

The Day After Tomorrow: Scene 1

“I can’t believe you found my note,” said Margarite. “I thought it was lost forever.”

“I can’t believe I found it either,” said Marc. “The twister carried it all the way to my uncle’s fence, ten kilometers away.”

SILENCE

“I’m glad my uncle gave it to me,” Marc said sheepishly as he looked down at his shoes. His face turned red.

“Thanks for asking me to the movies,” Margarite said quickly, in a feeble attempt to cover up the awkward silence. “I hear the special effects in this movie are awesome.”

“Yeah, my brother says this stuff is really going to happen. I can imagine the newspaper headline “SOLAR RADIATION, GLOBAL WARMING, AND SUDDEN CLIMATE CHANGE KILL MILLIONS.”

“Do you really think they would be able to print the newspaper if that happened?” Margarite asked.

“Ssssssssh,” a voice hissed from behind. “Can you two be quiet? The movie is about to begin.”

The Day After Tomorrow: Scene 2

The movie begins showing ice floating in the sea. Next, we see three scientists drilling ice core samples on the Larsen B ice shelf in Antarctica. As one of the scientists is drilling, the ice shelf begins to crack and breaks apart. After returning safely back from the ordeal, Jack Hall, one of the scientists, addresses the United Nations about the possible causes of the ice shelf cracking and the possible consequences. He reports that right now, heat from the sun is carried from the equator to the North Pole by the North Atlantic Current. Melting ice caps will change that current and could trigger another ice age. Dr. Hall reports that we need to reduce the burning of fossil fuels and production of greenhouse gases to prevent further warming of the earth but the Vice President of the United States responds that such actions would be too costly to the world's economies.

Transcript from the movie "The Day After Tomorrow" *Scene: U.N Conference on Global Warming, New Delhi, India*

Dr. Jack Hall: What we have found locked in these ice cores is evidence of a cataclysmic climate shift that occurred around 10,000 years ago. The concentration of these natural greenhouse gases in the ice cores indicate that runaway warming pushed this planet into an ice age that lasted for two centuries.

Country Representative: I'm confused. I thought you were talking about global warming not an ice age?

Dr. Hall: Yes, it is a paradox. But global warming can trigger a cooling trend. Let me explain. The Northern Hemisphere owes its temperate climate to the North Atlantic Current. Heat from the sun arrives at the equator and is carried north by the ocean. But global warming is melting the ice caps and disrupting this flow. Eventually it will shut down and when that occurs, well, there goes our warm climate.

Country Representative: Excuse me, when do you think this could happen, professor?

Dr. Hall: I don't know, maybe 100 years, maybe 1000. But what I do know is that our children and our children's children will have to pay the price.

Vice President of the United States: And who is going to pay the cost of the Kyoto Accords? It would cost the world's economies hundreds of billions of dollars.

Dr. Hall: With all due respect, Mr. Vice President, the cost of not doing anything could be even higher. The climate is fragile. At the rate that we are burning fossil fuels and polluting the environment, the ice caps will soon disappear.

Vice President of the United States: Professor Hall, our economy is every bit as fragile. Maybe you should keep that in mind before you start making sensationalist claims.

Dr. Hall: Well, the last chunk of ice that fell off was about the size of the state of Rhode Island. I think some people might call that pretty sensational.

Name: _____
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When Land Ice Melts

Objective

The objective of this activity is to demonstrate what could happen to sea levels when land ice melts (for example, from a glacier).

Time

The ice will take the entire day to melt. Each class will record the changes that they observe during their class period and all of the observation over the entire day will be used in the lab writeup.

Materials

- An aquarium with a ruler taped to the sides for measuring water levels
- Bricks or a large piece of wood (that does not float but is large enough to have a surface above water)
- Water
- Blocks of ice
- Lamp (sun lamps or heat lamps work best)

Procedure

1. Fill the aquarium half full with water and place the bricks / wood in the water.
2. Put a large block of ice on the bricks / wood.
3. Position the lamp so that it is about 1 foot away from the top of the ice. Turn it on and watch and note the level of water in the container. Every 20 minutes, measure how much the water level rises in millimeters.

