

Skill puzzles for structural geology



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Component skills

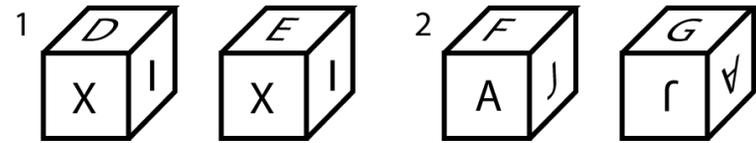
mental rotation

spatial manipulation

penetrative thinking

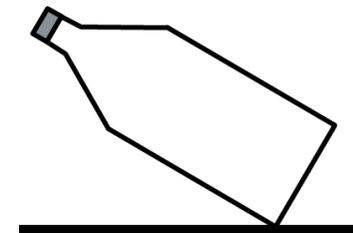
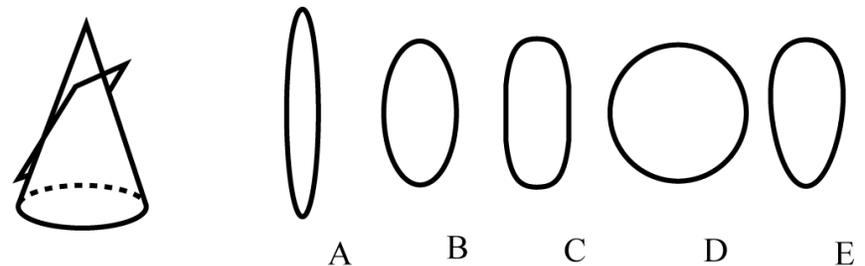
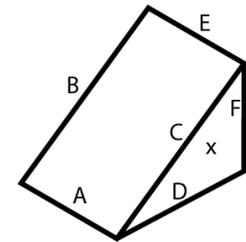
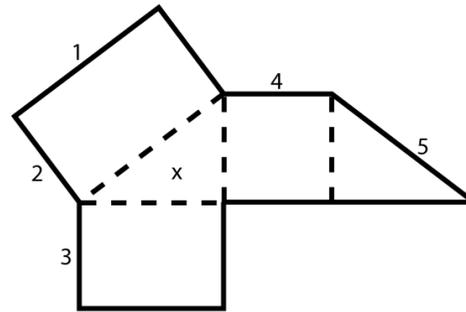
spatial principles

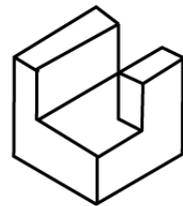
mostly from Ekstrom et al. (1976)



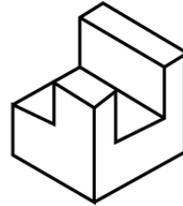
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S □ D □

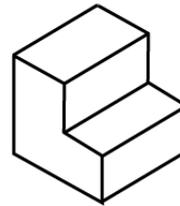




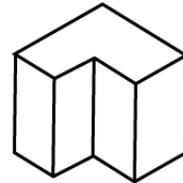
IS TO



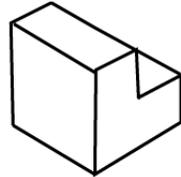
AS



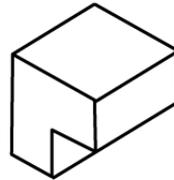
IS TO



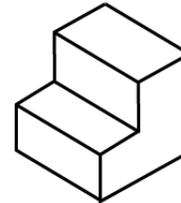
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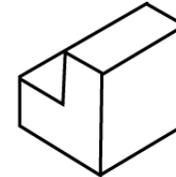
B



