Topographic Maps

Introduction	This lesson illustrates the following concepts: • What is the water table? • The water table has different elevations. • The elevation of the water table can be represented as contours on a map just as surface topography is represented with contours. This lesson is a suggested follow-up to the Tsongas Industrial History Center's Industrial Watershed program.
Level	Grades 5-8
Time	45 minutes
Lesson Preparation	Duplicate the activity pages (Sheets #1 and #2 for elementary, lower middle school students. Sheets #1 & #3 for upper middle and high school students.)
Prior Knowledge Required	Students should be familiar with a topographic map, and be familiar with the water cycle.
Vocabulary	**Topographic Map**: a map intermediate between a general map and a plan on a scale large enough to show roads, plans of towns, and contour lines. **Elevation**: the height of a place, in this case land (e.g. mountains, hills, etc). **Vertical:** perpendicular to the plane of the horizon or to a primary axis. **Contour Line:** a line (as on a map) connecting the points on a land surface that have the same elevation. **Infiltrate:** to cause (as a liquid) to permeate something by penetrating its pores, in this case surface water is absorbed into the ground. **Water Table**: the highest underground level at which the rocks and soil in a particular area are completely wet with water. **Vector**: a quantity (such as velocity) that has size and direction.
Background Information	When we think of where the earth's water is located, we often think of lakes, ponds, streams, and rivers. There is a source of water that is not visible, water beneath the surface of the earth, groundwater. An easy way to envision groundwater is to imagine drilling or digging a well in the earth. You dig down until you find water. If you were to drill or dig deeper, you would find that the bottom of your hole would fill with water. In some places around the world, you might have to go down hundreds of meters below the surface of the earth to find water. In other places, the water may be less than a meter below the ground. The location and depth of groundwater on a map is sometimes called the water table.
Anticipated Student	Students will likely be unaware that the water table has different elevations in different areas.

Topographic Maps

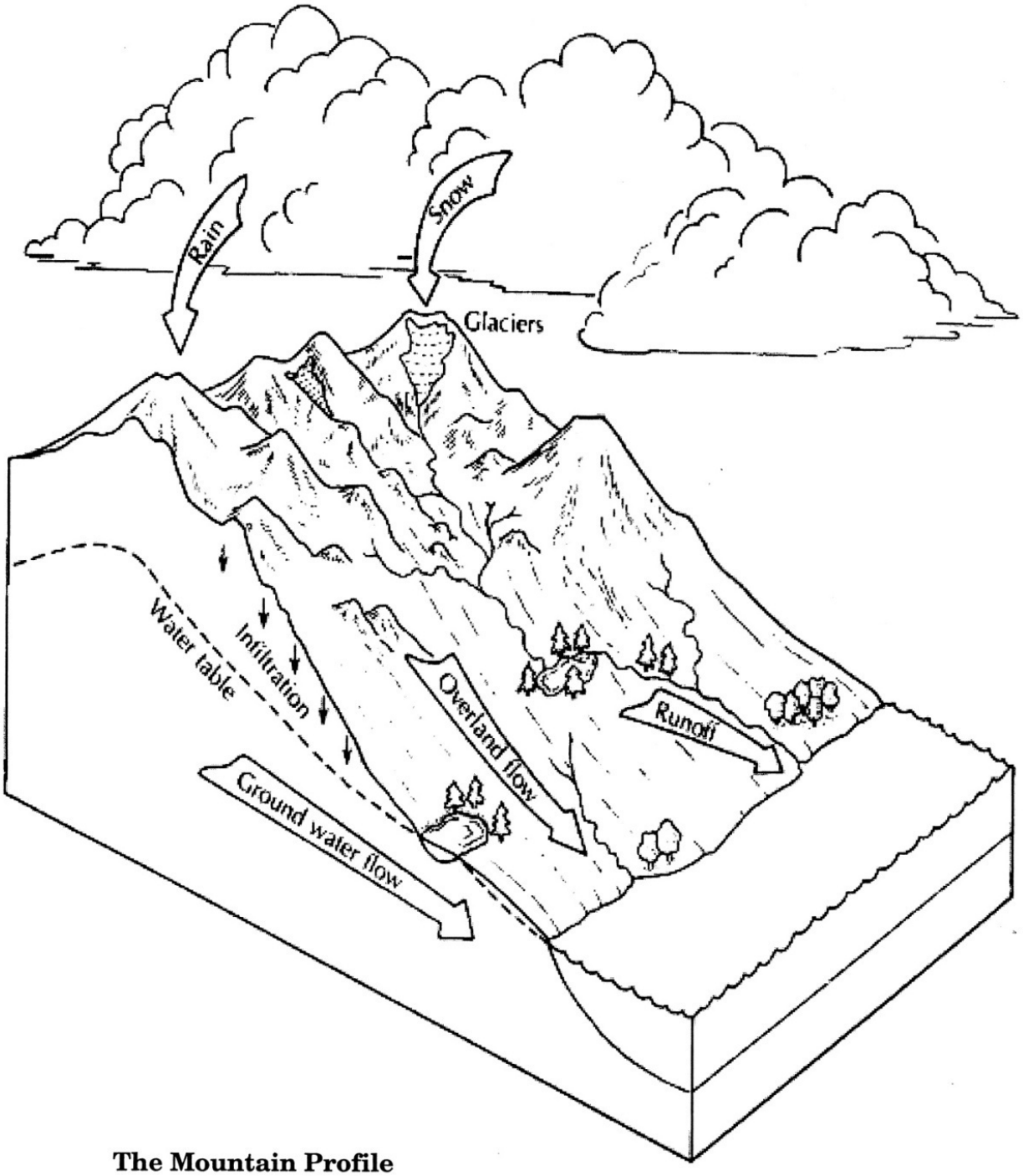
Preconceptions/ Misconceptions	
Frameworks	**Massachusetts Science Frameworks** **Grade 5** **ESS2-1:** Use a model to describe the cycling of water through a watershed through evaporation, precipitation, absorption, surface runoff, and condensation. **New Hampshire Science Frameworks** **Grades 5-6** **S:ESS1:6:2.3:** Identify and distinguish between various landforms using a map and/or digital images.

