

NASA SnowEx – Citizen Science Snowpack Depth Guide

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Intro to the 2019-20 NASA SnowEx Mission

NASA snow scientists focus on answering scientific questions about the snow and ice covered areas of the earth (*the Cryosphere*) using state of the art geophysical, remote sensing, modeling, and engineering methods. Current research includes quantifying the spatial variability of snow properties using ground-based microwave radar and snow micropenetrometry, improving estimates of snow water content from airborne and satellite-based radar. The use of remote sensing for the mapping of snow-cover characteristics has a long-lasting history reaching back until the 1960s. Because snow cover plays an important role in the Earth's climate system, it is necessary to map snow-cover extent and snow mass in both high temporal and high spatial resolutions. This task can only be achieved by the use of remotely sensed data.

SnowEx is a five year program initiated and funded by NASA to address the most important gaps in snow remote sensing knowledge. It focuses on airborne campaigns and field work, and on comparing the various sensing technologies, from the mature to the more experimental, in globally-representative types of snow. The goal is to address the most important gaps in our snow remote sensing knowledge, and thus lay the groundwork for a future snow satellite mission.

Video Link: <https://youtu.be/O23JsWzVwQM>

The 2019-20 NASA SnowEx mission aims to further advance the newest technology to remotely detect snow density (water content) from aircraft and, ultimately, an orbiting satellite. WWA ambassador and Boise State University snow scientist Hans-Peter Marshall is leading the mission, and several of the aircraft flight paths in CA, ID, UT and CO will go directly over SnowSchool sites. NASA scientists need students to collect snow depth and density samples on the ground and, with help from Community Snow Observations, send to researchers to compare to the data collect from aircraft. This is an exciting an opportunity for SnowSchool students!

Flight paths: SnowEx is happening in 2019-20 in Idaho, California, Utah, Colorado and New Mexico. To see specific SnowSchool program locations, click here - <https://winterwildlands.org/nasa-snowex/>

Measuring Snowpack Depth

How to frame it: The idea behind the classic SnowSchool snowpack depth activity is that each student gets to explore the snowpack through firsthand experience. A good way to introduce this is to tell the students that for the next few minutes you are going to imagine as though you are a group of snow scientists. Each pair of scientists will explore, make observations and then report back to the group. You'll need to rulers/rulers/probes and/or shovels depending on your snowpack and how you want to do the activity. Pair the students up and proceed as follows:



Start with a question: *How deep do you think the snowpack is here?* Have students make an initial estimate. Make sure each pair has a shovel and/or ruler/probe to share. If students have shovels then challenge the students to dig a hole from the top of the snowpack all the way to the ground!

Dig and Measure: Use your shovel and/or ruler/depth-probe to obtain a measurement the depth of snow to the nearest centimeter:

1. Find a representative area in undisturbed snow to make your measurement. For example, avoid tree wells, or spots where snowshoers may have compressed the snow.
2. If students are using shovels, have them dig a pit all the way to the ground, leaving the uphill side untouched for measurement purposes.
3. If you are using a probe firmly press it through the snowpack down to the ground. Make sure you push firmly to make sure you are measuring to the ground and not intermediate ice or dense snow layers.
4. Read the snow depth on the probe from ground level to the nearest centimeter at the snow surface.
5. If possible, repeat 3-4 times in a small radius (<1 m) and take the average of those measurements.
6. **Very deep snow:** If the snow depth is greater than a probe length, you'll have to use a shovel. Dig a shallow pit (~50 cm or so) with a clean vertical wall. Push your probe firmly to the ground in your pit. Mark the top of the probe on the vertical wall of snow. Remove your probe and use it to measure the additional distance from the mark to the snow surface. Add the two numbers and you'll have the total snow depth!

Snow Science Report: Briefly discuss what each group found. *Was every team's snowpit the same depth? What does that mean?*

Transmitting Data to NASA

Transmitting data to NASA is made possible by our partners at Community Snow Observations. You'll need a computer or smartphone to do this. Visit the SnowSchool SnowEx webpage - <https://winterwildlands.org/nasa-snowex/> - click on your location and follow the instructions provided. Question? – email kmcclay@winterwildlands.org

Connection to Standards- When combined with in-class presentations and the SnowSchool field trip, this activity may connect to the following national curriculum standards:

NGSS (CCSS-MS-ESS2-4) – Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

NGSS (HS-ESS2-2): [Earth's Systems](#): Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems

Common Core State Standard (High School Math Content): Modeling

Common Core State Standard MP.2: Reason abstractly and quantitatively