C



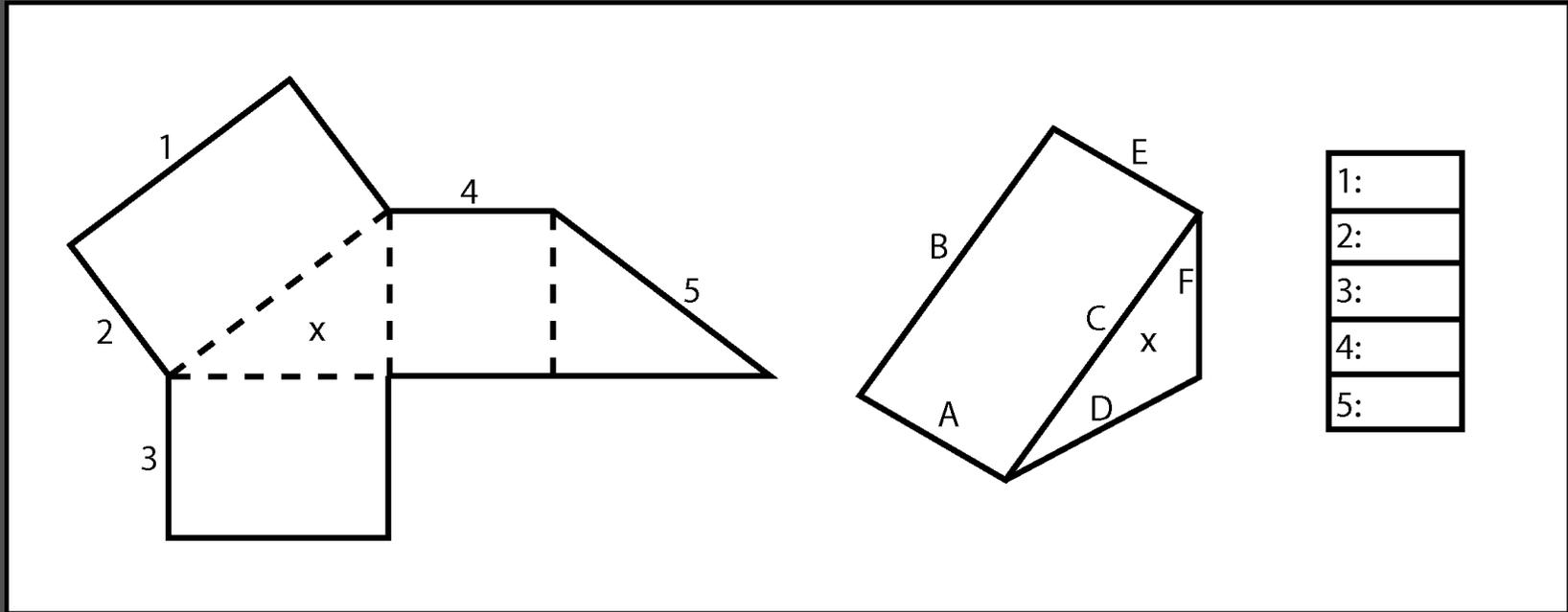
D



E

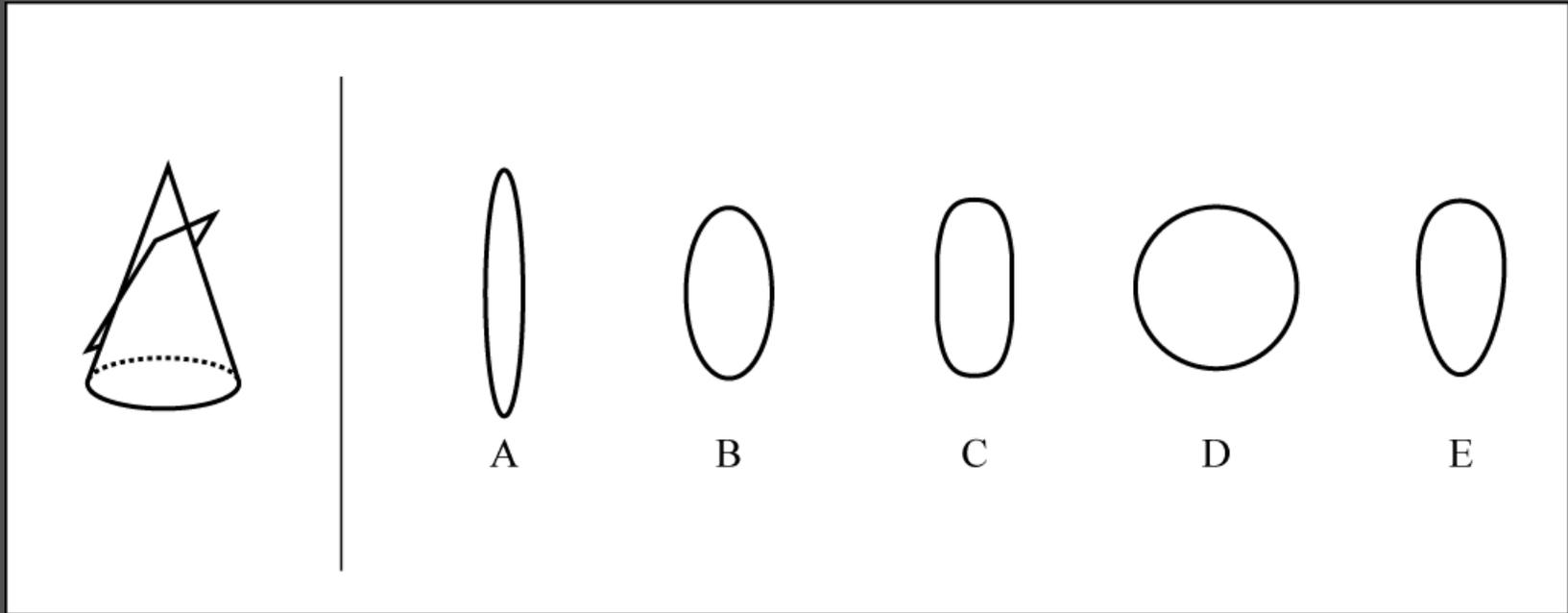
mental rotation

Guay (1976)