Hypothesis

1. I think that the water level will _____ when
the ice melts because _____
_____.

DATA (continue collecting data until your ice totally melts, even if it takes longer than 300 seconds)

Time (in seconds)

	Beginning of class	25 minutes	End of class
Water Level (mm)			

Illustrations

Draw a picture of your land, land ice and the water level at the beginning of your class period.



Draw a picture of your land, land ice, and the water level at the end of your class period.



1. What happens to the water level in the container?
2. What happens to the north and south edges of the block of wood as the ice melts?
3. Do you think melting ice and other land-based ice masses will make sea level rise? Why or why not?
4. Will the melting ice completely cover the continents on which the ice used to be with water? Explain.

Name: _____
Date: _____
Period: _____

When Floating Ice Melts in the Sea

Objective

The objective is to investigate the effect on sea level due to the melting of floating ice due to global warming.

Materials

Each student or group of students will need the following:

- Aquarium with ruler taped to the side
- Water
- Blocks of ice

Procedure

1. Fill the aquarium with water.
2. Place the block of ice in the container.
3. Mark the water level at the beginning of the experiment.
4. Watch the water level as the ice melts. Every 10 minutes, measure how much the water level rises in millimeters.

Hypothesis

1. I think that the water level will _____ when the ice melts because

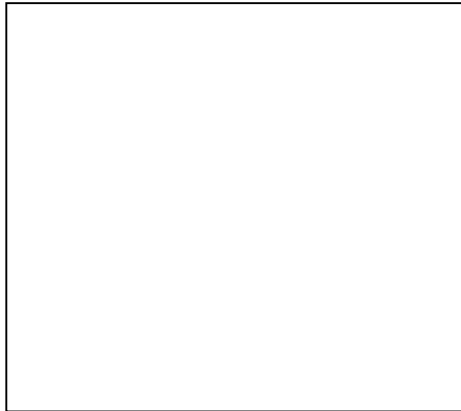
Data (Continue collecting data until your ice totally melts)

Time (in seconds)

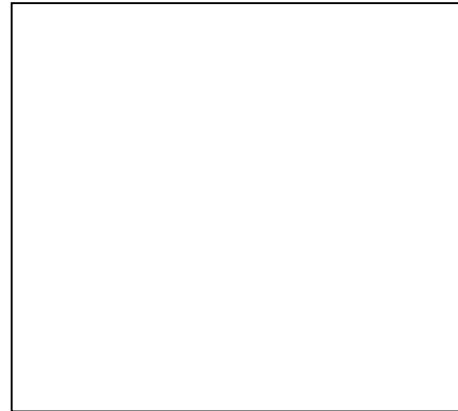
	0 s	10 minutes	20 minutes	30 minutes	40 minutes
Water Level (mm)	Zero mm				

Illustrations

Draw a picture of your “iceberg” and the water level at the beginning of the experiment



Draw a picture of your “iceberg” and the water level **after the iceberg has melted a lot.**



1. Does the water level rise when the ice melts? _____
2. Do you think that melting icebergs will make the sea level rise? _____
3. Explain your answer in question (2)?

Name: _____ Period: _____ Date: _____

THE LARSEN B ICE SHELF AND MELTING ICE CAPS
Learning Issue Research Guide

The Larsen B Ice Shelf

Click on the link “New Scientist: Giant Antarctic Ice Sheet Breaks Off”. Use the information provided in the article to research the following issues.

1. What is the Larsen B ice shelf, where is it located, and what happened to it?

2. What do scientists say may have caused the Larsen B ice shelf to break off?

3. Did the level of the sea rise when the Larsen B ice shelf melted? Why or Why not?

4. Scientists are now concerned about the Ross and Ronne Ice Shelves in West Antarctica. Why?

Melting Ice Caps:

Click on the link titled “Global Warming, So What’s the Big Deal? (EPA)” to research the following research issue:

5. How can global warming lead to higher sea levels (hint: there are two ways)?

Name: _____ Period: _____ Date: _____

6. How much are sea levels expected to rise over the next 100 years and why is this a big deal?

To research the following issues you will need information from your Physical Science textbook.

