Contour Maps and Profiles

Exercise 2
Oceanography Lab, ECC

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What is this lab about?

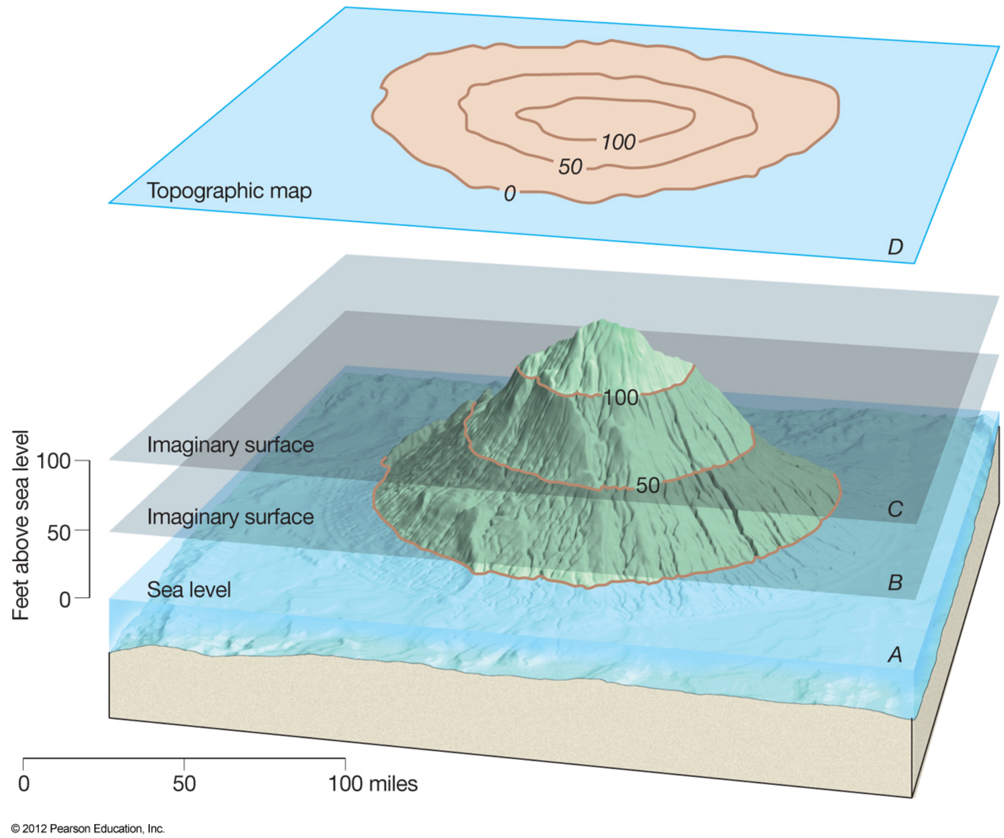
- This lab introduces you to techniques for reading and making contour maps

- Oceanographers use contour maps to visualize and summarize large amounts of numerical measurements

- We will also learn how to make cross-sections of profiles from a contour map

Contour lines

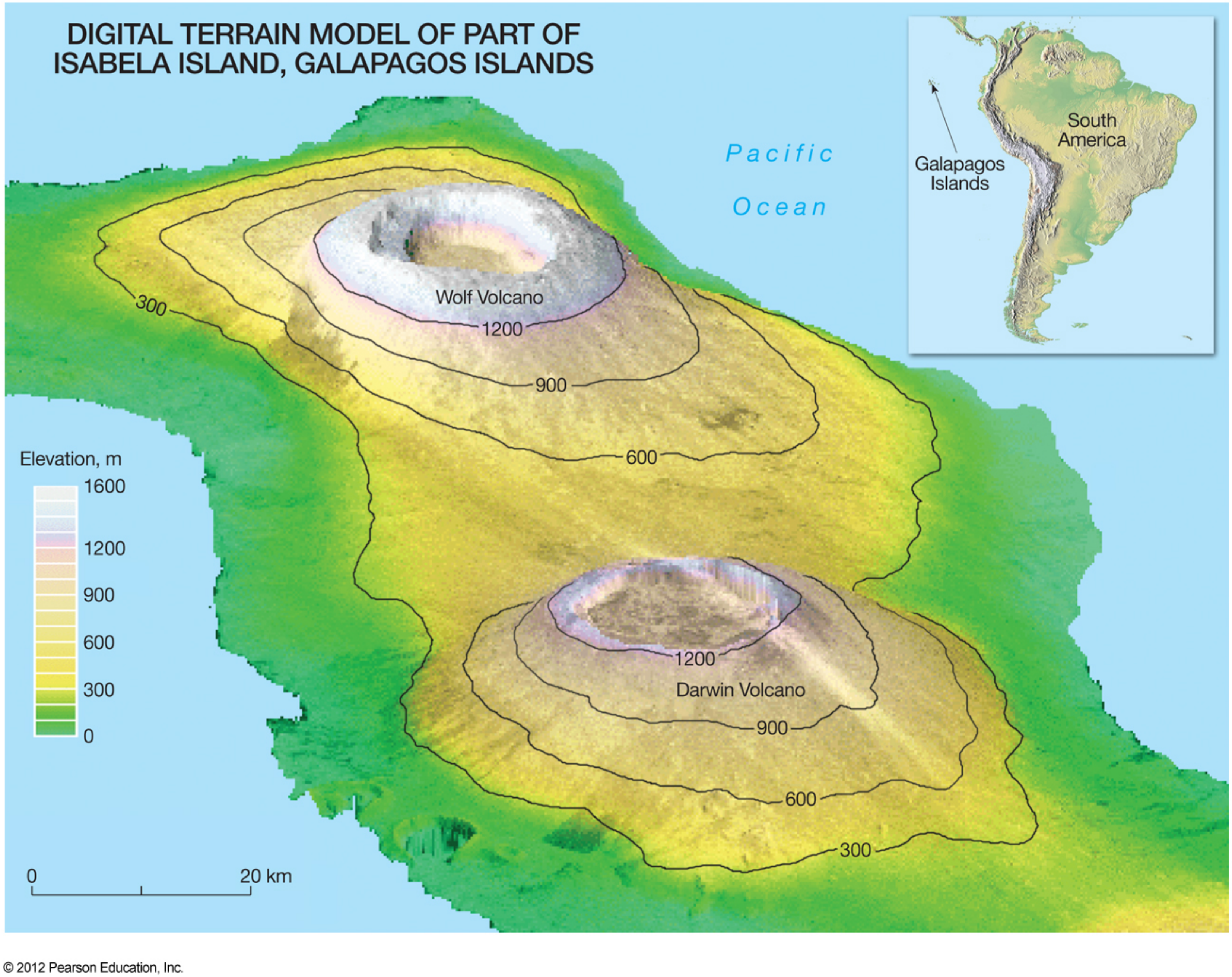
- Contour lines are lines that connect points with the same value
- On a map, they connect points at the same elevation, or the same depth