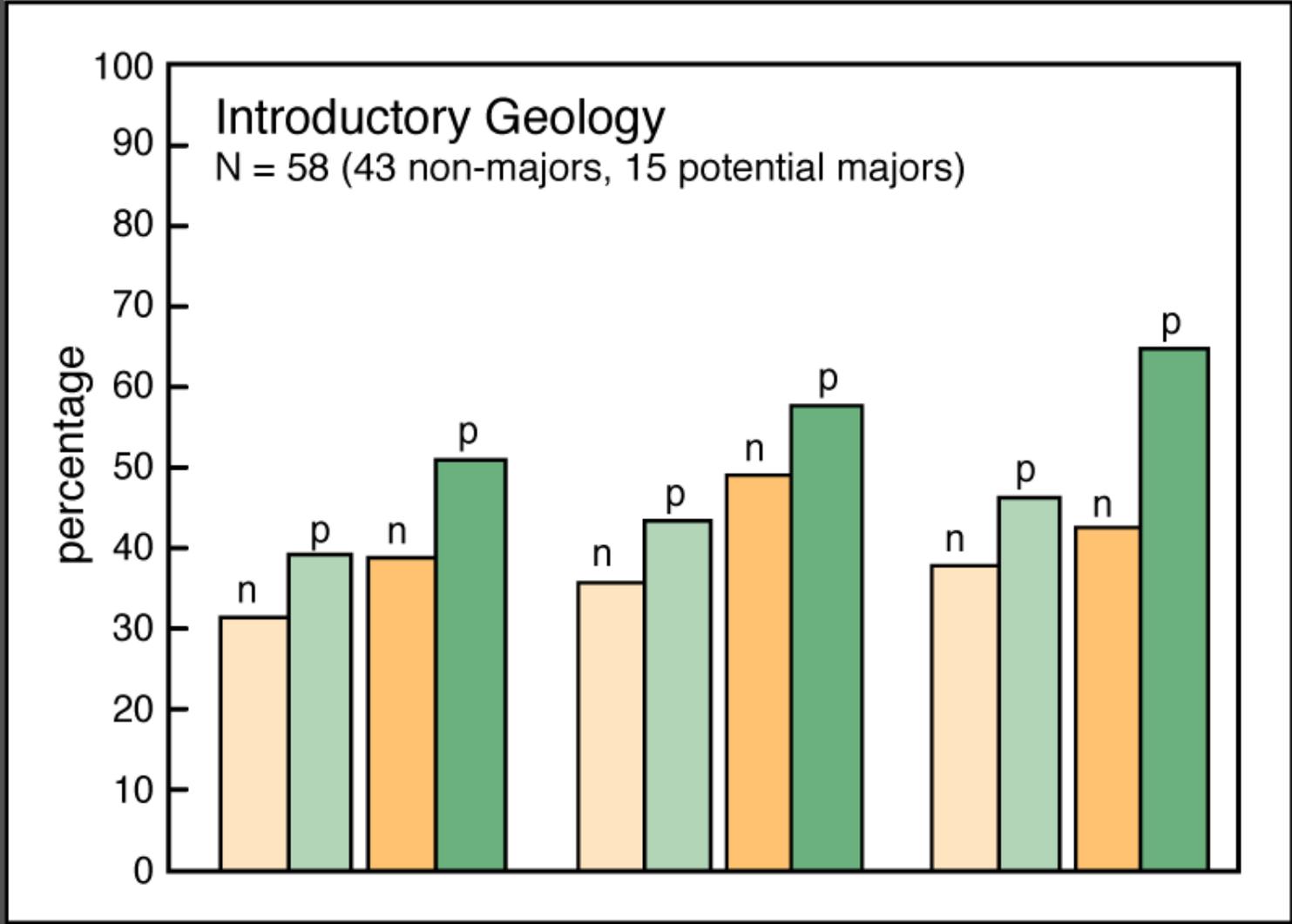
spatial manipulation

Ekstrom et al. (1976)