7. (Page 254; Convection) Which is more dense, the warmer water of the ocean or the cold water from the melting ice cap? _____

What happens when the warm water from the ocean meets the cold water from the melting ice cap? What does this create? _____

8. (pages 68-69) What is happening to the particles in the ice sheet as the ice melts? Is this a chemical or a physical change? Is energy absorbed or removed? _____

9. (pages 92-97) What type of mixture is the salt water in the ocean (alloy, solution, suspension, or colloid)? _____

Is dissolving salt into water a physical change or a chemical change? _____ Is the melting of fresh ice water into the salt water a physical or a chemical change? _____

*** Think about it, Bonus Questions***

As an ice shelf breaks, apart what force pulls the ice towards the ocean? _____

What force keeps the ice shelf from moving? _____

Name: _____ Period: _____ Date: _____

GREENHOUSE GASES AND THE GREENHOUSE EFFECT
Learning Issue Research Guide

Click on the link “Greenhouse Effect – EPA”. Use the information at this link and on page 255 in your physical science text to research the following issues

1. What are the greenhouse gases? _____

Are they elements or compounds? _____

2. What do greenhouse gases do? _____

3. What is the greenhouse effect? Is it a good thing or a bad thing (or both)? Explain your answer. _____

4. Watch the animation at the end of the website. Can you draw a diagram of how the greenhouse effect works – be sure to label solar radiation, infrared radiation, and greenhouse gases?

Take the quiz at the end of the animation. Give the correct answer for each of the following questions from the quiz

5. What is the most common greenhouse gas produced by human activities?

6. Greenhouse gases in the atmosphere are always bad for human health -- True or False

Name: _____

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7. What are three ways humans contribute to the production of greenhouse gases?

8. How do you think the greenhouse effect is related to global warming?

Use your physical science text to research these issues related to the greenhouse effect (pgs 232-236)

9. Scientists argue that burning fossil fuels produces greenhouse gases. What are the three main fossil fuels and what are they used for? _____

Are fossil fuels renewable or non-renewable resources? _____

10. What are three examples of renewable energy resources? _____

(pgs. 92-97)

11. What type of mixture is greenhouse gases in air (alloy, suspension, colloid, solution)?

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FOSSIL FUELS
Learning Issue Research Guide

Click on the link “Ask Jeeves for kids – Fossil Fuels” and use the information provided to research your learning issue.

1. What are the three main fossil fuels? _____
2. Fossil fuels are based on what element in the periodic table? _____
3. How old are the fossil fuels that we use today? _____
4. What are the main elements of coal? _____

5. Where can you find oil and natural gas? _____

6. What is natural gas (what is it made of)? _____

7. Is natural gas more or less dense than air? _____
8. Are fossil fuels renewable or nonrenewable natural resources? _____

Click on the link “Taranki Fossil Fuels” to research the following issues

9. How are fossil fuels related to global warming? _____

Name: _____ Period: _____ Date: _____

10. The article said that the Carbon dioxide contributes to greenhouse gases. What are greenhouse gases and what are some examples of greenhouse gases (hint – see pages 255 in your textbook)?

11. List 8 activities that use fossil fuels. _____

12. Is burning fossil fuels a chemical or physical change? Explain your answer.

Use your textbook (pages 232-237) to research the following issues

13. Which of the three fossil fuels produces the most pollution? _____

14. How does burning fossil fuels create electricity? Along this process, how, when, and what type of energy conversions occur? You can diagram the process if that helps.

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ICE AGES
Learning Issue Research Guide

Click on the link "The Big Chill (NOVA)". Use the information provided to help you research the following areas. Another website

1. What are ice ages? _____

2. What is the normal amount of time that passes between each ice age and how long do they usually last? _____

3. What are some of the hypothesized causes of ice age cycles? _____

4. Are we in a warming period or a cooling period right now? _____

5. How is carbon dioxide related to the warming and cooling of the climate? _____

Name: _____ Period: _____ Date: _____

6. Explain the greenhouse effect and how it regulates the temperature of the earth.

*Use pages 348-349 in the book entitled *The Handy Weather Answer Book* to answer the following questions (there are also copies of these pages in the classroom binder if someone else is using the book.)*

7. When did the last ice age end? _____

8. What were the average global temperatures during this last ice age? _____

9. Some argue that global warming will cause ice caps to melt. How much would sea levels rise if both the Greenland Ice Cap and the Antarctic ice cap were to melt?