- Not all contour lines can be labeled
  - They may be too close to each other
  - Their value must be interpolated

- Concept of “contour interval”
  - Can be read, or interpolated, from the map

- Neighboring contour lines can have the same value
  - Indicating a reversal of topography


DIGITAL TERRAIN MODEL OF PART OF
ISABELA ISLAND, GALAPAGOS ISLANDS
Pacific
Ocean
South
America
Galapagos
Islands
Wolf Volcano
Darwin Volcano
300
600
900
1200
Elevation, m
1600
1200
900
600
300
0
0
20 km
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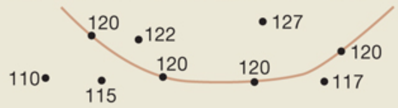
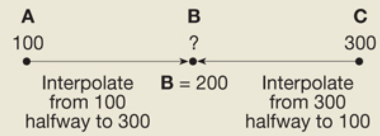
RULES FOR CONTOUR LINES

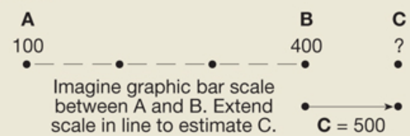
1. Every point on a contour line is of the exact same elevation; that is, contour lines connect points of equal elevation. The contour lines are constructed by surveying the elevation of points, then connecting points of equal elevation.



2. Interpolation is used to estimate the elevation of a point B located in line between points A and C of known elevation. To estimate the elevation of point B:



3. Extrapolation is used to estimate the elevations of a point C located in line beyond points A and B of known elevation. To estimate the elevation of point C, use the distance between A and B as a ruler or graphic bar scale to estimate in line to elevation C.



4. Contour lines always separate points of higher elevation (uphill) from points of lower elevation (downhill). You must determine which direction on the map is higher and which is lower, relative to the contour line in question, by checking adjacent elevations.

5. Contour lines always close to form an irregular circle. But sometimes part of a contour line extends beyond the mapped area so that you cannot see the entire circle formed.

6. The elevation between any two adjacent contour lines of different elevation on a topographic map is the *contour interval*. Often every fifth contour line is heavier so that you can count by five times the contour interval. These heavier contour lines are known as *index contours*, because they generally have elevations printed on them.

7. Contour lines never cross each other except for one rare case: where an overhanging cliff is present. In such a case, the hidden contours are dashed.

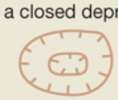
8. Contour lines can merge to form a single contour line only where there is a vertical cliff or wall.

9. Evenly spaced contour lines of different elevation represent a uniform slope.

10. The closer the contour lines are to each other the steeper the slope. In other words, the steeper the slope the closer the contour lines.

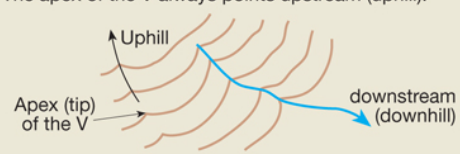
11. A concentric series of closed contours represents a hill:

12. *Depression contours* have hachure marks on the downhill side and represent a closed depression:

