



Physical Aspects of Climate - Cryosphere (Part 4:4)

Type of Lesson: Direct Instruction, Lab

Description of lesson: This program covers the physical aspects of climate change. There are three main activities that cover the direct content: Atmosphere, Oceans, and Cryosphere. This program is intended for classroom teachers to use as direct instruction and a hands-on activity for the students to complete. Direct instruction is given as a PowerPoint the teacher can project and a student note sheet has been created for interactive notebooks, or for students to fill out digitally. In addition, a lab has been curated that pairs with the material so students can have a kinesthetic learning experience to reinforce the material learned. Activities for vocabulary development and review have been included, as well as an end of the unit assessment where students show their knowledge of how the interactions between the Atmosphere, Cryosphere and Ocean create climate zones.

Enduring Understandings:

Climate is made up of multiple variables, a change in any of those variables can have a major impact on the planet

Essential Questions:

If predicted future impacts of Climate Change are as bad as the scientific community is predicting, is our home planet doomed or saveable?

Academic Standards:

HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth’s systems result in changes in climate.

HS-ESS2-8.* Construct an explanation of how heat (energy) and water (matter) move throughout the oceans causing patterns in weather and climate.

HS-ESS2-9.* Construct an explanation for how energy from the Sun drives atmospheric processes and how atmospheric currents transport matter and transfer energy

HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

HS-ENV1-2.* Use a computational representation to illustrate that humans are part of Earth's ecosystems and how human activities can, deliberately or inadvertently, alter ecosystems

HS-ENV1-3. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

Student learning targets:

- Students will identify parts of the cryosphere
- Students will be able to identify where the cryosphere is mostly located
- Students will be able to model how the cryosphere contributes to sea level rise
- Students will be able to connect how the cryosphere contributes to overall planetary climate



Assessment task - Students are given the choice of different climate regions.

This assessment can be done in a variety of ways. The two designs shown in this lesson plan are for a poster (group project) or an essay form (individual). In either format, students must describe how the atmosphere, ocean, and cryosphere come together to impact the climate of the region.

In order to be successful in this task, students should have practiced this skill in the previous three lessons.

Attached is the sample test, template for digital posters, and some sample student answers. This assessment is found at the end of this Lesson plan

Differentiation:

- The test can be broken down in a series of questions the students can answer (constructing explanations) instead of full paragraph form (argument from evidence)
- Allow students to use maps of ocean currents, atmospheric circulation cells, and locations of the cryosphere.
- For those students who took the pretest, give them a different climate zone.

Accommodations:

- Pre-filled notes printed out for students
- Embedding the PowerPoint in the LMS so that students can follow along at their own pace
- Vocabulary as a reference only instead of having them fill it out
- The use of notes during assessments

Prior Learning:

The climate unit is based on students who have learned about the atmosphere, hydrosphere and cryosphere. Before starting this unit students should be familiar with the following concepts

- Cryosphere
- Albedo
- Coriolis effect
- Axial tilt
- Hadley cells etc.
- Ocean water density
- Global Conveyor Belt

Prerequisite skills:

- Asking Questions
- Defining problems and creating solutions
- Data analysis
- Graphing
- Defending and argument with evidence
- Writing a free response

Materials

- Two large bins (for a demo) or bins for each student group
- Water
- Ice
- Rulers
- Heat lamps
- Rocks, blocks or something to signify land

Technology:

- Youtube
- Projector

Vocabulary Development:

If you have not had a cryosphere unit prior to this, you will need to work to define the following words with students

| | | | |
|---------|------------|-------------------------|-----------|
| Albedo | Sea ice | iceberg | Ice shelf |
| glacier | permafrost | Polar atmospheric cells | Ice cap |

Procedures:**Introduction/Anticipatory Set/Bellringer:**

Ask students to review concepts from the cryosphere lesson. Play a cryosphere quizlet or Kahoot.

[Cryosphere Kahoot](#)

Activity 1 – (45 minutes)**Materials**

- Computer and Project to project the PowerPoint to students
- Printed copies of the note sheet or a pdf uploaded so that students can fill it in digitally

Instructions and/or Summary of Activity

The PowerPoint has been designed for teachers to give direct instruction to their students. Students will fill out a note sheet as they listen to the teacher. This note sheet can be printed for an interactive notebook or filled in digitally on their iPads or Chromebooks.

Teachers should pause to ask students the discussion questions within the lecture. In addition, there are graphs that the teacher may want the students to attempt to analyze on their own.

Attached: Cryosphere PowerPoint and Cryosphere student note sheet

When the direct instruction section is finished, do the following closure activity to help students internalize the information:

Snowball fight! Have the students write one thing they learned from the lesson on a scrap piece of paper. Have them wad up the paper into a “snowball.” Set a timer and have the students throw the paper in a snowball fight. Have them pick up the snowballs that are closest to them and keep throwing for about 15 seconds. When the snowballs are thoroughly mixed and you don’t think a student will pick up their own, have the students pick up the snowball closest to them and read what is written. This is such a fun way to review the material and students can hear things they may not have picked up during the lecture.

Activity 2 – 45 minutes**Materials**

- Large bins
- Water
- Ice
- Rocks, blocks or something to represent land
- Ruler
- Additional craft supplies
- Heat lamps





Instructions and/or Summary of Activity

Students are creating a model in bins of sea ice and land ice (ice sheets) and how climate change will affect melting and sea level rise. This bin will be set up at the beginning of the lab and while they wait for the ice to melt, they will be working on a sea level rise simulation. This simulation has them analyze maps and assess risks for sea level rise in certain areas. Students are analyzing data and making connections to the cryosphere and global warming.

Attached: Cryosphere Lab (Melting Ice and Sea Level Rise)

Note: **Teachers: What they should find:** They should find that sea ice does not contribute significantly to sea level rise because sea ice floating in ocean water displaces approximately the same amount of water as it contributes to the ocean when it melts.

Adapted Lab link: <https://serc.carleton.edu/earthlabs/cryosphere/6.html>

- Contains:

- Overview & Teaching Materials
- Printable Materials
- Student Notebooks for Lab
- Teaching Notes and Tips
- Assessments □ Written Responses to Discussion Questions & Written Test ○ Additional Teacher Resources

Wrap-up

Wrap up the class by going over the discussion questions in the lab. Even though we live in Indiana, have student brainstorm how rising sea levels might affect us here in the Midwest.

Suggested Reading

<https://www.ipcc.ch/report/ar5/wg2/>

Suggested Videos:

https://www.youtube.com/watch?v=L2H_vIqyWTU

Nasa has a whole series on the cryosphere! Super cool!

Attach: Cryosphere PowerPoint
Cryosphere Student Note Sheet
Cryosphere Lab