Guiding Question	How does a topographic map help us find the water table in a particular location?
Objectives	Students will be able to: • Interpret basic features on a topographic map. • Explain how a topographic map, including a map of the water table, helps scientists and engineers learn about the natural world
Activity	**Part One:** Read students the Background Information (above) as an introduction to the lesson. The teacher might want to ask questions, or lead a short discussion, about the paragraph to affirm student comprehension of vocabulary. **Part Two:** Have students look at the illustration of *The Mountain Profile* on Sheet #1. Have one student read out loud the paragraph below the image. **Part Three:** Read the following word problems to the students and write the numbers on a classroom whiteboard. • Imagine that you are standing in a field that is 50 meters above sea level. You now dig a well and reach the water table after digging 15 meters. How far below the surface is the water table? (15 m). Knowing these two variables, how would you calculate the water table's elevation above sea level? *(Subtract the depth of your well from the elevation of the ground above sea level). In this case, 50-15=35. Thirty-five meters is the elevation of your water table at that spot.* • Now, let's say that you were to determine (by digging holes) a number of the points in a certain area where the water table elevation was the same, and you marked these spots on a map. If you connected these points on the map by a line, you could create a ground water contour.

	Part Four: Look at Sheet #2 – titled *Water Table Contour Map*. • You will see numbers where wells have been drilled and the elevation of the water table determined. Connect the numbers of equal elevation by a line and map out the ground water contours. • Once you have completed this, can you determine in which direction groundwater will flow? How? (Remember that the water is going to flow from a higher elevation to a lower one, perpendicular to the contours). Mark the direction of the flow with arrows showing the direction of the flow. The arrows showing the directions of the water flow are *vectors.* **Part 5:** Initiate a discussion at the end of the activity, beginning with questions such as: • Why are communities interested in learning the direction of groundwater flow? • What types of events might necessitate the examination of groundwater flow? • What types of professions would involve knowledge of topographic maps and groundwater?
Adapting the Activity for Other Grades	**Younger students:** Have students work in small groups. Using overhead projection, display Sheets #1 & #2 and have the students follow along on their sheets. **Older students:** Sheet #3, titled Contouring the Water Table has a more complicated set of data and can be used for part four in lieu of Sheet #2.