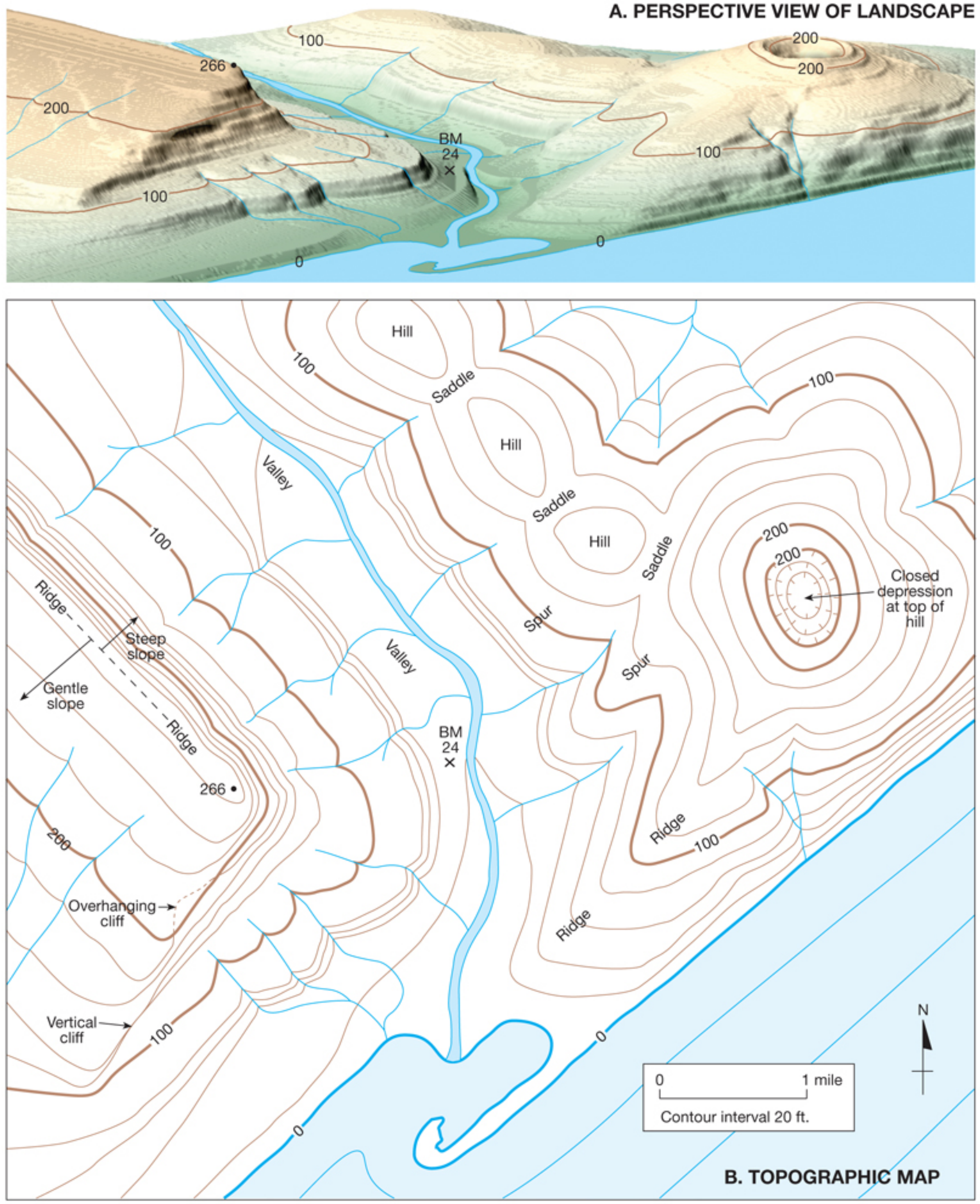


See Figure 9.12

13. Contour lines form a V pattern when crossing streams. The apex of the V always points upstream (uphill):



14. Contour lines that occur on opposite sides of a valley or ridge always occur in pairs. See Figure 9.13.



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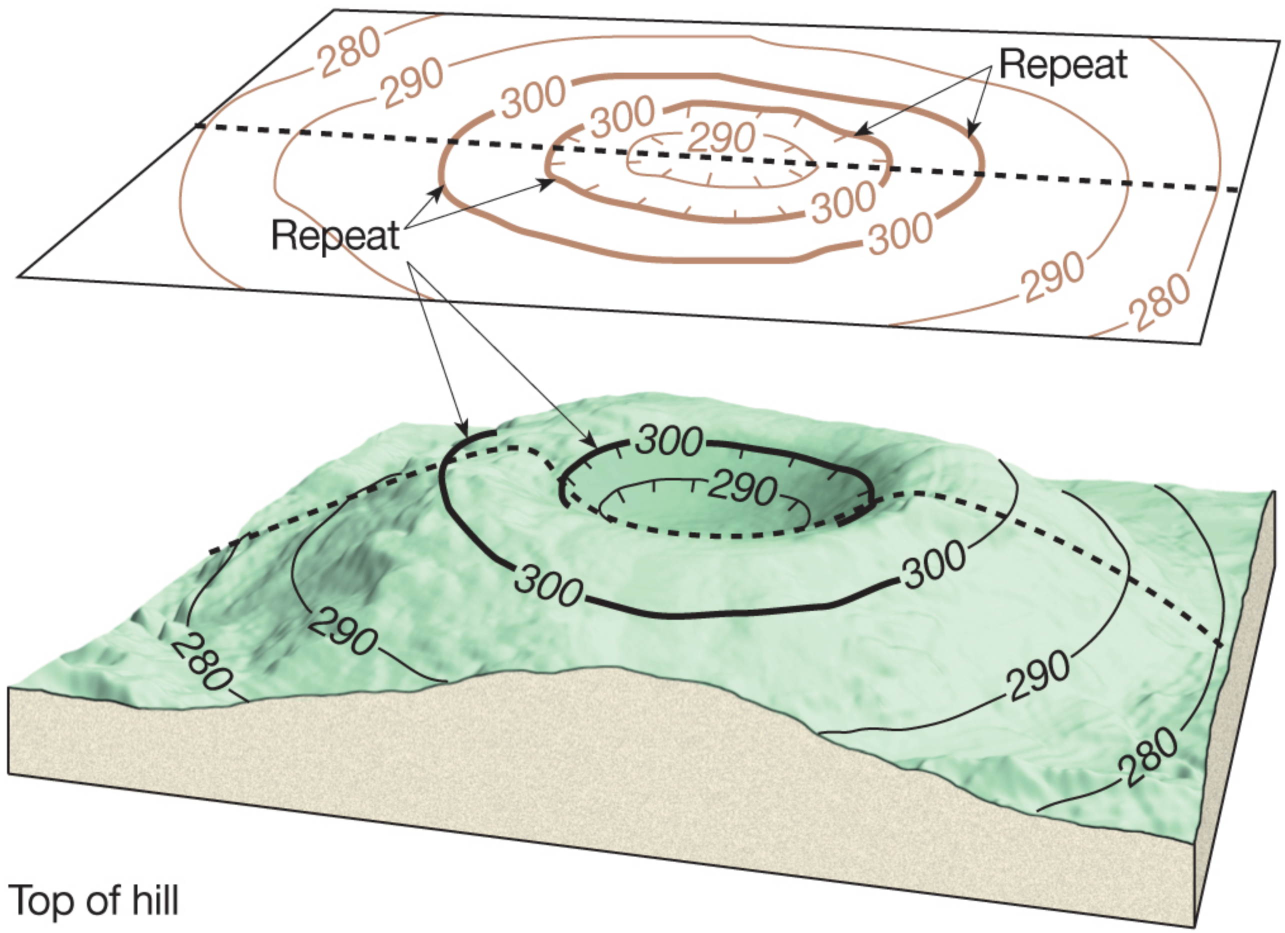
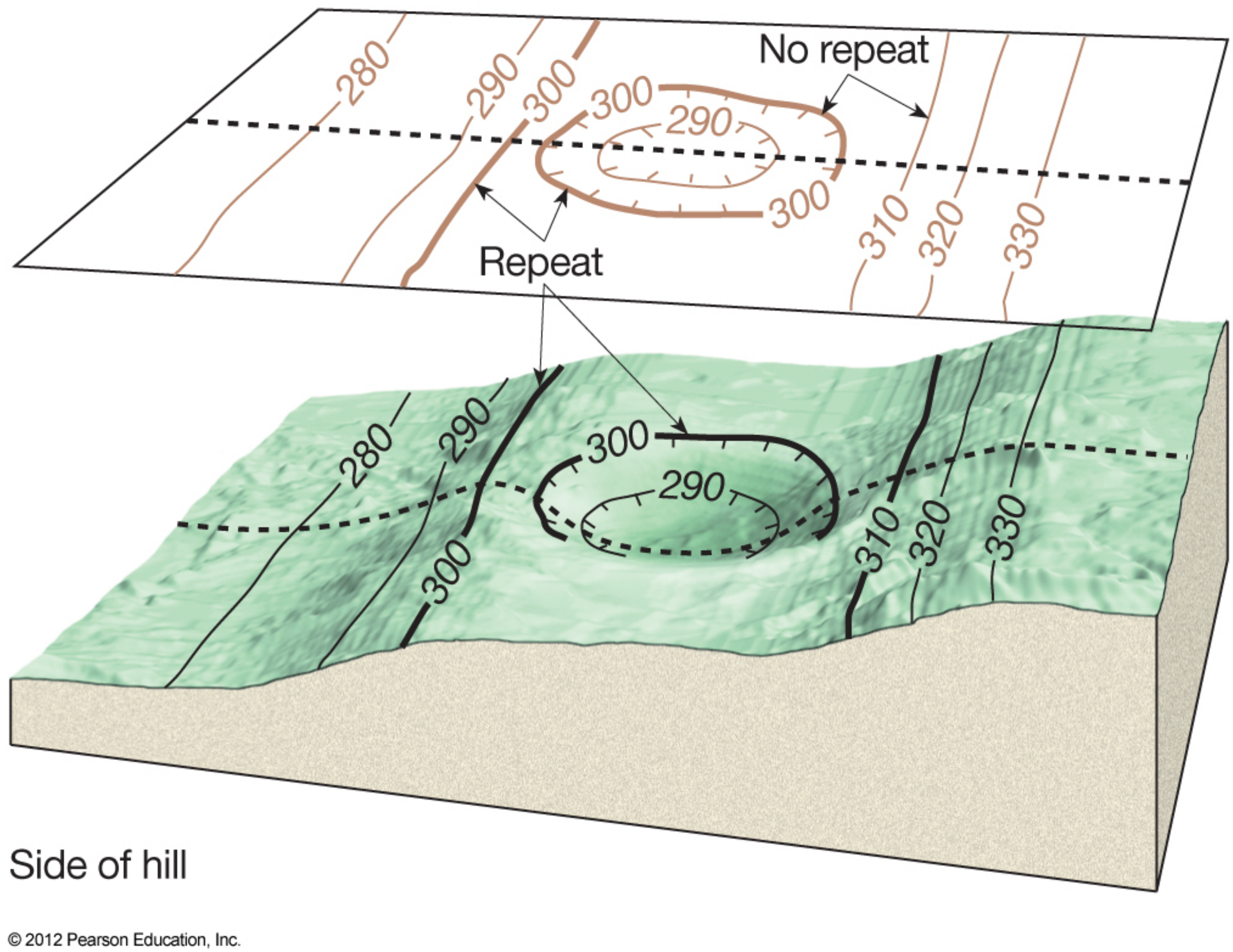

