reading

Evidence of Climate in the Past

The study of past climate is called **paleoclimatology**.

Paleoclimatologists have found evidence of past climate in tree rings, coral reefs, ice cores, and buried sediments.

Tree rings are affected by the weather. Trees produce one ring a year in most circumstances. However, in times of drought, they may not produce a ring. Additionally, the density and composition of the ring tells us about the conditions of the atmosphere at the time the ring was formed.

Coral reefs are built from calcium carbonate, which can be measured for isotopes of oxygen and trace metals that tell us about the temperature of water at the time the coral grew.

Ice cores can be collected from glaciers and other solid masses of ice. Ice cores contain trapped bubbles of ancient air. These ancient air samples can tell us about the ancient atmosphere on Earth.

Glacial scars are left by glaciers scouring the rocks underneath them. When a glacier moves, melted water underneath the glacier serves as lubrication to help the massive glacier slide over the rocks below. Often, rocks caught in the glacier press against the rocks underneath and leave glacier scars.

On the islands of Hawai‘i, evidence of climate change exists in wave ledges, which record the height of the tides and reflect the undercutting of the water into rock, and in marine fossils found on land.

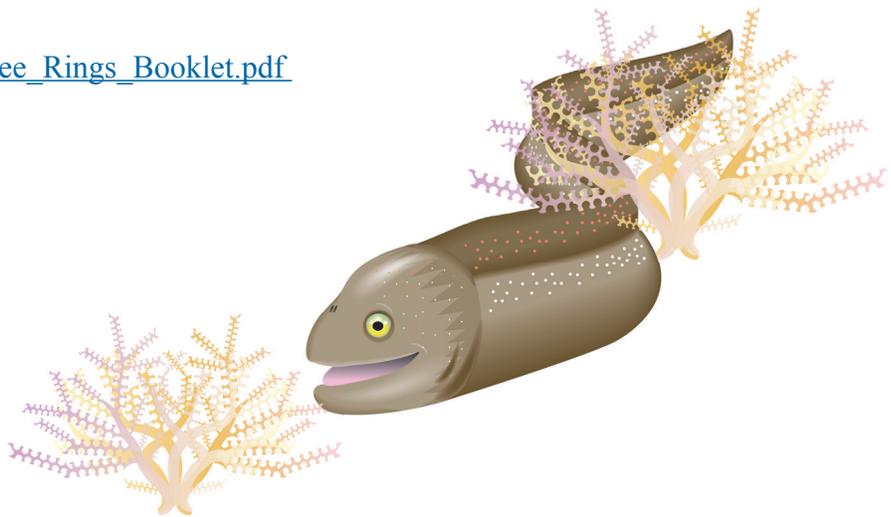
Also preview the following websites:

EPA Climate Change – Kids Site, available at
<http://epa.gov/climatechange/kids/climateweather.html>

Tropical Weather, part of the National Weather Service’s Topic Matrix found at
www.srh.weather.gov/jetstream/matrix.htm

To share their evidence of past climate changes in Hawai‘i, students could role play, make a poster, or create a multimedia presentation.

NOAA NCDC tree ring booklet -
http://www.ncdc.noaa.gov/img/edu/Tree_Rings_Booklet.pdf