Name: _____

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KYOTO ACCORDS
Learning Issue Research Guide

Use the information provided in the links, “Kyoto Treaty (BBC)” and “Warming Treaty (USA Today)” to research the following issues.

1. What are the Kyoto Accords (Kyoto Treat)? _____

2. What are the purposes of the Kyoto Accords? _____

3. What needs to happen before the Accords can be enacted? _____

4. What do supporters of the treaty hope that the Accords will do? _____

5. *Click on the link “The fact and the fiction and the science in The Day After Tomorrow”. At the bottom of the page are several points about the Kyoto Accords. Summarize what you find in these key points.*

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NORTH ATLANTIC CURRENT
Research Learning Guide

Click on the link “Deep Sea Current Faltering in Atlantic” and use the information there to research the following issues. The information in “The Science, and Fiction, and Fact in The Day After Tomorrow” (on the Atlantic thermohaline circulation) could also be very helpful.

1. What is the North Atlantic Current and what does it do for the climate?

2. How can the melting of Arctic and Antarctic ice alter this current?

3. What has happened to the current in the past 50 years? _____

Why is this a problem? _____

Name: _____ Period: _____ Date: _____

4. The article refers to North Atlantic current many times as a “conveyor belt” and a “circular convection”. Use your physical science textbook (p.254) and describe convection. Why is the N.A.C considered circular (hint: it may help to look at the “oceans threaten our climate” website)?

Click on the link “Ocean Forces Threaten Our Climate” and use the information provided there to research the following issues.

5. Briefly describe how the North Atlantic current works (hint – use the current diagram).

Use your textbook (pgs. 86-97) to answer the following questions

6. Is ocean water a compound, a solution, an alloy, or a colloid? _____

7. Is the salt in ocean water a compound, a solution, an alloy, or a colloid? _____

8. **BONUS:** Ocean currents move because of density differences. Explain how density makes ocean currents move.

Name: _____

Period: _____

Date: _____

GLOBAL WARMING
Research Learning Guide

Click on the link “Global Warming, what it is... (EPA)” and use the information provided to research the following issues.

1. What is global warming? _____

2. What are greenhouse gases and what is the greenhouse effect and what does it have to do with global warming (hint: while in this page, click on the link for greenhouse effect)?

3. Do scientists know what causes global warming?

Click on the link “Global Warming: Can we change the climate.” Use the information provided to research the following issues.

4. Scientists claim that human activities (cutting down forests and not replanting, population growth, and burning fossil fuels) are contributing to global warming. Describe how each of these can specifically contribute to global warming.
Deforestation: _____

Burning fossil fuels: _____

Population growth: _____

Name: _____ Period: _____ Date: _____

5. How much has the earth warmed in the past 100 years and is that a big deal?

Click on the link “Global Warming Controversy –1 (BBC)”. Use the information here and in the previous two links to research the following issue.

6. List some of the pieces of evidence that scientists have that makes them think that the earth is warming?

Use your textbook to research the following.

7. Scientists often measure global warming with temperature. What is the difference between temperature and heat?

8. What is thermal pollution?

Do you think global warming (or things that may contribute to the greenhouse effect) is a type of thermal pollution? Explain your answer.

There are some scientists who disagree with the hypothesis that global warming is caused by human events. They claim that warming of the earth is a natural process. Click on the three global warming controversy links to read more from both sides of the global warming debate.

Self & Group Evaluations

Name: _____ Teacher: _____ Period: _____

Reflect on how you and your group members did at working as a team. Be specific and be fair. Scores range from "0" (unacceptable) to "5" (excellent).

SELF (score): _____

What I did well: _____

What I can improve: _____

Group Members:	(score)	comments
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

What did your group do well? _____

What can your group do to improve your results for next time? (Be very specific)

1. _____

2. _____

3. _____

4. _____