280
290
300
300
290
300
300
290
280
Repeat
Repeat
300
290
300
300
290
280
290
280

Top of hill


No repeat
280
290
300
300
290
300
310
320
330
Repeat
280
290
300
300
290
310
320
330
Side of hill
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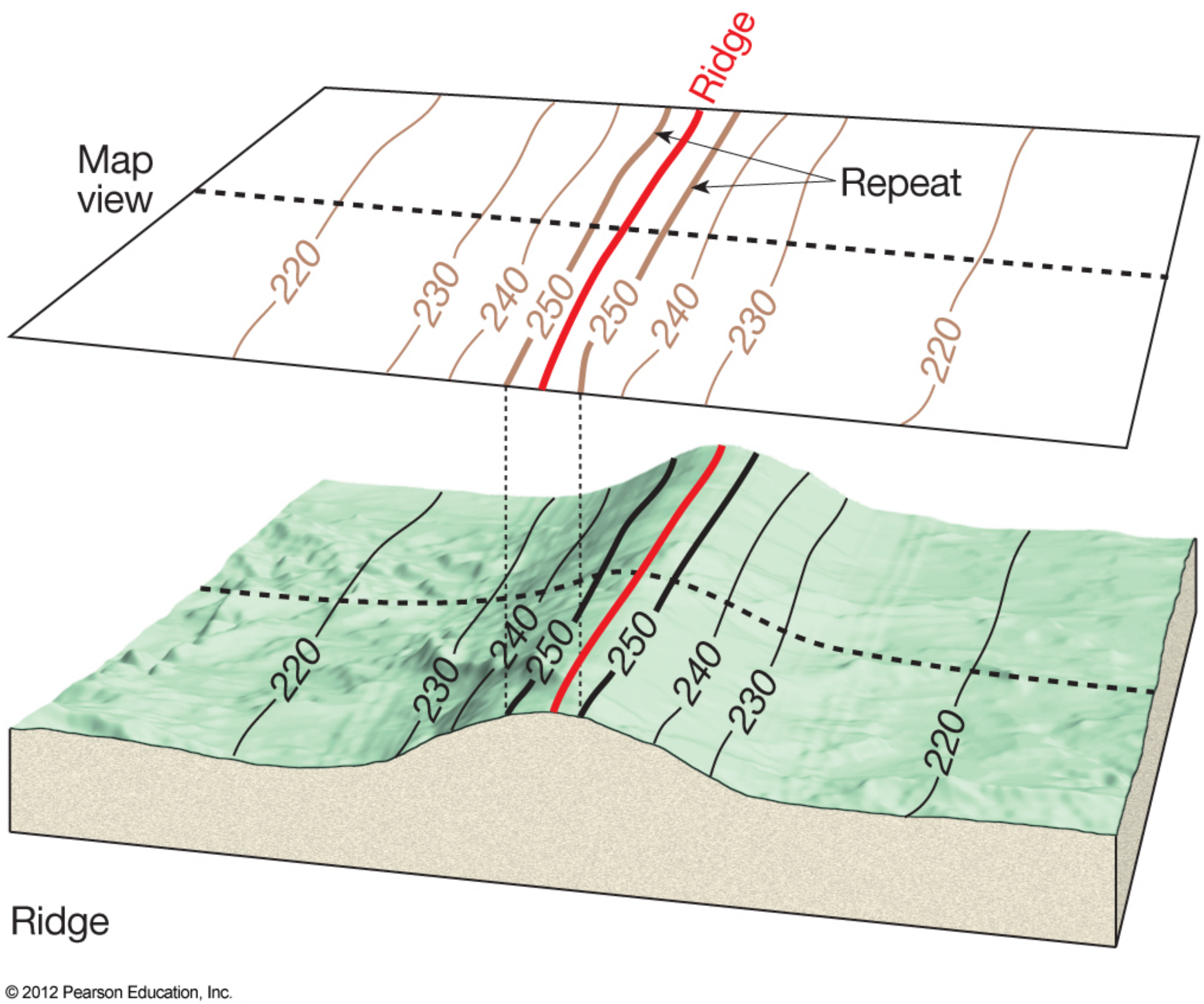
Ridge
Map view
Repeat
220
230
240
250
250
240
230
220
220
230
240
250
250