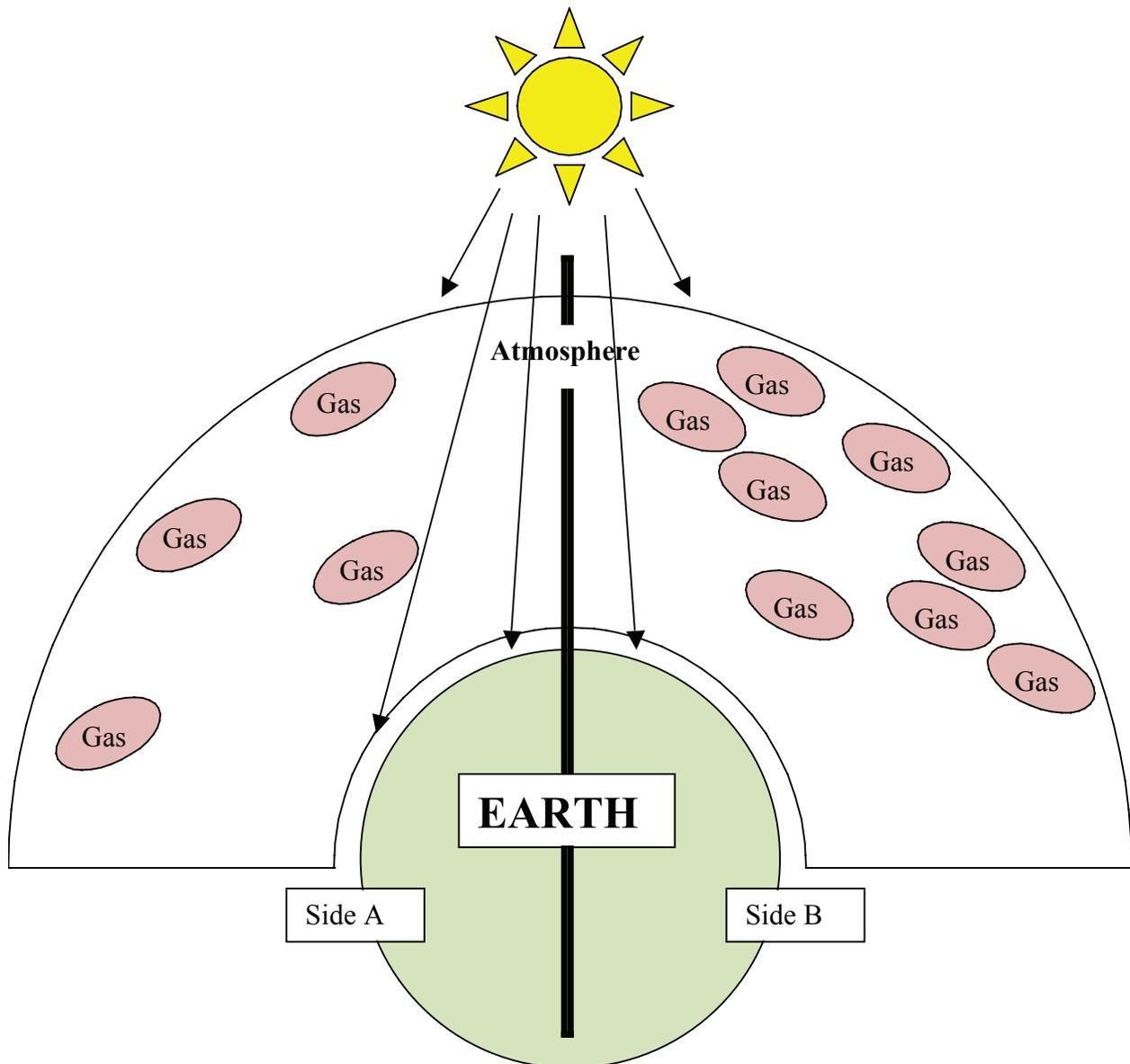
LESSON 3

Name: _____

Date: _____

Greenhouse Gases

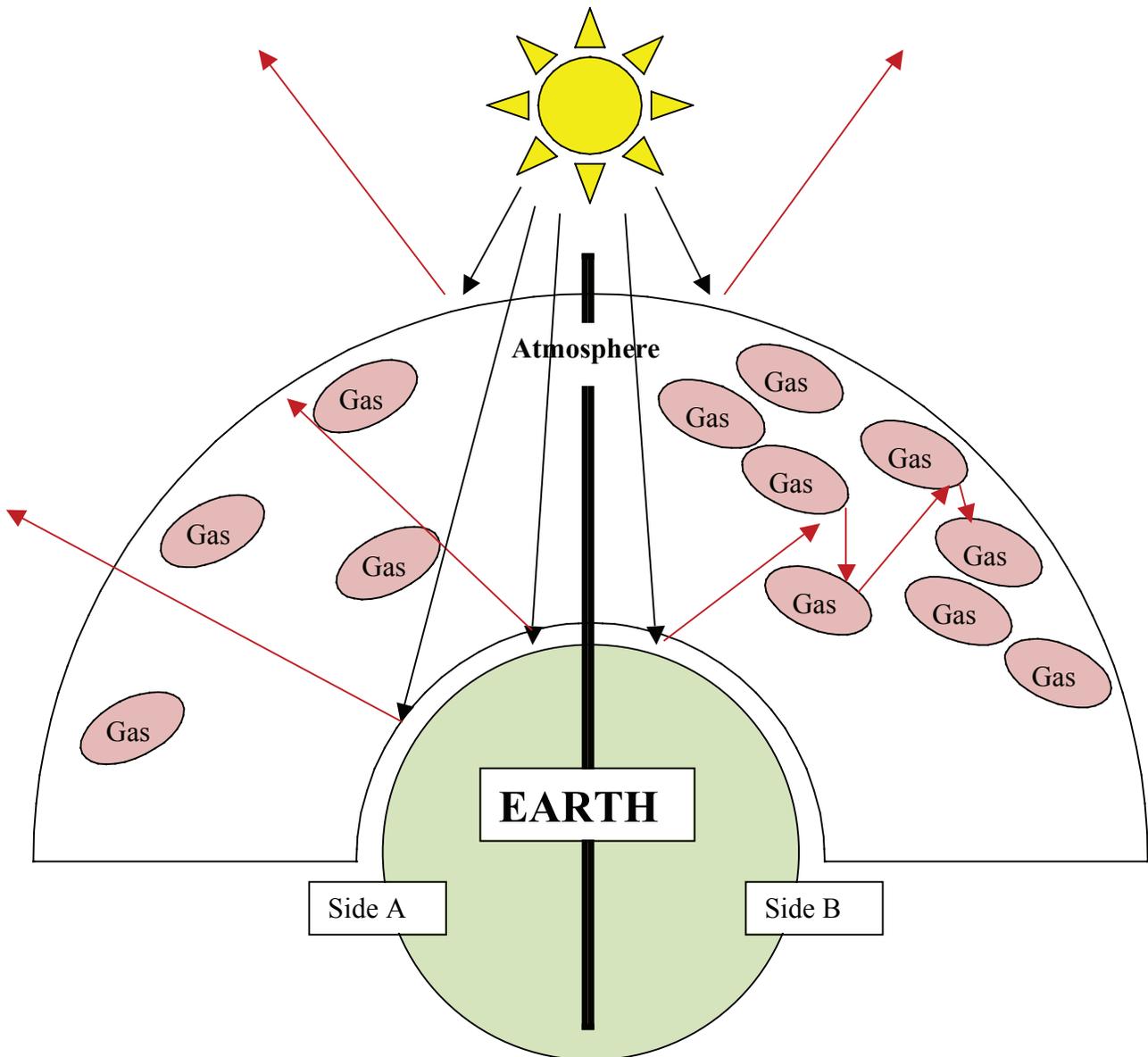
Solar radiation is light we can't see. It comes from the sun, hits the Earth and is reflected back up into our atmosphere. Our atmosphere has greenhouse gases – carbon dioxide, nitrogen, and oxygen just to name a few. Side A has less Greenhouse gases in the atmosphere than side B. How will this change the light coming from the sun? Draw lines from the sun showing sun light reflected, refracted and absorbed. Show that a greater amount of greenhouse gas in the atmosphere has an effect on how much solar radiation is refracted and absorbed. We drew the first lines for you.



LESSON 3 - Teacher Answer Key

Greenhouse Gases

Solar radiation is light we can't see. It comes from the sun, hits the Earth and is reflected back up into our atmosphere. Our atmosphere has greenhouse gases – carbon dioxide, nitrogen, and oxygen just to name a few. Side A has less Greenhouse gases in the atmosphere than side B. How will this change the light coming from the sun? Draw lines from the sun showing sun light reflected, refracted and absorbed. Show that a greater amount of greenhouse gas in the atmosphere has an effect on how much solar radiation is refracted and absorbed. We drew the first lines for you.



LESSON 3

Name: _____ Date: _____

Evidence of Climate in the Past

Directions

Record what you learned about past climate changes from each of the presentations.

Tree Rings	
Coral Reefs	
Ice Cores	
Glacier Retreat	

LESSON 3

Evidence of Climate in the Past Task Cards

Task Card for Expert Group 1:

Tree Rings

Background Information:

As trees grow, they develop growth rings.

Trees produce one ring a year in most circumstances.

In times of drought, they may not produce a ring.

The thickness, density, and composition of the ring provide information about the weather at the time the ring was formed.

Trees grow to be hundreds, some thousands of years old.

By examining the tree ring patterns of old trees, we obtain information about climate conditions.