penetrative thinking

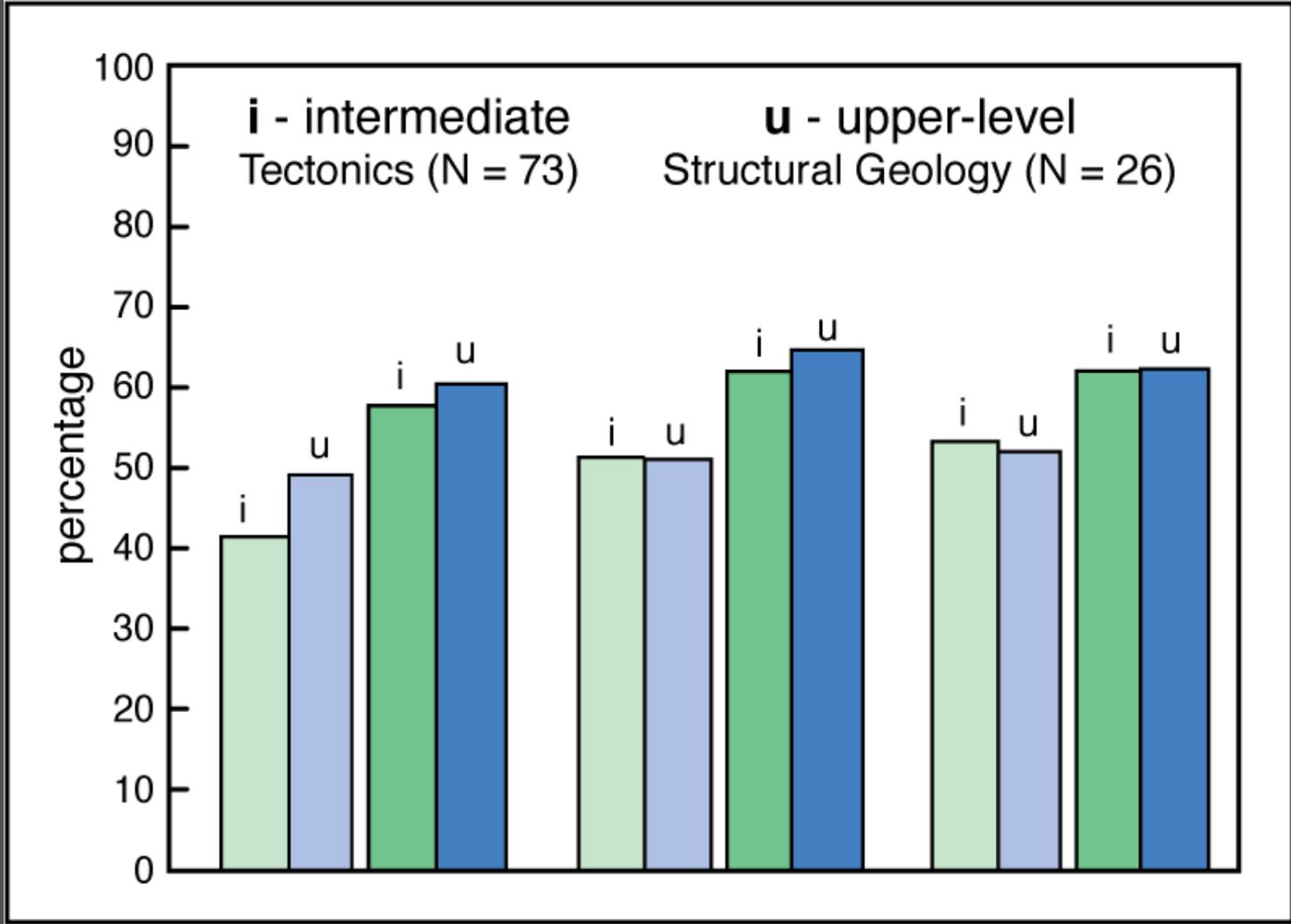
Crawford & Burnham (1946) and Myers (1953)