240
230
220
Ridge
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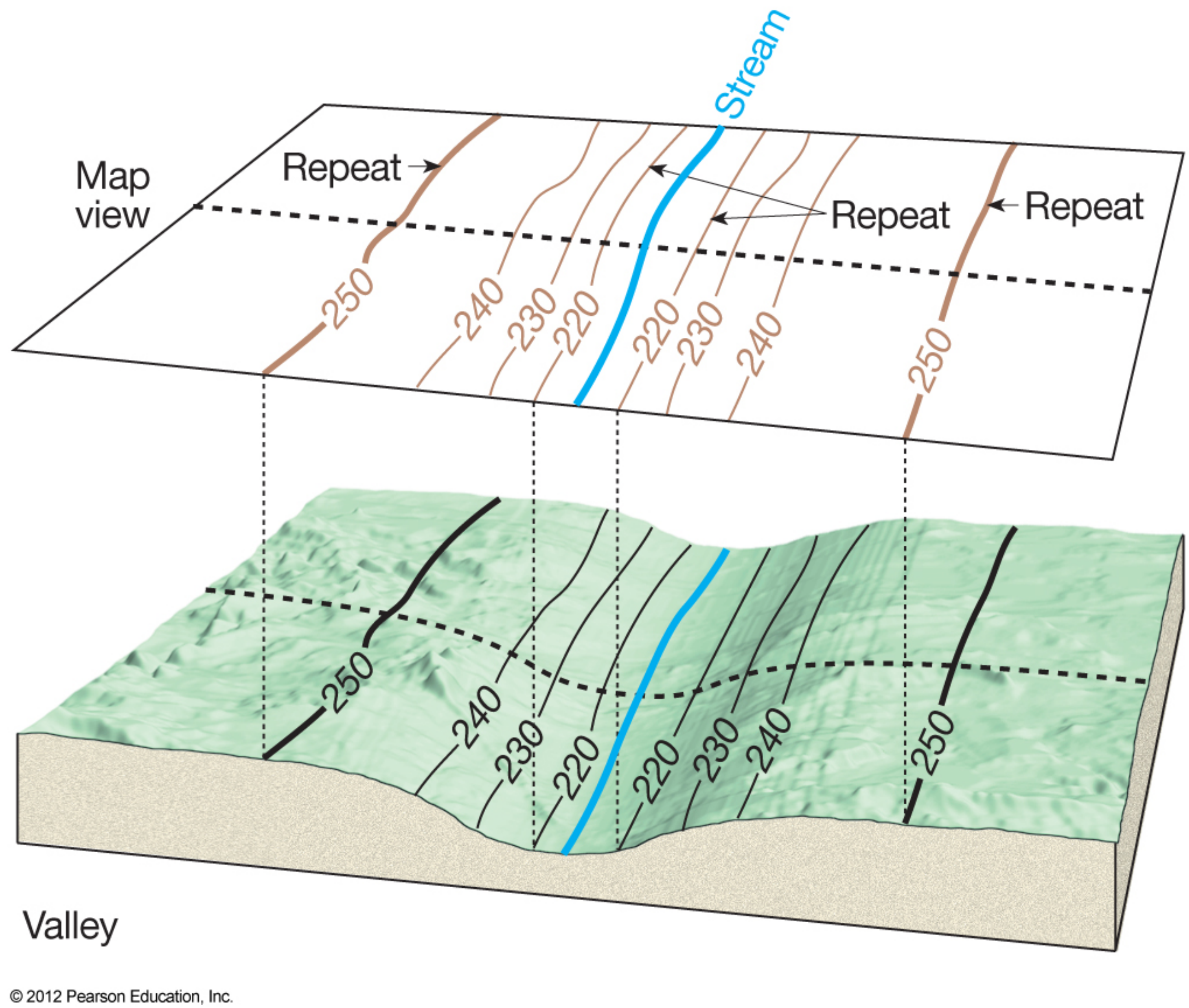
Map view
Repeat
Stream
Repeat
Repeat
250
240
230
220
220
230
240
250
250
240
230
220
220
230
240
250
Valley
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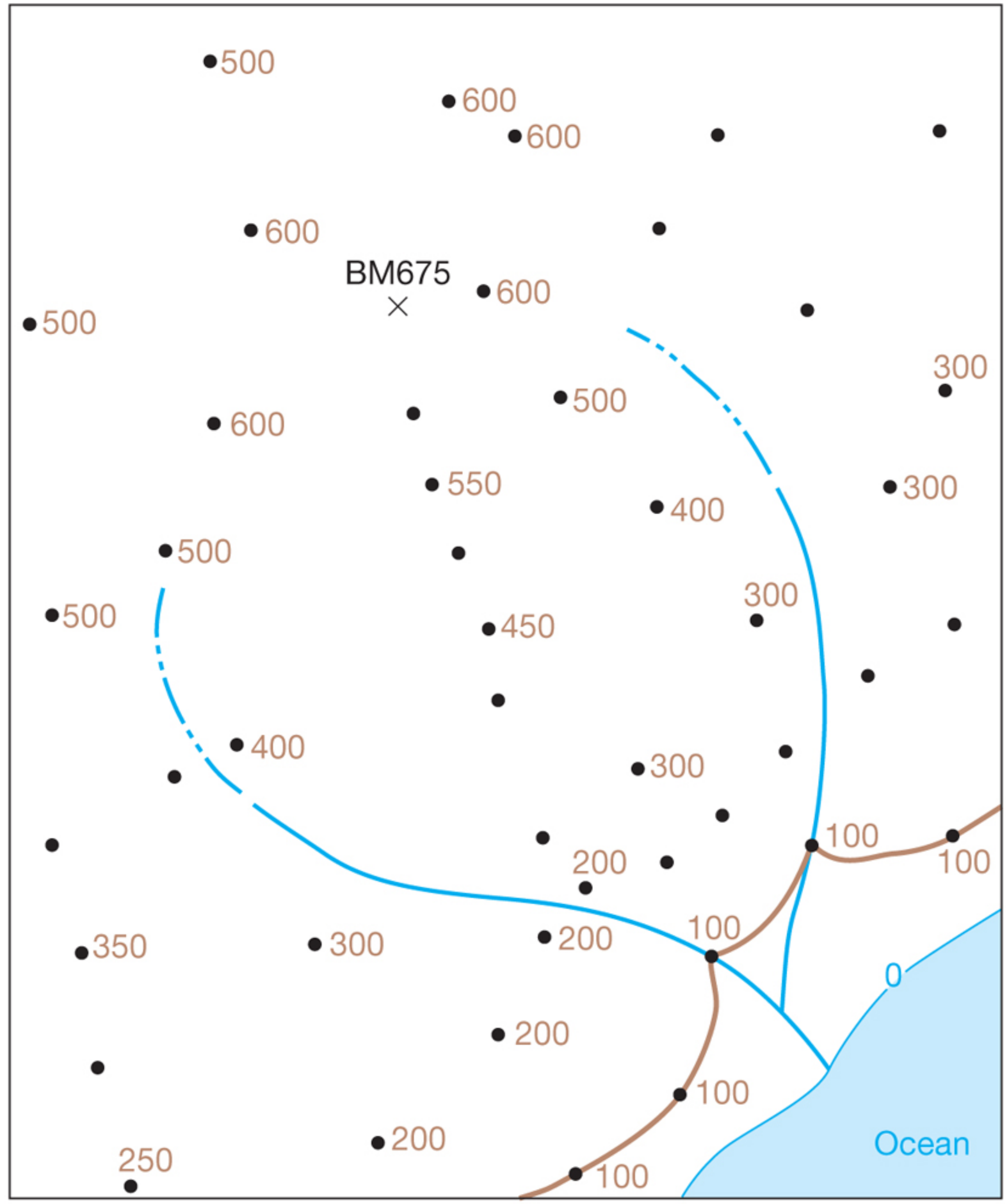
Activity 1: making a contour map (example)



