SNOWSCHOOL

4ᵗʰ Grade Activities for Schools *Surrounded by Snow!*

About this Guide:

The SnowSchool program was created in 2001 to introduce America's youth to the joy of exploring winter wildlands. Since those early beginnings the program has grown into national network of dozens of sites. Today many SnowSchool sites are located in nature centers, Nordic centers, national forests, national parks and ski areas that engage thousands of participants each winter. This model has worked effectively for reaching students in urban areas, but in many rural mountainous areas students don't need to get on a bus and drive to a nature center to explore the wilds of winter-- they have public land right out the front door of their school. To take better advantage of this opportunity, SnowSchool is now collaborating with schools that are "surrounded by snow" to develop a new program model designed especially for this context. This represents one critical approach in an increasingly diverse array of strategies that WWA is using to connect kids with nature and help them understand the importance of our nation's public lands. By combining our nationally recognized snow science curriculum with fun outdoor exploration, SnowSchool participants gain both an emotional connection to winter wildlands and a greater understanding of their important ecological role.

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The SnowSchool Curriculum

The SnowSchool program aims to inspire a lifelong interest in exploring the wonders of our winter wildlands. Thus the curriculum that accompanies the program is designed to match the interest and abilities of individuals as they grow through life. SnowSchool has been around long enough that, in some places, the first generation of students have now grown up and become educators!

SnowSchool also strives to be much more than a limited "one-and-done" field trip program. Research conducted on the SnowSchool model and field-trips in general demonstrates that in order to maximize student benefits these learning experiences must extend over time and connect classroom study to the field-trip itself. We've designed a spiraling curriculum model (right) to do just this, and the details of how to make it happen at your site are captured here in this guide.

Additionally the SnowSchool curriculum is designed to align with existing state science standards, the newer Next Generation Science Standards and the Common Core State Standards. This is important component of the program because SnowSchool is intended contribute to K-12 students' overall learning and academic achievement. Also, when field-trips are aligned with teachers' required curriculum it makes it much easier for them to justify their students' participation. Details regarding this curriculum alignment appear throughout this document.

Between 2012 and 2017 Winter Wildlands Alliance conducted a series of evaluations of the program's science curriculum. For this evaluation hundreds of students completed pre and post SnowSchool science quizzes. The results showed that when students participated in three simple and specific experiential snow-science/water-cycle activities during the SnowSchool program, dramatic increases in student science learning occurred. These "three essential" activities are fun, help students learn through firsthand experience and encapsulate an important theme of ecological interconnectedness between snowpack, watershed systems and human use of water. To fit into the context of a K-12 school that is surrounded by snow, the SnowSchool three essential activities (snowpack depth assessment, snow/water equivalency experiment and watershed map) have been modified to help students explore these topics each year during their entire K-12 career (hence the spiraling curriuculum). Together these activities combine to create a powerful learning experience that solidifies the connection between nature, science and the students' own lives.
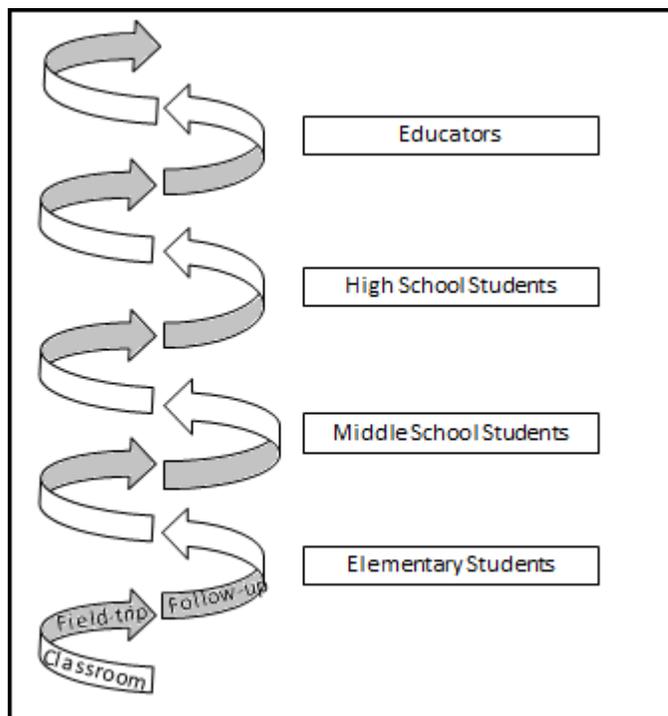

Figure 1: SnowSchool's spiraling curriculum model enables students at a variety of grades levels to explore snow science and ecology in a manner that connects classroom study, field excursions and follow-up extension projects. Eventually SnowSchool students might one-day become volunteer SnowSchool educators and continue their learning through teaching, self-guided study and ongoing SnowSchool trainings.