mental
rotation

spatial
manipulation

penetrative
thinking

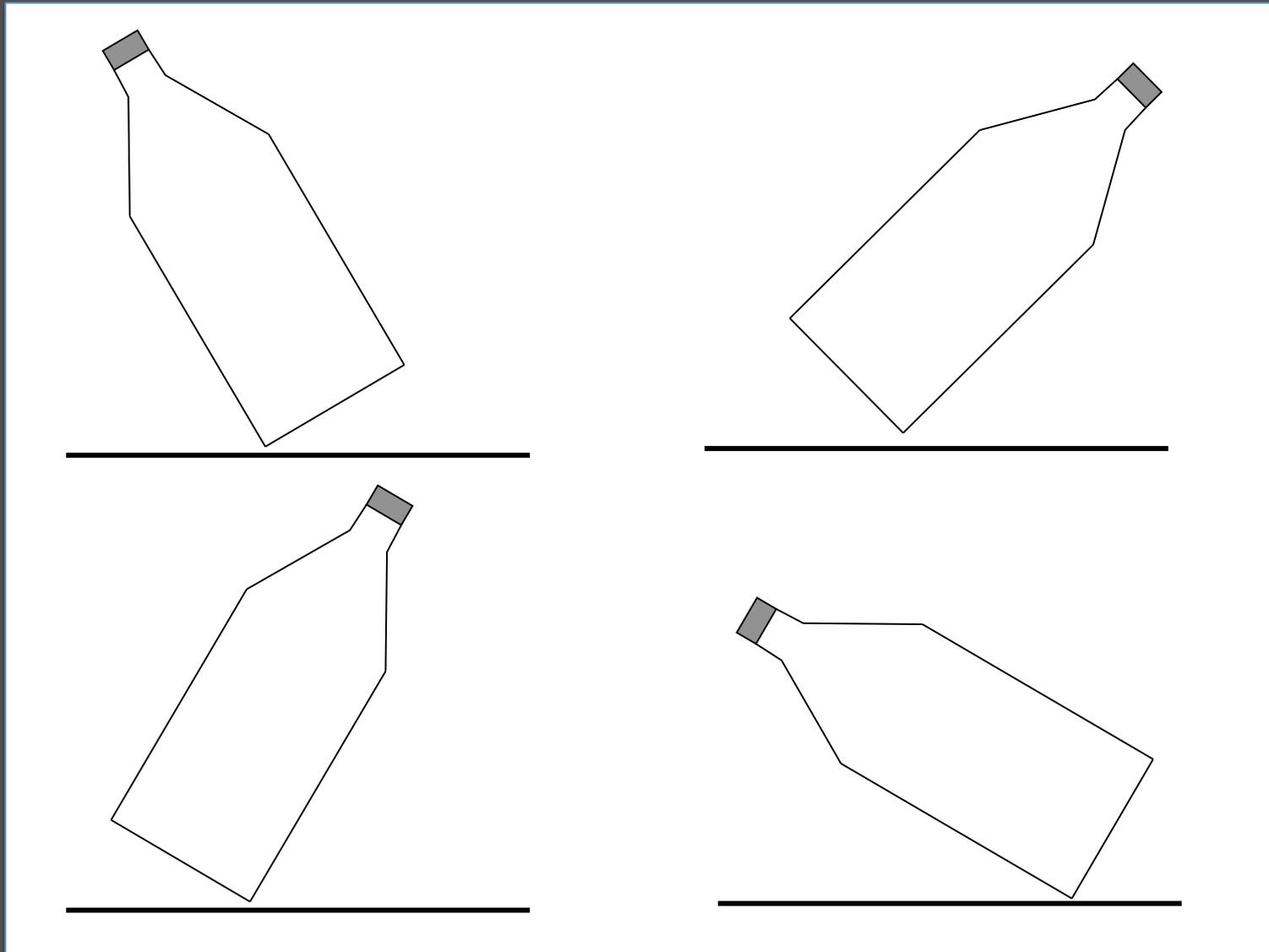


mental
rotation

spatial
manipulation

