1. INTRODUCTION

Instructors of advanced level science courses offered in selective universities often face for granted certain basic propensities in their students. Belief, ready instructors – who themselves have high levels of the component skills needed for these disciplines – may not even question whether their students have necessary component skills. For geologists, accurately measuring and orienting the orientation and strike of a rock layer is such a skill.

2. WHAT FIELD GEOLOGISTS DO: THE EXPERT’S TASK

Field geologists observe the orientation of a planar surface or strike and dip. Strike is the line at the intersection between the horizontal plane and the plane of the rock surface, it is usually reported by a line on a map or as a compass direction. Dip is the angle between the horizontal and the incline, usually reported as a “steepness” or “angle.” A dip is vertical, a few students gave answers larger than 90°.

3. WHY SOME STUDENTS MAY BE CHALLENGED

The first step in measuring strike and dip is to visualize a horizontal plane intersecting the sloping rock surface. Within cognitive and developmental psychology, there is a surprising but robust finding that a large number of college students, especially women, perform poorly on this task.

4. METHODS

Screening Participants with 2-D Water Level Task:

Volunteers from Penn State psychology classes received extra course credit for their participation. As part of a screening program, approximately 60 students completed a six-item paper and pencil water level task. Male and female students from each of three categories were invited to participate (roughly 20 per group):

• High WL Group: All 5 items have correct answers
• Medium WL Group: Mixed correct and incorrect responses
• Low WL Group: All 5 items have incorrect answers

The sample consisted 125 participants, divided by WL group and sex. Order of tasks and order of items within tasks were counterbalanced or randomized across participants.

3-D Water Level Task:

We developed new 3-D horizontality and verticality tasks, roughly analogous to the 2-D water level task. Our goals were to examine the difficulty using the horizontal to determine and record the strike and dip in a geological field setting. The students’ strike answers differ from the correct answer by 30° or more.

Bottom Line:

• The scatter for both dip and strike is large and there are many poor answers. 47% of the students’ dip answers differ from the correct answer by 20° or more. 40% of the students’ strike answers differ from the correct answer by 30° or more.

Dip: 45° Men 55° Women
Dip: 60° Men 70° Women
Dip: 75° Men 80° Women

3-D Water Level:

As in the 2-D confab, most students struggled with the 3-2 water level task. The kind of error was similar. Although the population was larger, more students demonstrated difficulty in the 3-D confab.

Dip: 45° Men 55° Women
Dip: 60° Men 70° Women
Dip: 75° Men 80° Women

The circle shape was as coherent as the rectangle or the amorphous shape; however, the triangle and amorphous shapes are more similar to the geologist’s task than the circle shape.

4. RESULTS

Rationale for the 3-D task.

Shoreline Task

The component skills involved in measuring strike and dip, even when stripped down to their bare essentials, are difficult for many undergraduates.