Snow Science Background Information:

You will most likely want to review some of these foundational science concepts in the classroom before heading outside with your students:

- **Snow science** is a current field of science exploring questions in three main realms- Water Supply (*How much water do we get from snow?*), Avalanche Forecasting (*What types of snow conditions produce avalanches?*) and Climate Science (*How is annual snowfall and global snow distribution changing over time?*) The SnowSchool program focuses primarily on exploring snow science in the context of Water Supply and Climate Science.
- Snow is part of the **Water Cycle**. Water cycles through the Earth's landscape in an endless process and goes through many changes along its way from the ocean to the mountains and back again. The sun heats the liquid water in oceans and lakes causing the liquid to **evaporate,** or turn into a gas. The water molecules then rise on warm air currents into the atmosphere where they begin to cool which causes **condensation**. Condensation of water molecules from a gas to a liquid usually occurs around a dust particle. When enough molecules condense clouds begin to form.If the condensation process occurs at temperatures below 32 degrees F then ice crystals begin to grow from the water and form **snow crystals** or flakes. Once enough water molecules condense either as a liquid (rain) or as a solid (snow) and join together, they get heavy enough to fall back to the earth. This is called **precipitation.**
- A watershed is an area of land where all the water drains to the same place. Most watershed are named by the river or stream to which they drain. The start of the watershed is located high above at the tops of the surrounding mountains.
- Accumulated mountain snow, usually referred to as the **snowpack**, is a critical component of many watersheds. When it melts it provides liquid **runoff** water for plants, animals and fish in streams and rivers, as well as for human needs such as irrigation and drinking water. In the Western US, for example, snow provides 75-80% of the annual water supply (that's eight out of every 10 glasses students drink at home)! Domestic and commercial use, irrigation supply and recreation are a few of the social and economic impacts that snowpack has on a region. Understanding the important ecological connection between a local community and its snowpack is an essential SnowSchool goal.
- **Depth** is an important measurement of the snowpack that is monitored closely by scientists. Because of factors like elevation, sunlight, shade, plants, temperature and wind the depth of the snowpack varies immensely.
- **Density** is another important measurement of the snowpack that is monitored closely by scientists. Because of factors like melting/freezing temperatures, crystal size/shape, snowpack weight and wind loading, the density of snow can vary greatly within the snowpack. Because the density of water never changes, the density of snow is synonymous with water content. For example, if you melted a container of snow and discovered it was half water, you could say that the density of the snow was 50%.
- **Snow water equivalent** is the depth of water that would result if you instantaneously melted all the snow on the ground in a specific location.

4th Grade One Page Curriculum Outline

Group: 30 students from Adams Elementary 4th Grade
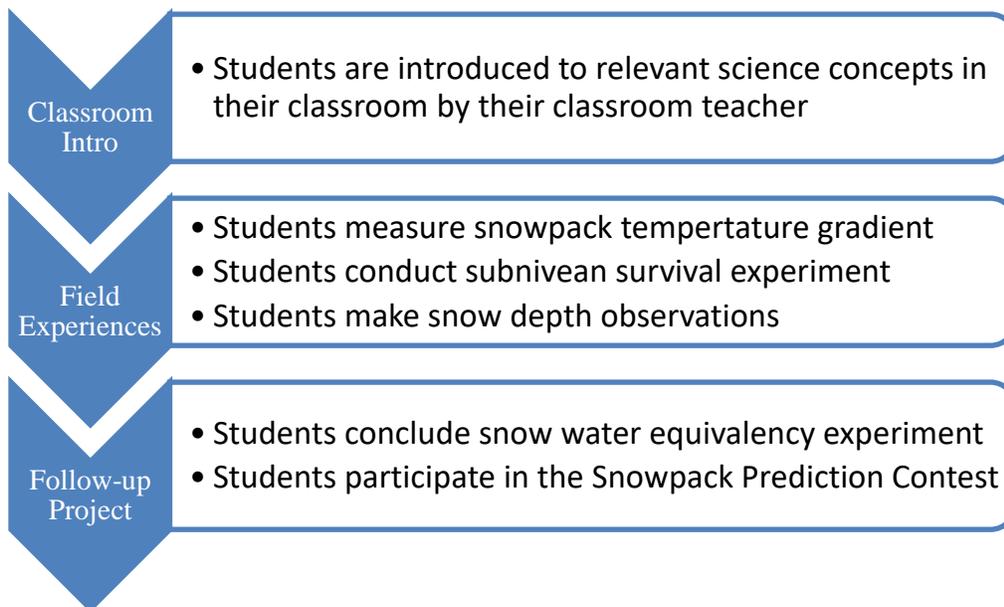
Focus: Snow Hydrology and Winter Ecology