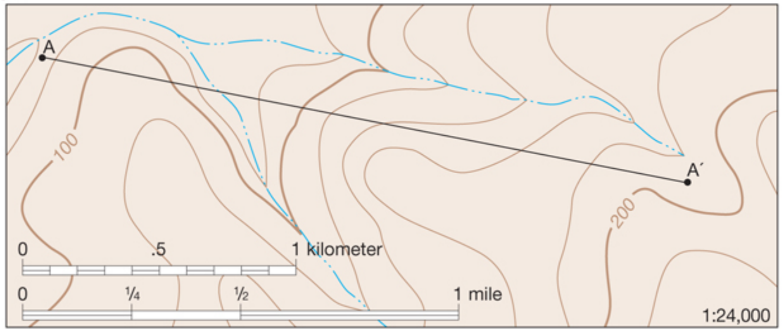
Activity 2
Reading Bathymetry Contour Maps

- Bathymetry: measurements at depth
- Works like other maps, but isobaths (lines at the same depth) are often in fathoms
- 1 fathom is 6 feet
- On your map, land contours are in feet
- Most of the world uses the metric system for both above and below sea level!

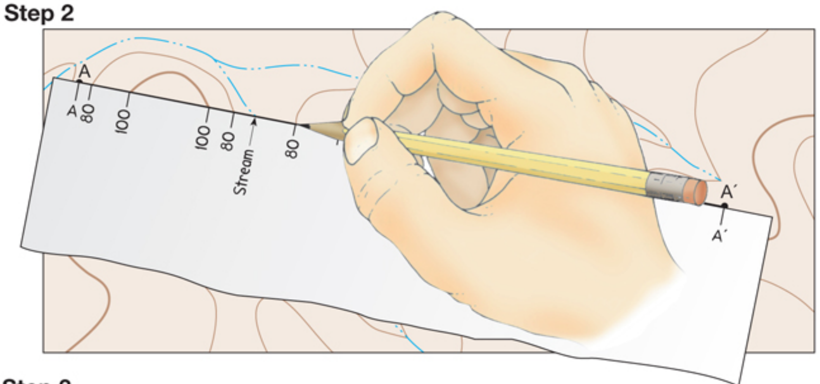
Activity 3 (follow instructions on lab manual)
Activity 4 – Making profiles

- In this section, you will construct profiles of isobaths to help you visualize the shape of the ocean bottom
  - A profile is a cross-section, or “side view”

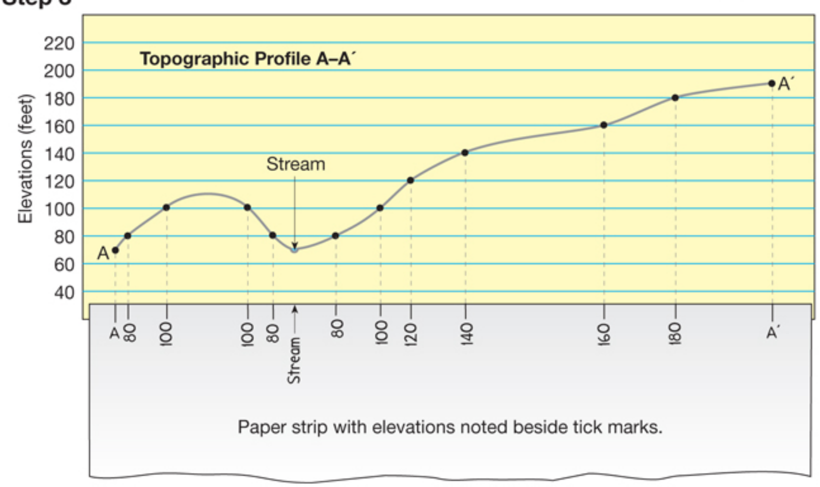
Step 1



Step 2



Step 3



Step 4 Vertical Exaggeration

On most topographic profiles, the vertical scale is exaggerated (stretched) to make landscape features more obvious. One must calculate how much the vertical scale (V) has been exaggerated in comparison to the horizontal scale (H).

The horizontal scale is the map's scale. This map has an H ratio scale of 1:24,000, which means that 1 inch on the map equals 24,000 inches of real elevation. It is the same as an H fractional scale of 1/24,000.

On the vertical scale of this topographic profile, one inch equals 120 feet or 1440 inches (120 feet x 12 inches/foot). Since one inch on the vertical scale equals 1440 inches of real elevation, the topographic profile has a V ratio scale of 1:1440 and a V fractional scale of 1/1440.

