

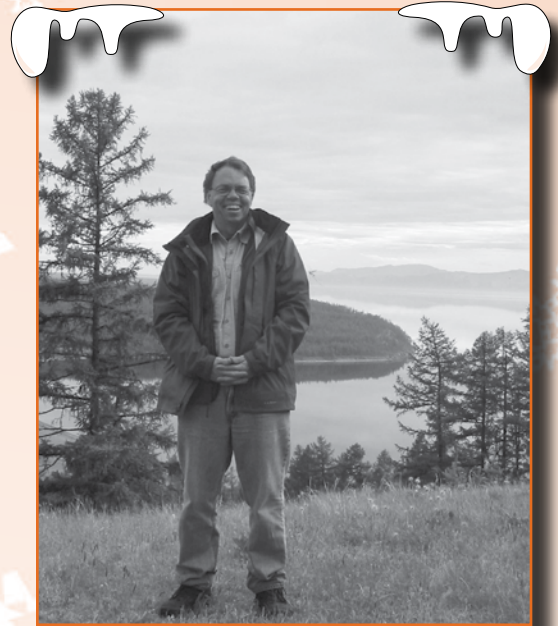
# Snowed In?

## A Closer Look at Soil Activity in the Wintertime



### Dr. Campbell

My favorite science experience was seeing the **aurora** (uh rôr uh) **borealis** (bôr e al is) (northern lights) while hiking back from a long day of fieldwork in Adirondack Mountains in New York.



### Dr. Mitchell

I am most interested in understanding how climate change is affecting **watersheds** (wă tür sheds). A watershed is an area of land from which all of the water drains into one stream or river. Specifically, I am interested in watersheds with forests during the winter. This work has included efforts at various sites in the northeast United States including Hubbard Brook Experimental Forest and Huntington Forest. I am also studying the effect of climate change in East Asia. Most recently, I have been working on a project at Lake Hovsgol in northern Mongolia.

The picture shows me at Lake Hovsgol in summer 2008 where I was doing field work related to watersheds.



### Dr. Groffman

My favorite science experience was when we looked at the chemical results from our field experiments. We saw that our experiment had worked and that our **hypotheses** (hī poth uh sēs) about the effects of winter climate change were correct. A hypothesis is an unproven idea. With a complicated field experiment, so many things have to be done exactly right to get scientific results. It's great fun when it all happens the way it is supposed to!



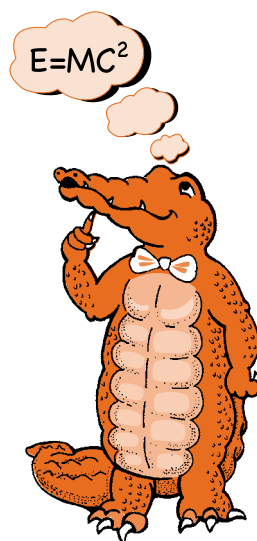
### Dr. Christenson

It is difficult to pick just one experience; science can be really fun (most of the time!). So if I have to choose just one, it would be tracking moose through the snow to find their fresh droppings! I collect the 'moose poop' then analyze it for a number of elements back in the laboratory. This allows me to better understand how moose interact with their **habitat** (hab uh tat). A moose's habitat is the natural area in which it lives.



# Thinking About Science

Scientists discover new information. This new information affects the work of other scientists. Can you guess why this is so? New information creates new scientific questions. In this study, evidence of a changing climate caused scientists to ask questions they had never asked before.



Wintertime in the northeastern United States (**figure 1**) seems like a time when everything slows down. Scientists thought this was also true of some **natural processes**



**Figure 1.** This map shows some of the states that are in the northeastern United States. The states shown are Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Pennsylvania.

(**na cha rôl prä ses es**). Natural processes are things that happen naturally in nature, such as tree growth and rainfall. The reports of warming temperatures caused scientists to start thinking about wintertime.

They wondered how rising temperatures would affect wintertime natural processes. Scientists thought about this question a lot. They also read work of other scientists to see what other scientists thought about the question.

# Thinking About the Environment

Do you ever wonder what happens under the ground? Is the soil just dirt? (**figure 2**). Is it a home for plants and animals? Although soil often looks like it



**Figure 2.** The soil may look dead, but it is full of living things!

is just dirt, it is a busy place! For example, earthworms live in the soil. You probably know about earthworms, but there are other **organisms** (ôr gä niz ums) in the soil. An organism is any living thing.