Objectives (what we want the students to learn):

- Students will be introduced to the basic properties of snow/snowpack; depth, thermal properties
- Students will learn about the local role of snow in their watershed

Outcomes (how we will know the students learned):

- Students will have the opportunity to describe what they know about snow
- Students will test snowpack temperatures on different days
- Students will analyze and interpret snow/water data from maps
- Students will make hypotheses, predictions and draw conclusions based on results of experiments and activities

Three Phases of the SnowSchool experience:

Classroom Intro	• Students are introduced to relevant science concepts in their classroom by their classroom teacher
Field Experiences	• Students measure snowpack temperature gradient • Students conduct subnivean survival experiment • Students make snow depth observations
Follow-up Project	• Students conclude snow water equivalency experiment • Students participate in the Snowpack Prediction Contest

Snowpack Thermal Properties

Background: Snow is an amazing insulator and thus on cold winter days it will act like a blanket over the surface of the earth and be warmest near the bottom of the snowpack. On a warm day the snowpack will become "isothermal" (one temperature, usually about 31F), this indicates that the snow is starting to melt and yield water.

Part I: On a Cold Day- Make sure each pair of students has a shovel to share and then challenge the students to dig a hole from the top of the snowpack all the way to the ground. *Where in the snowpack do you think it will be warmest?* Have them use thermometers to measure the top layer of snow, the snow in the middle and the bottom layer of the snowpack. A demonstration of how to create a vertical wall in the snow pit may be helpful for them. **Report:** Briefly discuss what each group found. *Why is it warmer at the bottom? Who can provide us with a theory about this thermal phenomenon?*

Part II: On a Warm Day- Make sure each pair has a shovel to share and then challenge the students to dig a hole from the top of the snowpack all the way to the ground. *Will today's temperature experiment have different results?* Have them use thermometers to measure the top layer of snow, the snow in the middle and the bottom layer of the snowpack. **Report:** Briefly discuss what each group found. *Why is all one temperature? Who can provide us with a theory about this thermal phenomenon? What is happening to the snow?*

Follow-up: As the snow is melting ask the students to make observations about where the water is going. How can they tel? Look for evidence of the effects of erosion by water/ice movement overtime. Back in the classroom have the students draw a map of where all this water is headed.

Materials: Shovels, thermometers

Curriculum Connection:
Next Generation Science Standards (4-ESS2-1)- Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.]

Snow Homes

Challenge the students to apply their knowledge of the winter landscape!

How to do it: To do Snow Homes you need 1 film canister for every 2 kids, a digital thermometer and enough hot water in your own personal water bottle to fill up all of the canisters. Tell the kids you are about give them an "animal" to take care of (the canister filled up with hot water). Their job is to make a home for their animal, a home that will keep them warm in the winter. Real animals must do this too, and they have to make good choices about what part of the winter environment is good for home making. Talk a bit about wind chill, heat from sunlight, and the insulating properties of snow. Build on what the kids learned from the snow pit analysis: What part of the snowpack is warmest? Tell the kids that they must build a small home for their animal (the film canister filled with hot water) using natural materials. Their home must be warm enough that the temperature of the animal does not significantly drop over the 10-15 minutes they will be in their home. Make sure to test the original temp of the hot water bottle for comparison. Once the homes are built, the kids can place the animals inside. Start a timer immediately. Play a quick game while you wait. When you get back take the temperature of the water and compare how each animal/home fared. Depending on how harsh the leader is feeling, he or she can set a hard-cap (i.e. 45 degrees) below which the animal "freezes". For a lighter approach to concluding the game, just facilitate a discussion about which animal/canister was warmest:

- *Where is the warmest place in this habitat? Coldest?*
- *What animals are well adapted to access the warm areas? What animals are not? How does this affect survival?*

Materials: Empty film canisters, digital thermometer, warm water bottle

Curriculum Connection:

National Science Education Standards (Life Science) - All students should develop understanding of organisms and environments.

Next Generation Science Standards (4-LS1-1). Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. [Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.]

Schoolyard Snow Survey

Transform your schoolyard into a multi-year snow survey site!

Background: Many of the important trends in snow science require making observations over a period of time much longer than just one day or even one winter. Thus studying snow requires collecting data across multiple years. This activity allows students to participate in this long-term effort by transforming the landscape around the school into a snow survey site. This activity starts in 3rd grade and continues with increasing sophistication through each grade level.