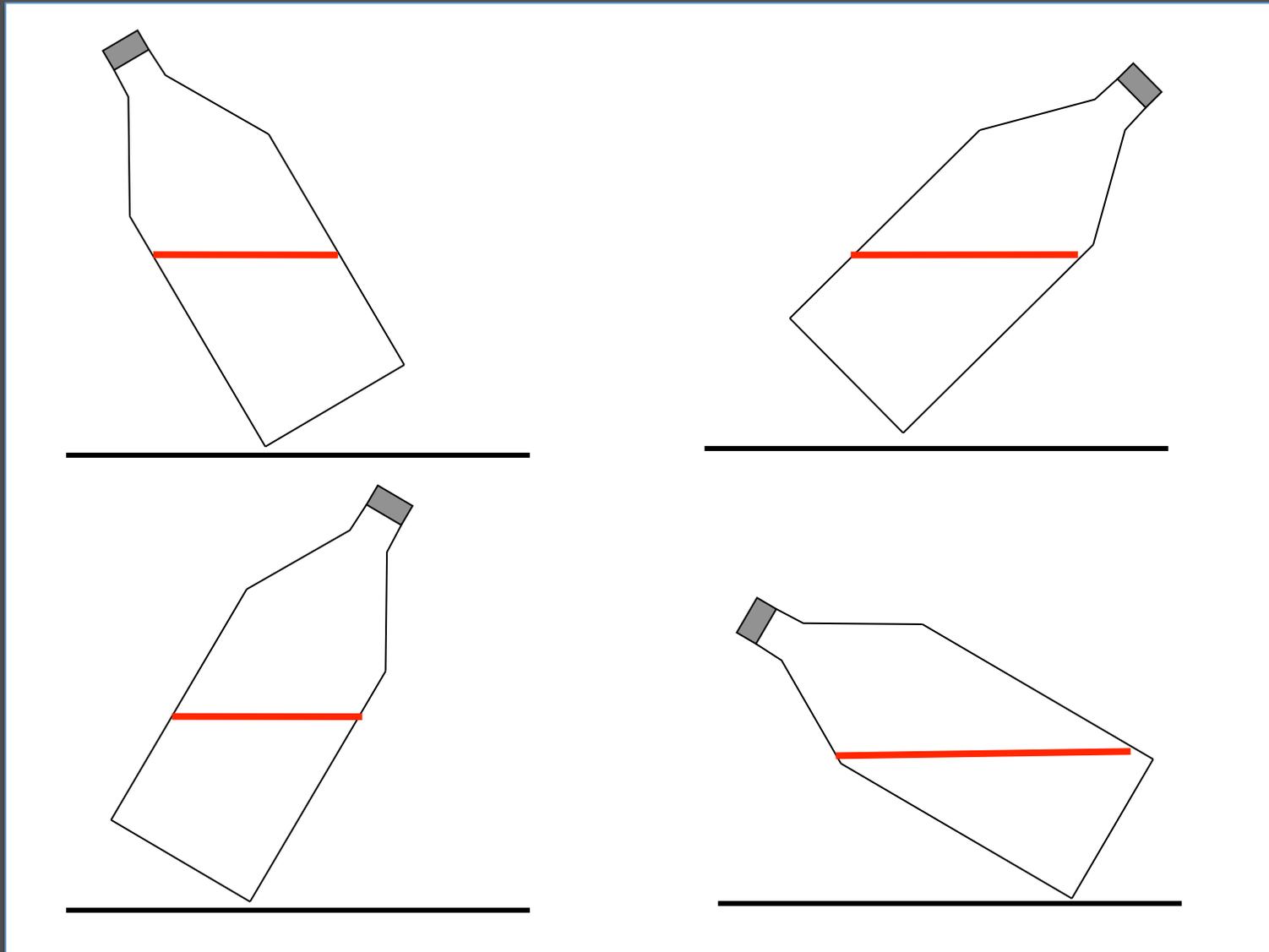
penetrative
thinking

Spatial principles: water level task



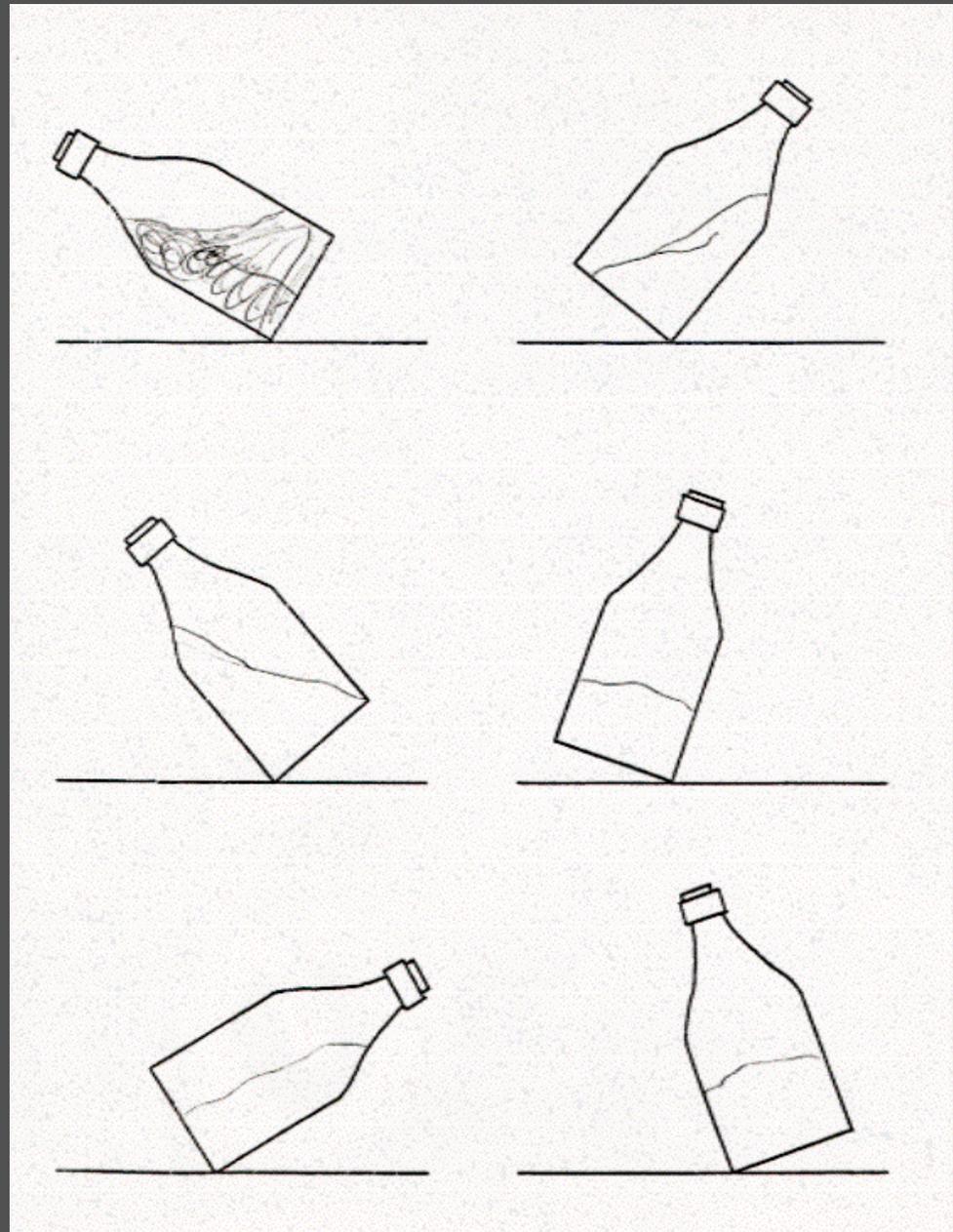
