



Part A: Exploring Arctic Climate Data - Teacher Guide

Setting the Stage

Students will learn about albedo and feedback loops in the climate system. They will practice calculating albedo as a simple ratio of incoming to outgoing short-wave radiation.



Albedo Sketch Sea Ice. Photo Credit: NASA

Lesson Overview

In this lesson, students will calculate albedo and make sense of their data.

- **Lesson 1** – (30 minutes) *Understanding Albedo*
Students will calculate albedo values and answer questions about their data.

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Instructional Overview	
Grade Level	Middle/High School
Instructional Time	50 minutes (<i>total time needed</i>)
Activity 3 Goals	<ul style="list-style-type: none">• Calculate albedo from incoming and outgoing radiation data• Use known values to make sense of the calculated data• How to plot data and make sense of graphs<ul style="list-style-type: none">• Apply knowledge about albedo and the climate system to



	understanding Arctic change
Lesson Driving Question	<ul style="list-style-type: none"> How do you calculate albedo? How do you evaluate the data that you calculated?
Building Toward	NGSS: ESS2D , LS2C
NGSS Dimensions	<p>Science and Engineering Practices:</p> <ul style="list-style-type: none"> Analyzing and Interpreting Data Using Mathematics and Computational Thinking <p>Disciplinary Core Ideas:</p> <ul style="list-style-type: none"> Earth's Systems
Materials	<ul style="list-style-type: none"> <input type="checkbox"/> Powerpoint Slides <input type="checkbox"/> Student Worksheet <input type="checkbox"/> Student Data File <input type="checkbox"/> Teacher Data File (contains additional graphs that will be used in Part B)
Material Preparation	<input type="checkbox"/> Print copy of Student Worksheet for each student
Vocabulary	<u>Albedo</u> is a measure of how much light a surface reflects, with 0 representing no reflection (black) and 1 representing total reflection (white), and it refers to the fraction of sunlight or radiation that is diffusely reflected by a surface.


Lesson 1: Understanding Albedo (50 minutes)

How does surface material affect albedo and solar radiation reflection?

- (Slide 37) Using the information below and the diagram on slide 37, reinforce the concept of albedo with students. Students will record complete Part A of their worksheet.

Albedo is the ratio of incoming solar radiation that is reflected back into space. Albedo is expressed as a value from 0 to 1, with 1 meaning that 100% of the incoming solar radiation is bounced off the surface, and 0 meaning that all of the incoming radiation is absorbed by the surface of the Earth.

Note that albedo can be expressed either as a ratio or as a percentage. While reading about albedo, you are likely to find values expressed either way, for example, 30% or 0.30.


Activity 3
Student Worksheet

Arctic Climate Connections Activity 3: Exploring Arctic Data

Part A. Understanding Albedo

Note that albedo can be expressed either as a ratio or as a percentage. While reading about albedo, you are likely to find values expressed either way, for example, 30% or 0.30.

A surface that reflects most of the radiation it receives has **high** albedo.






1. Give an example of a surface that has high albedo.

2. Explain your reasoning. Why do you think this surface has **high** albedo?

A surface that absorbs most of the radiation it receives has **low** albedo.

3. Give an example of a surface that has low albedo.

4. Why do you think this is true?



2. (Slide 38) Have students use the “Incoming Shortwave Radiation” graph and [the student data file](#) to answer questions 5-7 on their student work sheet.
 - a. Students will use columns D & E (downward & upward shortwave radiation) to calculate the albedo on May 1st and July 1st.

Find more curriculum here:

<https://ceee.colorado.edu/resources/arctic-climate-connections>