Estimating Cloud Cover: A Simulation

Purpose

To help students better understand percent cloud cover and to take more accurate cloud cover observations

Overview

Working in pairs or small groups, students use construction paper to simulate cloud cover. They estimate the percentage of cloud cover represented by torn pieces of paper on a contrasting background and assign a cloud cover classification to the simulations created by their classmates.

Student Outcomes

Students understand the difficulties of visually estimating the percentage of cloud cover and gain experience estimating cloud cover, evaluating the accuracy of estimates, and using fractions and percentages.

Science Concepts

Earth and Space Science

- Clouds can be described by quantitative measurements.
- Clouds change over different temporal and spatial scales.

Geography

- The nature and extent of cloud cover affects the characteristics of the physical geographic system.

Scientific Inquiry Abilities

- Estimate cloud cover.
- Design and conduct scientific investigations.
- Use appropriate mathematics to analyze data.
- Communicate results and explanations.

Time

One class period

Level

All

Materials and Tools

- Sheets of colored construction paper, one blue and one white per student
- Glue stick, glue, or tape

Preparation

- None

Prerequisites

Familiarity with fractions and percentages

Background

Even experienced observers have difficulty estimating cloud cover. This seems to derive, in part, from our tendency to underestimate the open space between objects in comparison to the space occupied by the objects themselves, in this case the clouds. Students have an opportunity to experience this perceptual bias themselves, to reflect on its consequences for their scientific work, and to devise strategies to improve their ability to estimate cloud cover.

What To Do and How To Do It

Introduce students to the idea of observing and quantifying cloud cover. Explain that they will simulate cloud cover using construction paper and estimate the amount of cloud cover represented by white scraps of paper on a blue background. Demonstrate the procedures covered in steps 3 - 6 below so that students understand how to proceed.

You may review the *Cloud Cover Protocol* with students before doing this learning activity or use the activity as a first step in presenting the protocol to students. Step 7 below requires you to explain the

classification categories that are used – no clouds, clear, isolated, scattered, broken, and overcast.

1. Organize students into pairs.
2. Provide each pair with the necessary materials:
   - one sheet of light blue construction paper
   - one sheet of white construction paper divided into 10 equal segments
   - GLOBE Science Log
   - glue stick, glue, or tape.
3. Have each student pair choose a percentage of cloud cover that they wish to represent. They must choose a multiple of 10% (i.e. 20%, 30%, 60%, etc. not 5% or 95%). They should not reveal the percentage they have chosen to anyone else.
4. Have each pair cut their white paper so that it represents the percentage of cloud cover they have chosen. For example, if they have chosen 30%, they should cut out 30% of their white piece of paper and recycle the remaining 70%.
5. Students should then tear their white paper into irregular shapes to represent clouds.
6. Have students paste or tape the cloud pieces onto the blue paper, taking care not to overlap the pieces of white paper. On the back of the blue paper, record the percentage of cloud cover.
7. Have students take turns visiting each others' simulations and estimating the percentage of cloud cover. For each simulation they should classify the sky as "clear, isolated, scattered, broken, or overcast using Table AT-CO-1." They should then record their estimates in their GLOBE Science Log, using a table similar to that shown in Table AT-CO-2.

   Have all students visit all the simulations, or divide the class in some way so that students visit only some of the simulations.
8. When students complete their estimates of cloud cover, create a table on the board to compare the estimates with the actual percentages. See Table AT-CO-3.
9. Create a second table that compares correct classifications with incorrect classifications. See Table AT-CO-4.
10. Discuss with the class the accuracy of their estimates.
    Which were more accurate — the percentage estimates or the classifications?

Table AT-CO-1

Percentage	If less than	If greater or equal to
10%	Clear	Isolated
25%	Isolated	Scattered
50%	Scattered	Broken
90%	Broken	Overcast

Table AT-CO-2

Name	Estimated percent	Classification
Jon & Alice	40%	scattered
Juan & Jose	70%	broken

Table AT-CO-3

Name	Actual %	Underestimates	Correct estimates	Overestimates
Jon & Alice	60	4	5	12
Juan & Jose	70	6	9	6

Table AT-CO-4

Name	Correct classification	Classified too little cover	Classified correctly	Classified too much cover
Jon & Alice	Broken	4	9	8
Juan & Jose	Broken	7	12	2

Where did the greatest errors occur?

Can students come up with a quantitative measure of their collective accuracy?

Does the class have a tendency to overestimate or underestimate cloud cover?

What factors influenced the accuracy of the estimates (e.g. size of the clouds, clustering of the clouds in one part of the sky, the percentage of sky that was covered)?

Do students feel that making these estimates is something they have a talent for, or is it something that they can learn?

Where else might such spatial estimation skills be valuable?

Which cloud classifications were the easiest and most difficult to identify?

What strategies enabled students to correctly estimate cloud cover?

What strategies might produce more accurate classifications?