The vertical exaggeration of this topographic profile is calculated by either method below:

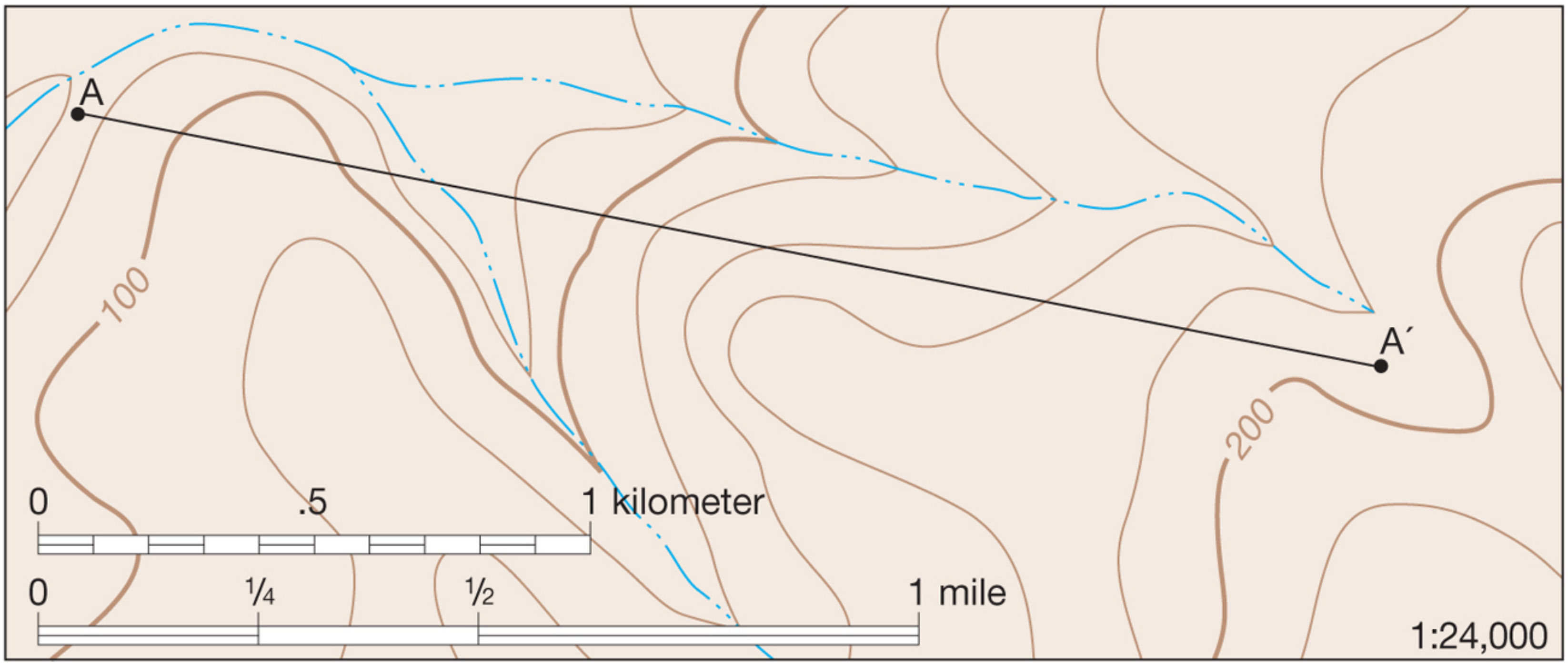
Method 1: Divide the horizontal ratio scale by the vertical ratio scale.

$$\frac{\text{H ratio scale}}{\text{V ratio scale}} = \frac{1{:}24{,}000}{1{:}1440} = \frac{24{,}000}{1440} = 16.7\times$$

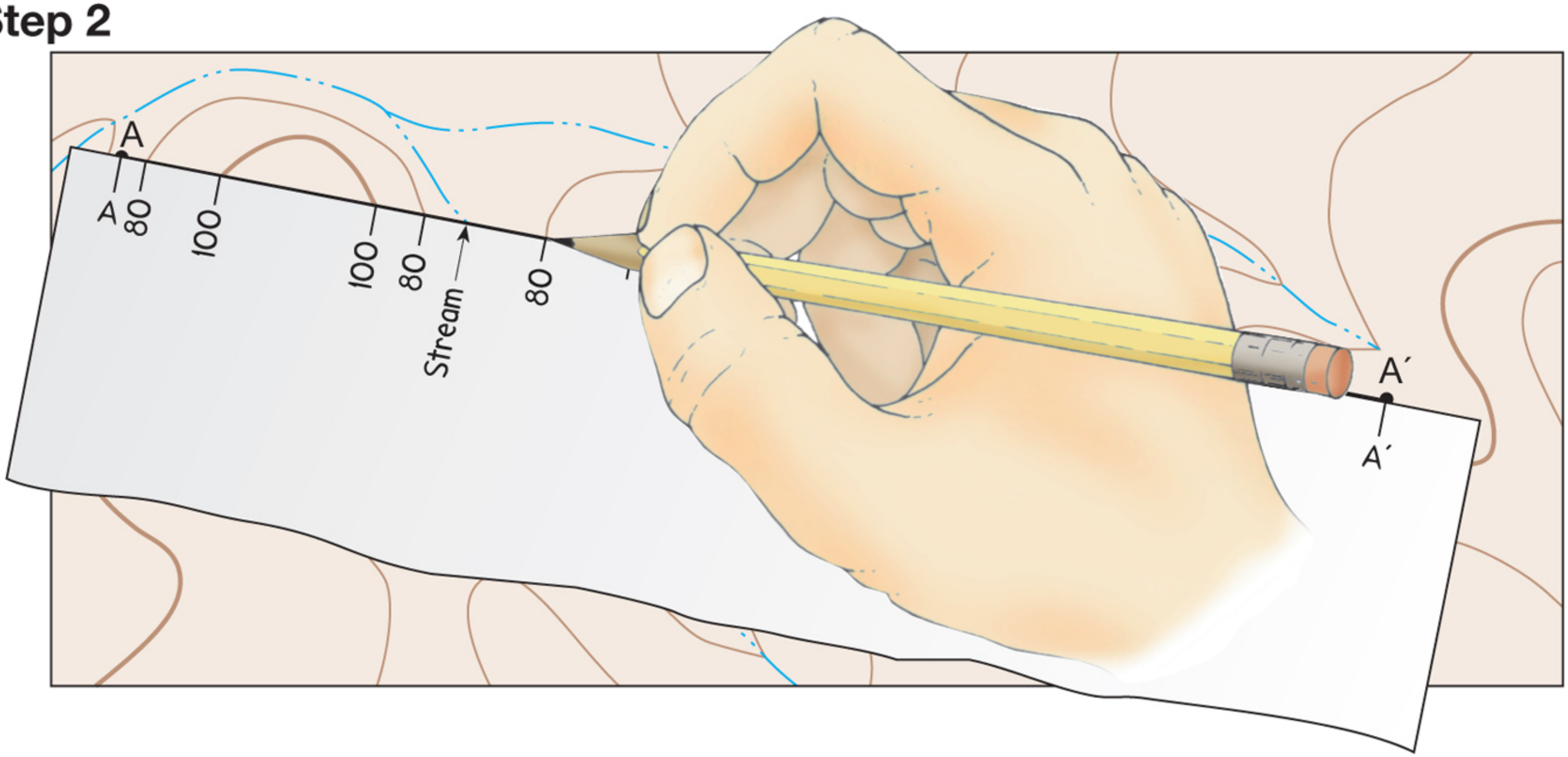
Method 2: Divide the vertical fractional scale by the horizontal fractional scale.