Task from Lynn Liben

Spatial principles: water level task



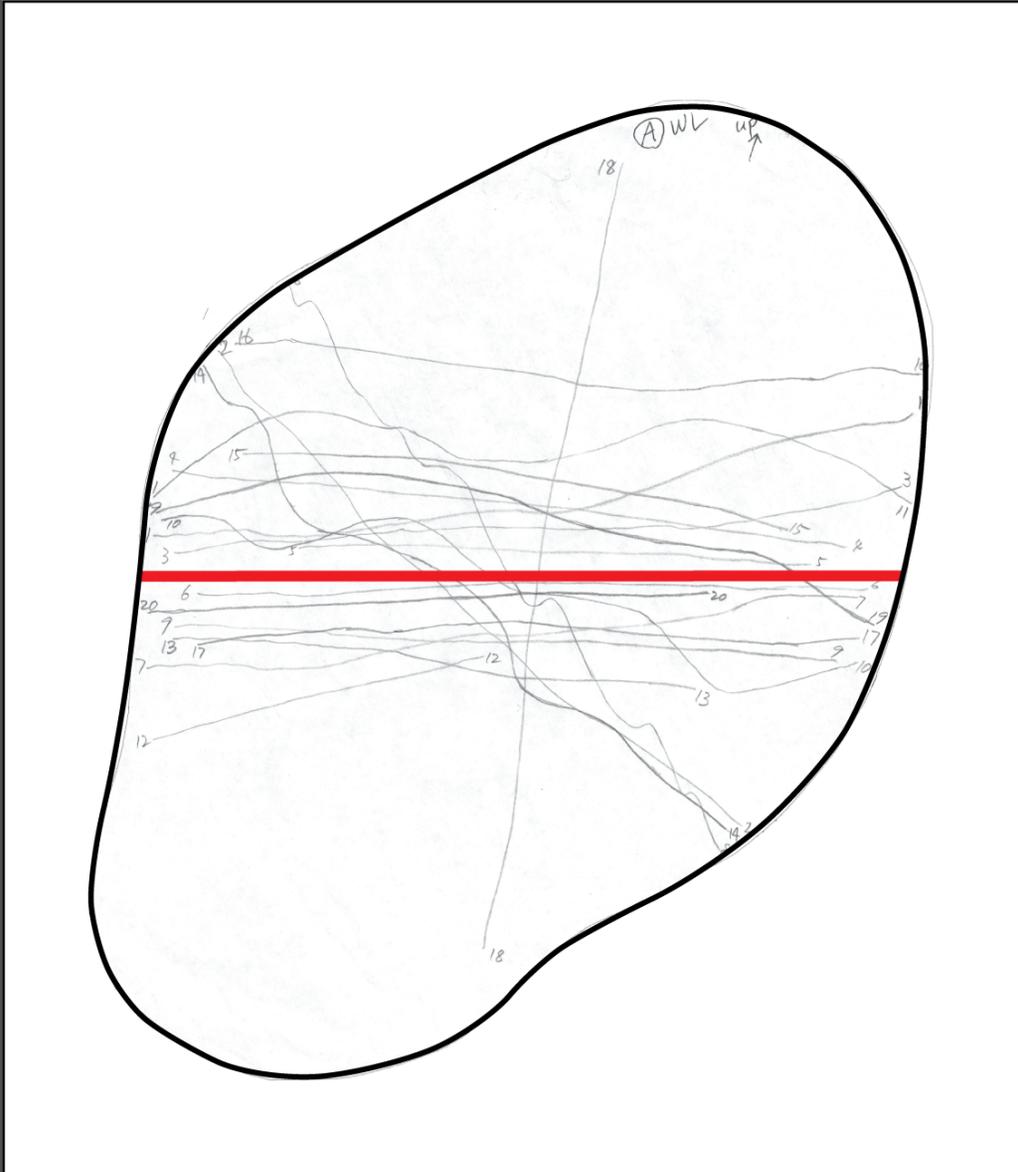
Task from Lynn Liben

Sample answers



Data from Lynn Liben