Topographic Maps

Sheet #1

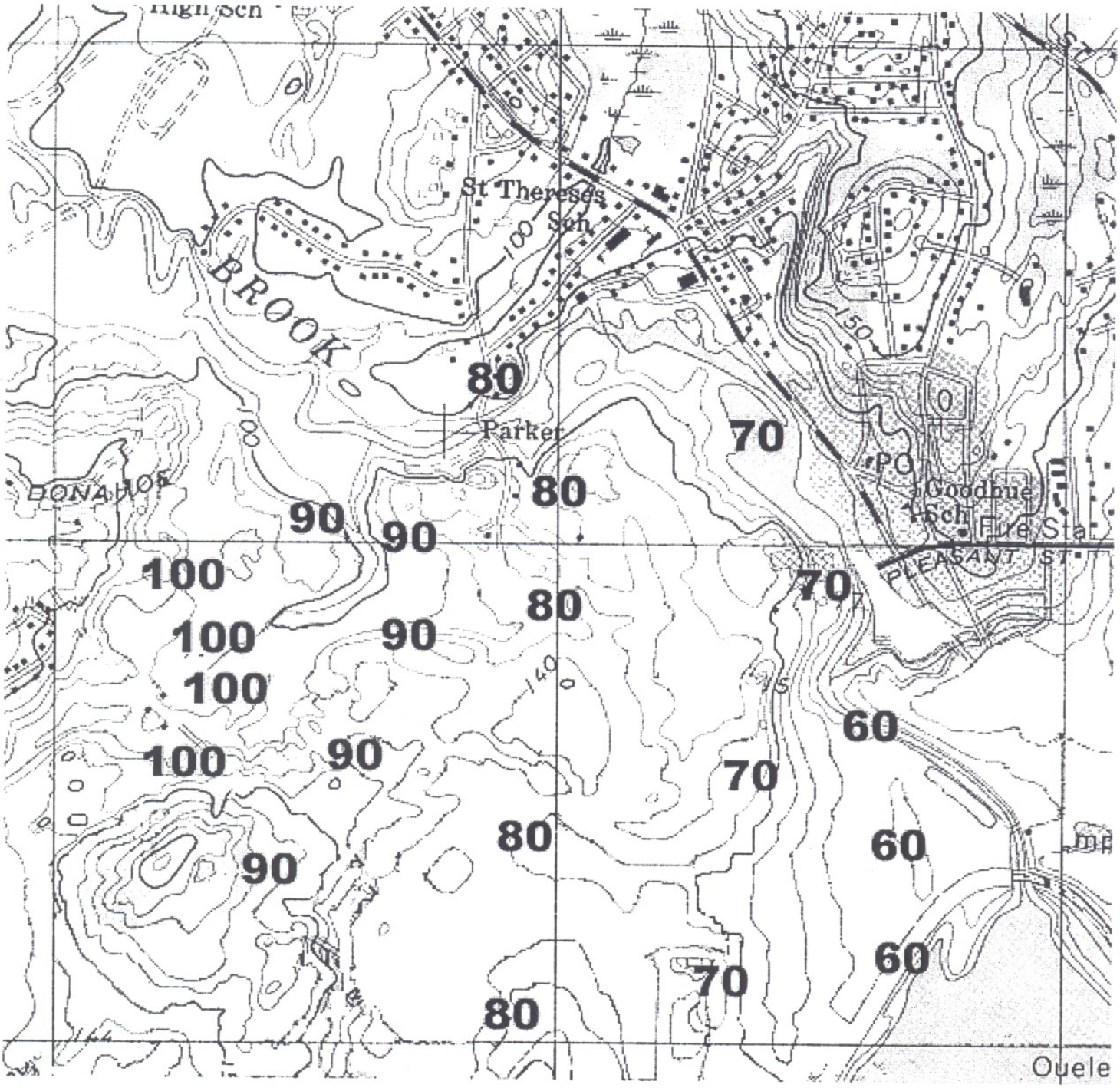


The Mountain Profile

Some of the water that falls on the surface of the ground seeps down through the soil. This is called *infiltration*. Eventually it reaches the level of the *water table*. Below the water table, the soil is saturated, or in other words, all of the spaces between the particles of the soil are filled with water. When digging a hole in the ground, the point at which you find water is called water table. As we know from everyday experience, water on the surface of the earth flows from higher elevations to lower elevations – that is, it flows *downhill*. Though we cannot observe it directly, water beneath the surface of the earth, *groundwater*, also flows from high areas to lower areas.

