

# Did They Make the Gradient?

## Introduction

- **What do you think determines the shape of a stream?** *A stream's shape is more than its direction of flow. Students should consider a stream's width and depth as things that help determine its shape. They should also think about the type of bedrock through which the streamflows. Some streams, for example, are relatively straight because they cut through softer rocks. Other streams have a lot of bends and turns because they must flow around rocks, or their soils are easily eroded. Brainstorm with your students to come up with factors that determine a stream's shape.*
- **Do you think that a rise in the average air temperature would cause a rise in a stream's water temperature? Why or why not?** *Students should reason that, if air temperature affects a stream's water temperature, then a rise in average air temperature over time would result in an average rise in a stream's water temperature over time.*

## Methods

- **Why do you think the scientists studied streams that were near each other but had a different geology?** *The geology, or underlying rock type, helps determine the stream's shape. To compare different stream shapes, the scientists needed to find streams with different underlying geology (or structure). To be comparable, however, it was best to find streams that would otherwise be close geographically, so that air temperature, solar radiation, and other weather data would be similar for all streams. This question gives students an opportunity to understand the concept of controlling as many variables as possible in a study.*
- **Why was it important to study streams with similar day-to-day weather?**

*Because the scientists were interested in how a stream's shape affects water temperature, the weather data needed to be as similar as possible for all streams. This would remove one of the sources of variation from the study. This question gives you another opportunity to discuss with your students how scientists control independent variables so that the dependent variable(s) can be more accurately studied.*

- **Look at figure 6. Why did the scientists not compare the two variables represented by the lower right rectangle?** *Because at nighttime, there would be no shade without sunlight.*
- **Which other variable in this figure would not be compared with nighttime water temperatures?** *Solar radiation.*

## Findings

- **Why do you think the most shaded streams had the lowest daytime summer temperatures?** *Students should realize that shade provides some protection from the Sun's warmth.*
- **Why do you think that stream temperatures in a future warmer climate might rise more in the winter than in the summer? (Hint: think about what is different about many of the trees along streambanks in the summer and winter.)** *Because trees provide more shade in the summer, they will moderate the rise in stream temperatures. They will do this no matter the air temperature. This does not mean that stream temperatures will not rise in a warmer climate. It means, however, that trees can help reduce the effect of a warmer climate on stream temperatures, especially in the summer when they have leaves.*

## Discussion

- **Think back to the first question in the first Reflection Section. Did you or your class consider the gradient of the stream as one way to describe its shape? Do you agree that the gradient of a stream is part of its**

**shape? Why or why not?** *Students will have to answer this question themselves. They should, however, explore why they did or did not think of the gradient as part of a stream's shape. If they have difficulty with this, challenge them to think of whether the steepness (or gradient) of a mountain is a part of its shape. How is a mountain's shape similar to and different from a stream's shape?*

- **Most States have laws that protect streams and rivers. These laws prohibit the removal of trees and other plants within a certain number of feet from the water's edge. Do you think this is a good thing? Why or why not?** *Students will have to answer based on their own assessment. Most students should come to the conclusion that laws meant to protect streams are good for a number of reasons. You may challenge your students to think of other ways streamside vegetation protects streams. These include, for example, the reduction of soil erosion into streams, the provision of wildlife habitat, the protection of the scenery along streams, and the protection from pollutants that might wash into the streams and waterways.*

## There's Snow Place Like Home

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### Introduction

- **What questions were the scientists trying to answer?** *What is the geographic range of wolverines over time? How might climate change affect the geographic range of wolverines?*
- **What are some other animals that burrow or make dens for their homes?** *There are many different animals that burrow or make dens. Some examples include groundhogs, ants, hamsters, foxes, ferrets, chipmunks, badgers, moles, prairie dogs, pikas, rabbits, shrews, and sand dollars.*

### Methods

- **Why do you think the scientists divided the years into three different time periods?** *The scientists divided the time because it was easier to discuss and analyze their findings based on smaller time periods. Scientists often place large amounts of information into categories so that it can be more easily analyzed and understood.*
- **How do you think warmer temperatures might affect wolverines? (Hint: look back at the Introduction section to see where wolverines typically give birth.)** *Warmer temperatures may cause the snow to melt earlier. If the snow melts earlier, the wolverine's denning habitat won't be as good or may not be available at all.*

### Findings

- **In your own words, summarize what the scientists found.** *The scientists found that spring snow cover, alpine areas, and conifer forests were important to the range of wolverines. They also found that by the 1950s, wolverine range had begun to shrink.*
- **Do you think the findings support the idea that the wolverine's habitat may be in danger? Why or why not?** *This is an individual question. Each student may answer this question uniquely. Students should be able to support their answers with examples from the article.*

### Discussion

- **Why would the wolverine's reproduction be affected? (Hint: think about why wolverines need spring snow cover.)** *The wolverines make their dens in the snow. They reproduce and raise their kits in these dens.*
- **Based on what you have learned from this article, do you think it is possible that the wolverine may need to be listed as an endangered species?** *Each student may uniquely answer this question. Students should be able to support their answers with examples from the article.*