Did you know that tiny organisms, called **microbes** (mi kröbz), live in the soil? Most microbes are too small to see with your eye alone. Microbes include algae, plants, bacteria, and other animals. One gram of soil contains millions of these small individual organisms! One gram of soil is about the weight of a paper clip. Some of these organisms eat material that is naturally in the soil. Others eat the waste products of other organisms. Although you cannot see microbes at work, their activity creates the soil. All life depends upon this soil. What are two ways that people depend on soil?

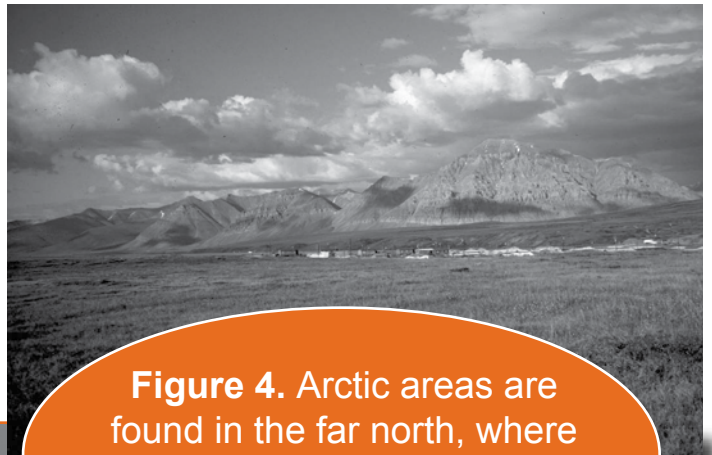
## Introduction

Scientists have done research on soil during the winter. Much of this research has happened in **alpine** (al pîn) and **arctic** (ark tik) areas. Alpine areas are found in high mountains, where there are few or no trees. Arctic areas are found in the far north, where winters are long and the ground stays frozen most of the year. In these areas there is little tree cover and winters are long (figures 3 and 4).

In the past, scientists did not spend much time studying wintertime soil in the

**Figure 3.** Alpine areas are found in high mountains, where there are few or no trees.

**Figure 4.** Arctic areas are found in the far north, where winters are long and the ground stays frozen most of the year.





northeastern United States. The reason they did not study the soil is because they thought the cold temperatures caused most of the activity of living things in the soil to stop. However, the changing climate made the scientists stop and think. Scientists began to wonder what would happen if climate change caused rising wintertime temperatures.

By studying other scientists' research, the scientists learned a lot. They found out that during the winter in alpine and arctic areas, many natural processes do not stop. The soil, in particular, is a busy place even during the winter. When snow covers the ground, it protects the ground from freezing (**figure 5**). This allows many of the soil activities to continue during the winter. If this is true for soil in the northeastern United States, then snow-covered ground provides an important **ecological** (e ko law juh kul) benefit to the plants and animals who live there. An ecological benefit means that there is a good relationship between the organism and the environment.



**Figure 5.** Snow-covered ground protects the soil from freezing.

Scientists believe that Earth's climate is getting warmer. If the climate continues to get warmer, then there could be more cycles of freezing and thawing. The scientists wondered what would happen to the microbes in the soil if there were more cycles of freezing and thawing. By studying other scientists' research, the scientists found that some scientists had already tested the impact of thawing and freezing on soil.

When these scientists did their study, they first tested it in a **laboratory** (lab ra tô e) setting (**figure 6**). A laboratory setting is usually inside a building where conditions may not be the exact same as conditions outside. It is a more controlled environment than a natural environment. In a laboratory

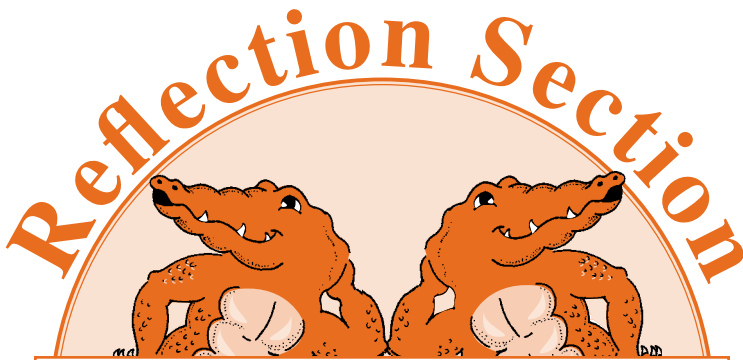


**Figure 6.** This is a picture of a Forest Service scientist's laboratory. Can you name some ways this setting is different than an outdoor setting?

setting, things like temperature and lighting can all be easily controlled. In the laboratory setting, the scientists found that freezing and thawing increases the activity of microbes. Scientists think that some of the microbes may die when the soil freezes and then the microbes that are left eat the dead ones to survive. The scientists wanted to know what happens to the activity of microbes if the freezing and thawing cycle happens in the natural environment instead of a laboratory setting.