Topographic Maps

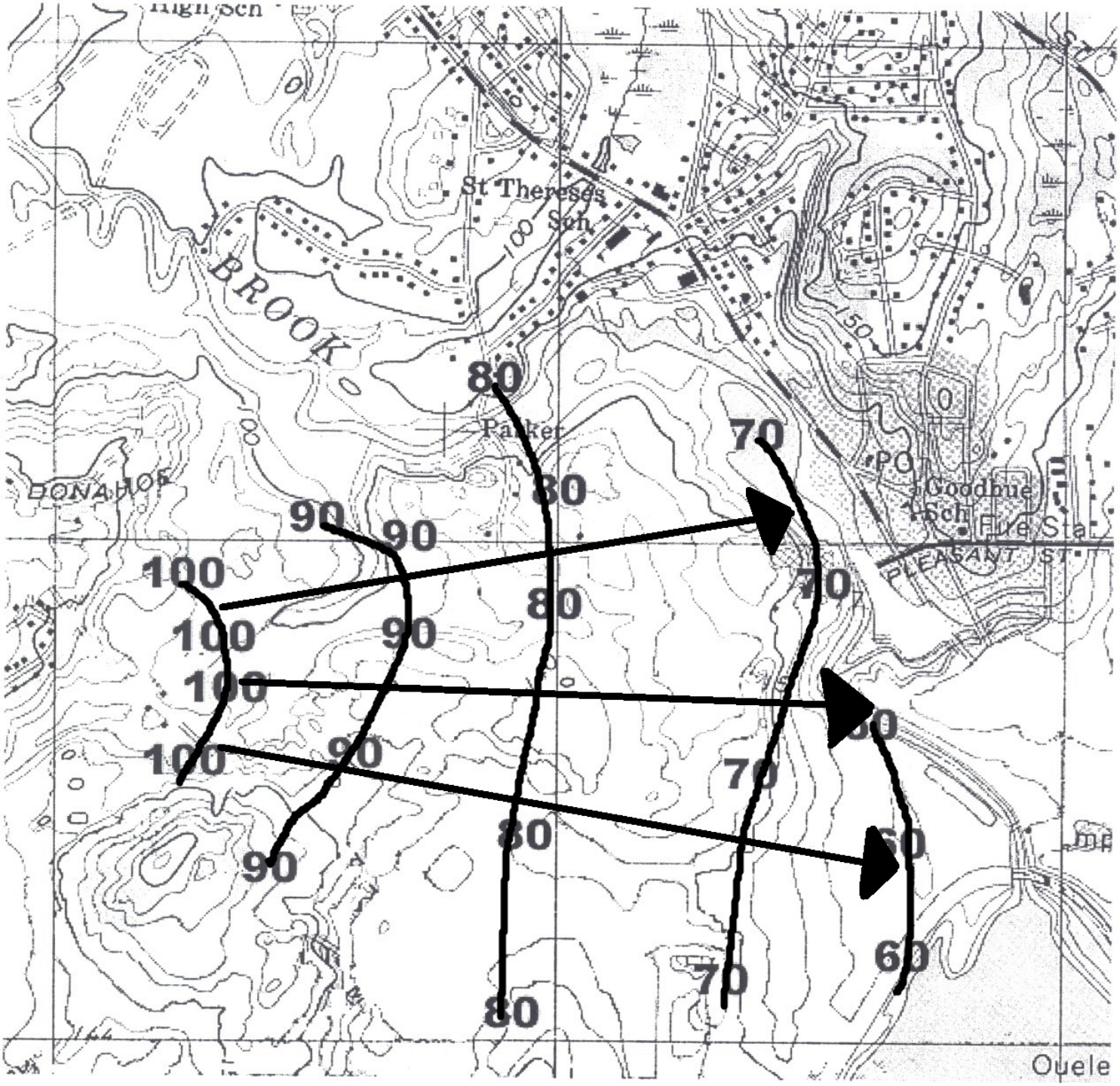
Sheet #2



Water Table Contour Map

Topographic Maps

Sheet #2 – Answer Key



Water Table Contour Map

Topographic Maps

Sheet #3