How to do it: The easiest way to start this activity is to place a semi-permanent snowpack depth stick in a spot that is easy to observe but also will remain undisturbed by humans (you don't want the snowpack depth to be altered by people stepping on the snow around your depth stick). Its probably best if there is one snow survey spot and depth stick for each school. For each day of the winter that there is snow have students go observe the depth and then record it on a classroom graph. After a couple winters you should have a graph/graphs that look something like this:
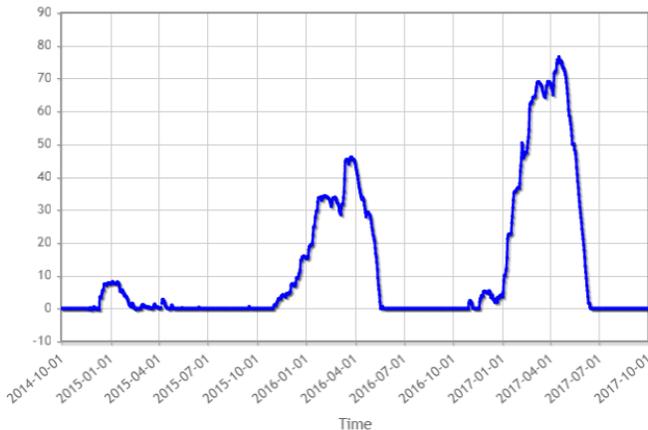
Questions for 4th Grade Students:
- *What trends over time do you see?*
- *Based on your snowpit experience do you think the depth would be different if the snow survey was in a slightly different location?*
- *Using the percentage of water you found by completing the snow/water equivalency experiment, what would the depth of water be in your schoolyard right now?*

Curriculum Connection:

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

Snowpack Prediction Contest

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Background: The Snowpack Prediction Contest challenges students to make predictions about how much snow will accumulate in the mountains around them. It uses live data for remote weather stations in the students own watershed. This extension activity works best if students have done the three previous outdoor activities: The idea here is that entry into the contest is relatively simple and takes little time. However, as the contest continues over the course of the winter and spring teachers will continually discover opportunities to connect SnowSchool related knowledge and information to their regular classroom explorations. Additionally, the design of the contest prompts students to analyze historical snowpack data allowing for greater connection to Common Core State Standards and alignment with the Next Generation Science Standards.

How to do it: To do this activity in the manner that is outlined in this guide you will need to first have the WWA SnowSchool Director construct a webpage to host the contest for you and your students. Its important that we keep this focused on your local area so students can make connections to their own community and lives. You can view Snowpack Prediction Contests happening in your area and around the country by visiting: https://winterwildlands.org/snowpack-prediction-contests/ If you don't have one already created for you, you can request it by contacting- kmcclay@winterwildlands.org

The Snowpack Prediction Contest webpage will provide instructions, prompt students to participate in the challenge and guide the exploration to conclusion:

SNOWPACK PREDICTION CONTEST: BOGUS BASIN SNOWSCHOOL 2018-19

Can your classroom accurately predict the amount of snow that we will have at Bogus Basin this year? How about the snow/water equivalent? Send SnowSchool your prediction and you could win a prize for your entire classroom! The closest class wins the prize!! Winners will be announced in the spring.

Send your prediction to:

kmcclay@winterwildlands.org

SnowSchool wants to know your prediction for the greatest snow depth measurement and the greatest snow/water equivalent measurement recorded during the course of the winter. One prediction (snow and water) per class please (this should be two numbers both in inches).

Example: *Prediction for Ms. Smith's Class- 50 inch snow depth, 14.1 inch snow/water equivalent*

Once you make your prediction your class name will be added to this page below and you will be able to track and compare your prediction to the live snowpack graph as it grows (or melts) each week of the winter!

SnowSchool is a national network of 65 education sites all working to connect kids to nature through snow, click to learn more!

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

Common Core State Standards (CCSS.ELA-Literacy.W.3.8) - Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.

Next Generation Science Standards (5-ESS2-2) – Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on earth.

Common Core State Standards (CCSS.SL.5.5) – Include multimedia components and visual displays in presentations when appropriate to enhance the development of main ideas or themes.

Next Generation Science Standard (4-ESS2-2) - Analyze and interpret data from maps to describe patterns of Earth's features.

Common Core State Standards (CCSS.5.G.A.2) – Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane and interpret coordinate values of points in the context of the situation.

Next Generation Science Standards (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.

Common Core State Standards (CCSS.MATH.CONTENT.6.SP.A.2) - Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.

Common Core State Standards (CCSS.MATH.CONTENT.6.RP.A.3) - Use ratio and rate reasoning to solve real-world and mathematical problems.