## Method

The scientists read the research of other scientists. Some of this research had been done in other places with cold winters. Two of the places researched were Colorado (figure 7) and Canada. Colorado has cold winters in the mountainous areas of the State (figure 8). Canada's winters are cold because Canada is far from the equator (figure 9). The scientists also read about research done in the northeastern United States.



- ➡ What question did the scientists want to answer?
- ➡ If soil that never froze before began to freeze during the winter, do you think soil activity would be affected? If so, how do you think soil activity might be affected?

**Figure 8.** Can you guess what time of year it is in the Rocky Mountains of Colorado?



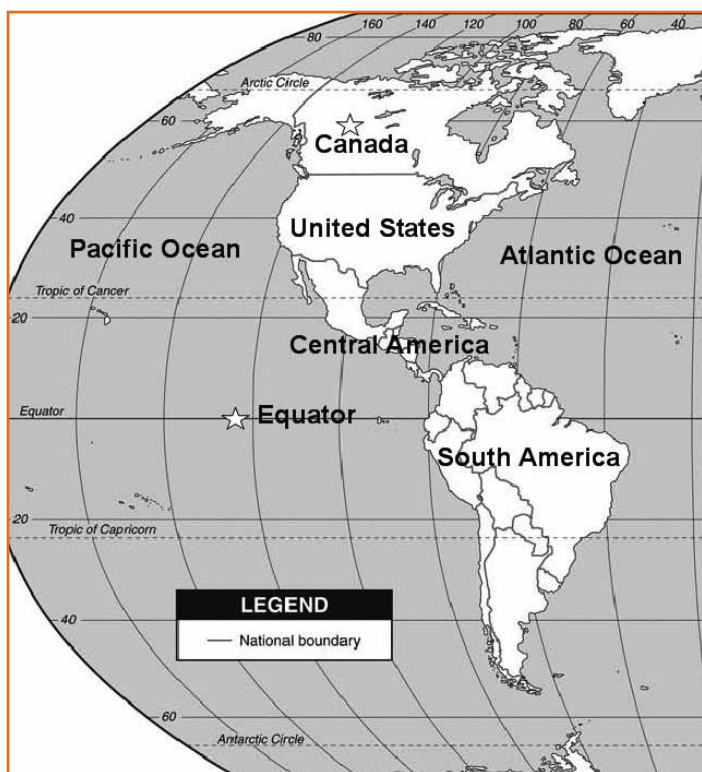
**Figure 7.** Colorado is located in the western United States.

Adapted from [www.lib.utexas.edu](http://www.lib.utexas.edu)



Fig. 8 courtesy of Reghan and John Cloudman, Canyon Lakes Ranger District





Adapted from <http://chuma.cas.usf.edu/~juster/volc1/world%20map.gif>

**Figure 9.** Canada is located far from the equator, where the climate is warm.

In this study, the scientists wanted to see what would happen to the activity of microbes when the freezing and thawing happened in a natural setting. To do this, scientists caused the soil to freeze outside by removing the top layer of snow during the winter (**figure 10**).



**Figure 10.** Snow was shoveled from an area in the Hubbard Brook Experimental Forest in New Hampshire to observe the effect of changing temperatures on winter soils.

## Reflection Section

Do you think that wintertime soil activity in the northeastern United States is similar to wintertime soil activity in Canada? Why or why not?

Do you think the scientists should have read about research done on wintertime soil activity near the equator? Why or why not?