$$\frac{\text{V fractional scale}}{\text{H fractional scale}} = \frac{1/1440}{1/24{,}000} = \frac{24{,}000}{1440} = 16.7\times$$

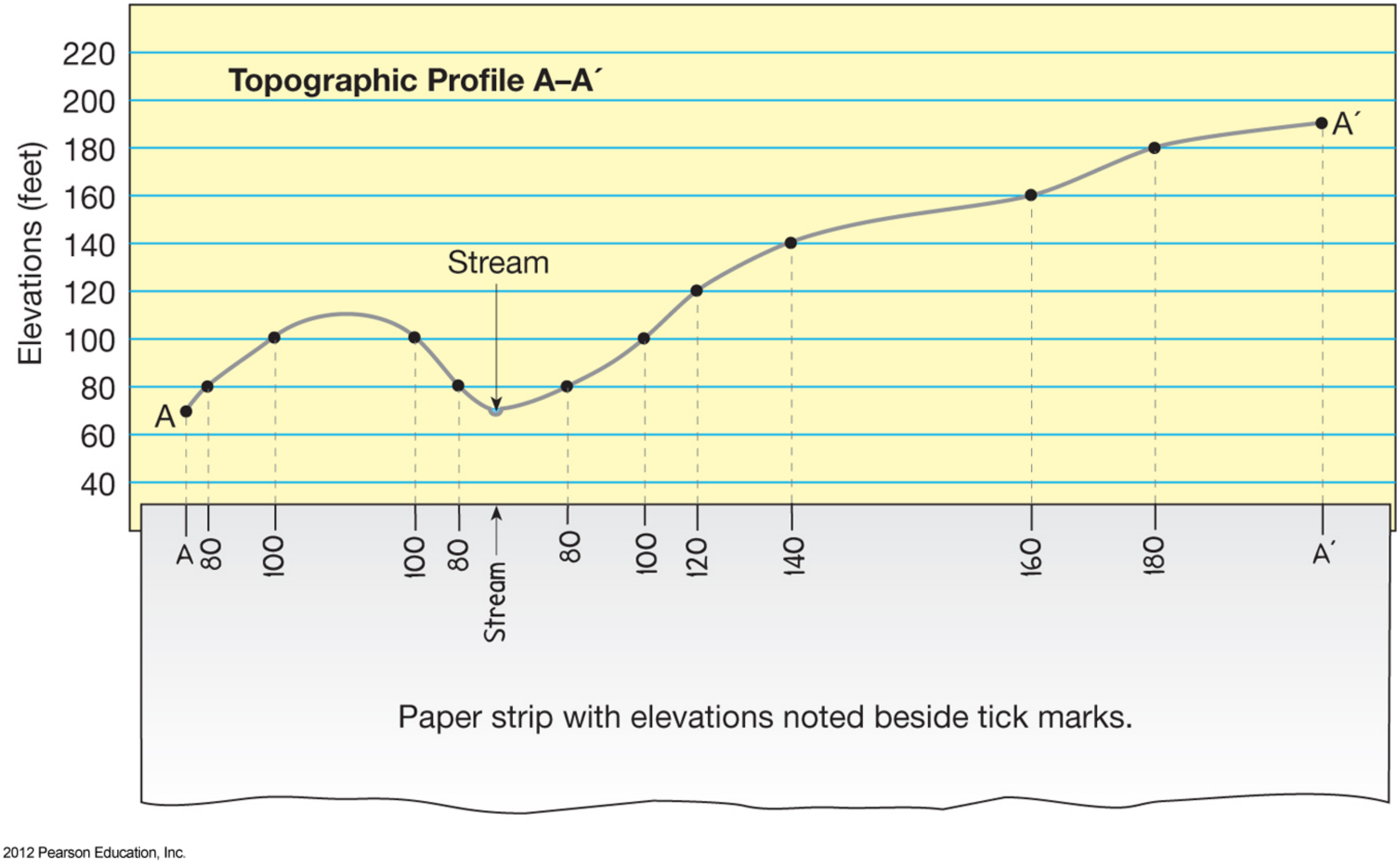
Step 1



Step 2



Step 3



Topographic Profile A–A´
Elevations (feet)
220
200
180
160
140
120
100
80
60
40
A
A´
Stream
A
80
100
100
80
Stream
80
100
120
140
160
180
A´
Paper strip with elevations noted beside tick marks.
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Activity 5
Measurements (Obtaining Data to Contour)

- Depth measurements are obtained through sound pulses

- Temperature, salinity, oxygen content, nutrient content must be measure directly by lowering an instrument and sample bottles mounted on a frame

- Temperature is measure in degrees centigrade, or °C
- Salinity is measured in ppt (parts per thousands), or ‰
- Oxygen content is measured in mL/L (milliliters of oxygen per liter of water)

- Vertically, our oceans can be subdivided in three layers. Based on variations in temperature, we have:
  - Mixed layer
    - Surface part where waves and wind “mix” water to uniform conditions
  - Thermocline
    - Layer below the previous, where temperature changes dramatically
  - Deep ocean
    - In here, conditions are relatively uniform and stable