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.

This project is funded by NSF, Award number 1107428

Instructional Overview	
Grade Level	Middle/High School
Instructional Time	50 minutes *(total time needed)*
Activity 3 Goals	• 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 ◦ Apply knowledge about albedo and the climate system to

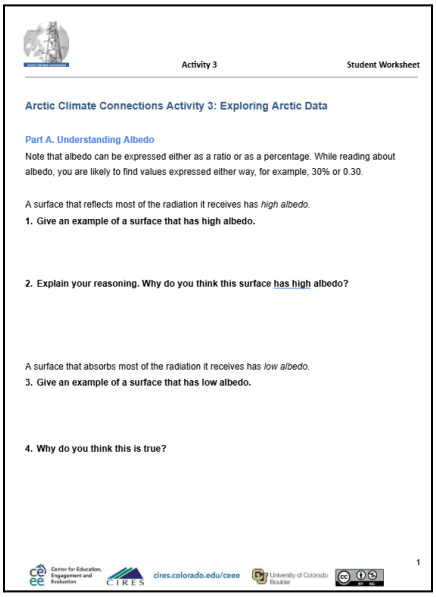
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	understanding Arctic change
Lesson Driving Question	• How do you calculate albedo? • How do you evaluate the data that you calculated?
Building Toward	NGSS: ESS2D, LS2C
NGSS Dimensions	Science and Engineering Practices: • Analyzing and Interpreting Data • Using Mathematics and Computational Thinking Disciplinary Core Ideas: • Earth's Systems
Materials	❑ Powerpoint Slides ❑ Student Worksheet ❑ Student Data File ❑ Teacher Data File (contains additional graphs that will be used in Part B)
Material Preparation	❑ Print copy of Student Worksheet for each student
Vocabulary	Albedo 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?

1. (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.


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?

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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.

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