Online Information and Images:

Climate Detectives: See section on tree rings at epa.gov/climatechange/kids/detectives.html

Front: (Picture of giant Sequoia tree)
www.ncdc.noaa.gov/paleo/slides/slideset/18/18_354_slide.html

National Climatic Data Center: tree rings, available at www.ncdc.noaa.gov/paleo/treering.html

Tree Ring Website:
<http://web.utk.edu/~grissino/>

- 1. Where in the world would scientists look for this evidence?**
- 2. Why does this piece of evidence show climate change?**
- 3. What do scientists look for within this piece of evidence to show whether climate change has happened or not?**

LESSON 3

Evidence of Climate in the Past Task Cards

Task Card for Expert Group 2:

Coral Growth Rings

Background Information:

Corals have calcium carbonate skeletons.

Some corals produce growth rings.

Coral grows slower when seawater temperature cools, and faster when seawater is warm. However, if seawater gets too warm, coral growth suffers, and the coral may die.

The chemical composition of coral skeletons varies somewhat when the seawater temperature changes. These slight differences in the coral skeleton chemistry provide additional information about changes in seawater temperature.

Evidence from coral growth rings, and differences in the chemical makeup of coral skeletons, provide information about seawater temperature and climate change.

Online Information and Images:

NASA: Coral reefs and climate

http://earthobservatory.nasa.gov/Study/Paleoclimatology_CloseUp/paleoclimatology_closeup_2.html

Bamboo Corals (a type of deep ocean coral)

www.niwasience.co.nz/pubs/wa/ma/12-4/coral

Indian Ocean Corals: Evidence for Climate Change

<http://archives.cnn.com/2000/NATURE/02/07/coral.climate.enn/index.html>

Photos of Researchers looking for Coral Reef rings

<http://www.ncdc.noaa.gov/paleo/slides/slideset/13/index.html>

- 1. Where in the world would scientists look for this evidence?**
- 2. Why does this piece of evidence show climate change?**
- 3. What do scientists look for within this piece of evidence to show whether climate change has happened or not?**

LESSON 3

Evidence of Climate in the Past Task Cards

Task Card for Expert Group 3:

Ice Cores

Background Information:

Glaciers form slowly, layer by layer, with the oldest layer at the bottom.

By drilling into a glacier, scientists obtain a sample of the layers, called an ice core.

Ice cores contain bubbles that have trapped ancient air.

These samples of ancient air can tell us about the past climate on Earth.

Ice cores may also contain trapped sediments or frozen biological specimens.

Online Information and Images:

BBC News: Ice Cores Unlock Climate Secrets

<http://news.bbc.co.uk/2/hi/science/nature/3792209.stm>

National Geographic: New Ice Core Reveals 800,000 Years of Climate History

<http://news.nationalgeographic.com/news/2007/07/070705-antarctica-ice.html>

Let's Get to the Core

http://www.keystonecurriculum.org/html/let_s_get_to_the_core_.html

Climate Detectives (See section on ice cores.):

<http://epa.gov/climatechange/kids/detectives.html>

Photos of Ice Core Researchers at work

<http://www.ncdc.noaa.gov/paleo/slides/slideset/15/index.html>

- 1. Where in the world would scientists look for this evidence?**
- 2. Why does this piece of evidence show climate change?**
- 3. What do scientists look for within this piece of evidence to show whether climate change has happened or not?**

LESSON 3

Evidence of Climate in the Past Task Cards

Task Card for Expert Group 4:

Glaciers

Background Information:

Glaciers grow bigger in colder times because it is cold enough for snow and ice to freeze in the glacier. Glaciers melt and get smaller in warmer periods; this is called glacier retreat. This tells us about the temperature.

Glaciers leave scars on the rocks underneath. Glaciers move, not just when growing or melting. These scars help tell the direction in which the glaciers move.

Online Information and Images:

Greenland Changes 1992-2002

www.arctic.noaa.gov/detect/detection-images/ice-seaice-greenland-ice-sheet.gif

Great Lakes formed from melting ice cap from NOAA

http://www.glerl.noaa.gov/pr/pr_images/glacier.jpg

Glacier movement http://www.nichols.edu/departments/glacier/glacier_retreat.htm

http://nsidc.org/data/glacier_photo/special_high_res.html

Glacier carved photos

<http://www.carbonfootprint.com/evidence.html>

- 1. Where in the world would scientists look for this evidence?**
- 2. Why does this piece of evidence show climate change?**
- 3. What do scientists look for within this piece of evidence to show whether climate change has happened or not?**