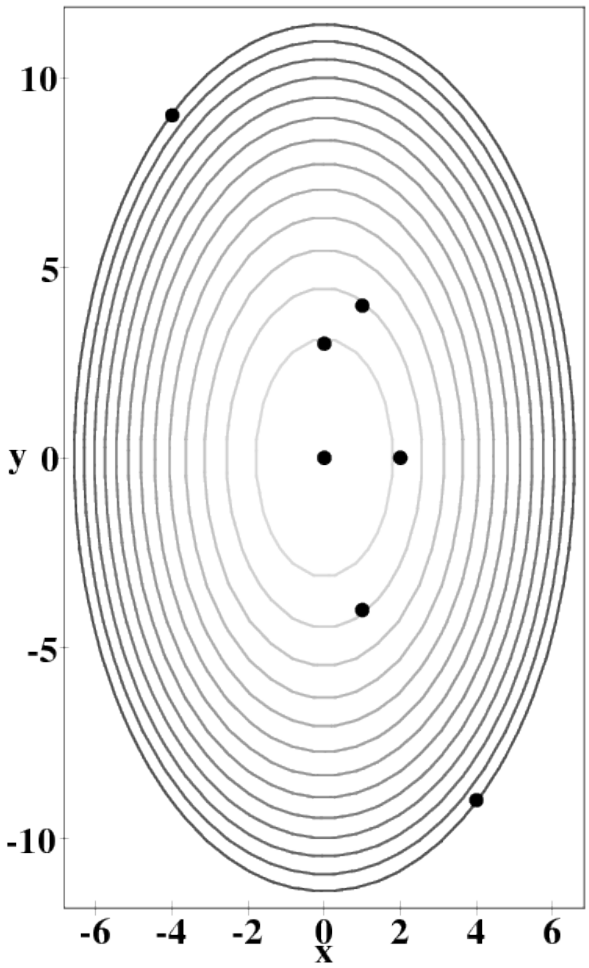
Student handout There is a hill in this classroom. The top of the hill is in the middle of the room at the ceiling. This topo map below describes the hill in the room. You are standing at some point on the topo map. Use your right arm to point in the direction of the gradient.



1 Instructor's Guide

1.1 Introduction

For this activity, the class is asked to stand from their seats. The students are told that they are all standing on an elliptical hill, represented by the topo map, and one location of the classroom is selected

as the top of a hill, typically in the center of the room on the ceiling. (If you are in a tiered lecture hall, then make use of the actual hill in the room, instead!)

The students are asked to close their eyes and point in the direction of the gradient, then open their eyes and compare what other students are doing.

1.2 Student Conversations

1. Many students will incorrectly point upward at an angle. For a function of two variables, the gradient does not have a third, vertical component. The gradient lives in the topo map, not in 3-d space.

2. Many students will incorrectly point towards the center of the configuration, rather than perpendicular to the level curves. The gradient is not always the direction of the center.

1.3 Wrap-up

Ask students to generalize the concepts in this activity to functions of three dimensions. Emphasize the understanding that the gradient is always perpendicular to the level curves (for two dimensions) or level surfaces (for three dimensions).