# Findings

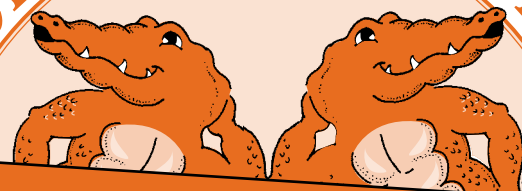
Do you remember that microbes live in the soil? These microbes are quite busy. They produce heat when they are active in the soil (**figure 11**). This heat causes the soil temperature to rise. This heat helps to keep the soil warm throughout the winter. When snow falls and the temperatures are cold, the snow stays on the ground throughout the winter. The snow **insulates** (in suh lats) the ground. Insulation keeps the area warmer. The warm ground enables the microbes to continue their activity.



**Figure 11.** A compost pile contains leaves and other waste products. If you put a thermometer in a compost pile, you would be able to see the temperature is warmer because of the heat generated by the soil microbes.

The scientists found that the freezing and thawing cycle in a natural setting did not cause microbe activity to increase. This finding was quite different than what the scientists in the laboratory setting found. Do you remember what they found in the laboratory setting?

## Reflection Section



Does the human body produce heat as a result of activity? How do you know?

Restate in your own words what the scientists discovered.

Why do you think the scientists had two different findings depending on whether they did their research in a laboratory setting or a natural setting?

## Discussion

Scientists do not know a lot about soil activity during the winter in the northeastern United States. However, they know that plants and animals are more active during the winter



than previously believed. From this study, the scientists learned that in a natural setting there was a different outcome than in a laboratory setting. In the natural setting, the scientists found that when soil was frozen, microbe activity did not increase. However, in the laboratory setting, scientists found that soil microbe activity increased. Scientists think that it may not have gotten as cold outside as it did in the laboratory setting and therefore they got different results.

This study shows why it is important to conduct a scientific study in an area that is as similar as possible to the environment the scientist is interested in studying. This study also shows why it is important that studies are repeated several times by different scientists before any conclusions are made.



➡ If you were the scientist, how would you explore whether higher average temperatures affect soil activity over the entire winter?

➡ Why do you think scientists first tested soil microbe activity in a laboratory setting?

# FACTivity



## Soil Investi-gators

In this **FACTivity**, students will investigate the soil in their school yard and some soil from home. You will need at least five empty plastic bins, five small hand trowels, magnifying lens, plastic spoons, plastic sandwich bags, permanent markers, rulers, plastic containers or sinks with water, and science journals.

Divide students into small groups of three or four students. Give each group a plastic bin and a hand trowel. Take students outside to collect two samples of the soil. Before students collect samples of soil, have student note-takers write down a description of the area from which each soil sample will be taken. The soil sample from the student's neighborhood should be brought back with the student the next day.

After each group has collected its soil samples, bring the samples to an area where students can sift through the soil and make notes about what they find in their soil sample. Students will use the chart provided to make their notes.

### Student Procedure:

1. Using your spoon and plastic bags, you will collect three different looking types of soil to investigate. Choose at least one from your neighborhood and two from the school grounds. The one from your neighborhood should be brought back with you tomorrow. Be sure to label the plastic bag with information about where you collected the soil.

Observations	Sample 1	Sample 2	Sample 3
Where did you collect this sample?			
Describe the sample site (i.e., sunny, moist, dry, shaded, forested-you don't have to use these terms)			
How deep did you dig to get your sample?			
What color is the sample?			
What does the sample smell like?			
What does the sample feel like?			
Is there any evidence of living or dead plants or animals? Describe.			
Does the sample contain iron? How could you check?			
Describe the particles. What about their size? Shape? Color?			

2. Complete the chart above.

3. After students have filled in their charts and had time to examine the soil, have a class discussion about the different types of soil the students found. As a class, you can create a soil chart of the different soils that were found.

\*This FACTivity was adapted from "Scoop, There it is!" by Todd R. Nickelsen.



If you are a PLT-trained educator, you may use PLT Activity #24, "Nature's Recyclers," as an additional resource.

### Useful Web Links:

To learn more about soil microbes, visit <http://rivenrock.com/soilmicrobes.htm>.

### Underground Virtual Adventure— The Field Museum

[http://www.fieldmuseum.org/undergroundadventure/virtual\\_tour/index.shtml#](http://www.fieldmuseum.org/undergroundadventure/virtual_tour/index.shtml#)

### Discovery Education Soil Safari

[http://school.discoveryeducation.com/schooladventures/soil/soil\\_safari.html](http://school.discoveryeducation.com/schooladventures/soil/soil_safari.html)

### Bureau of Land Management Just For Kids Soil Biological Communities

<http://www.blm.gov/nstc/soil/Kids/soilcrus.html>

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