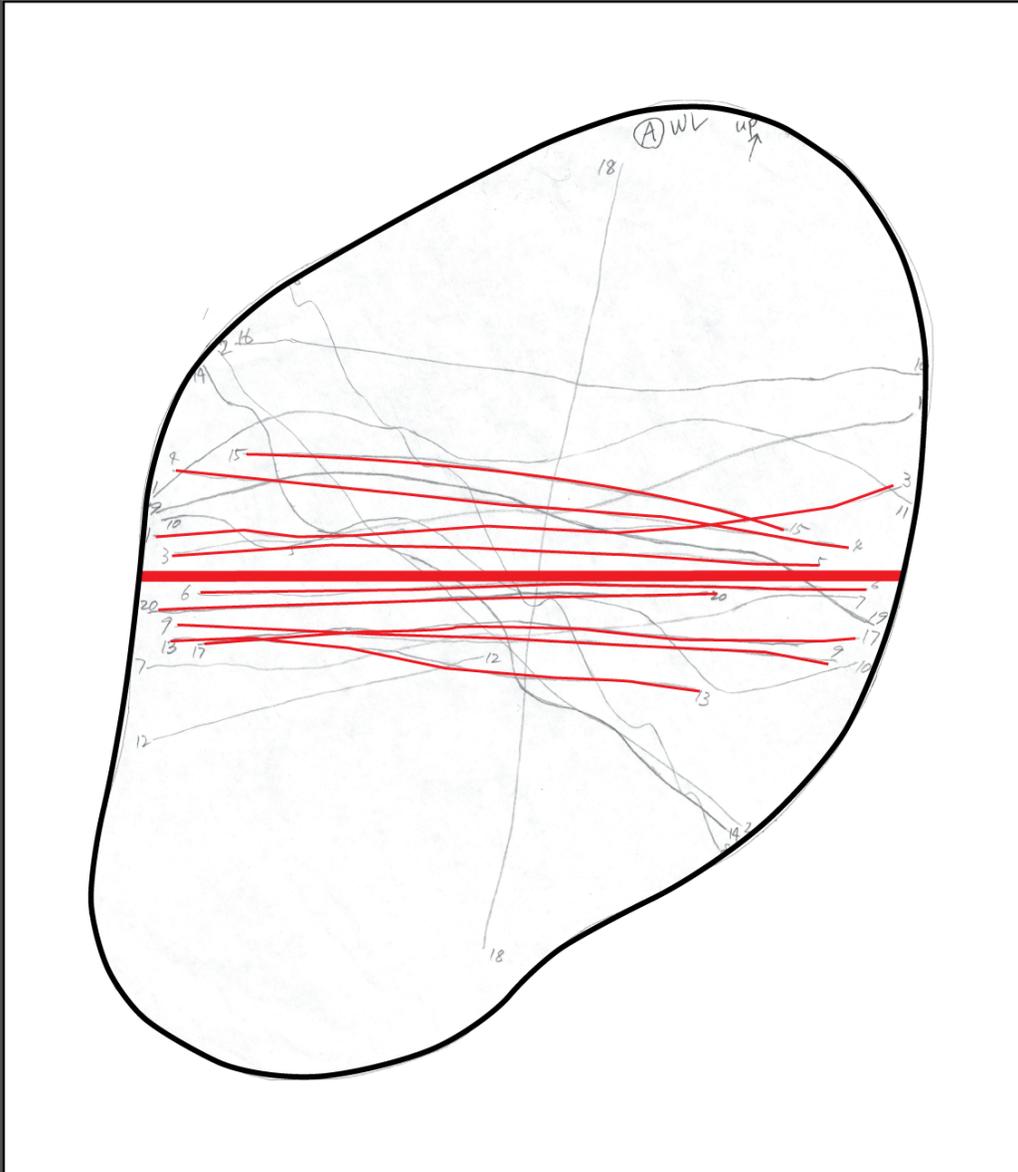
Shoreline task – estimating horizontal



**Correct answer
shown in red**

Data from Liben & Kastens

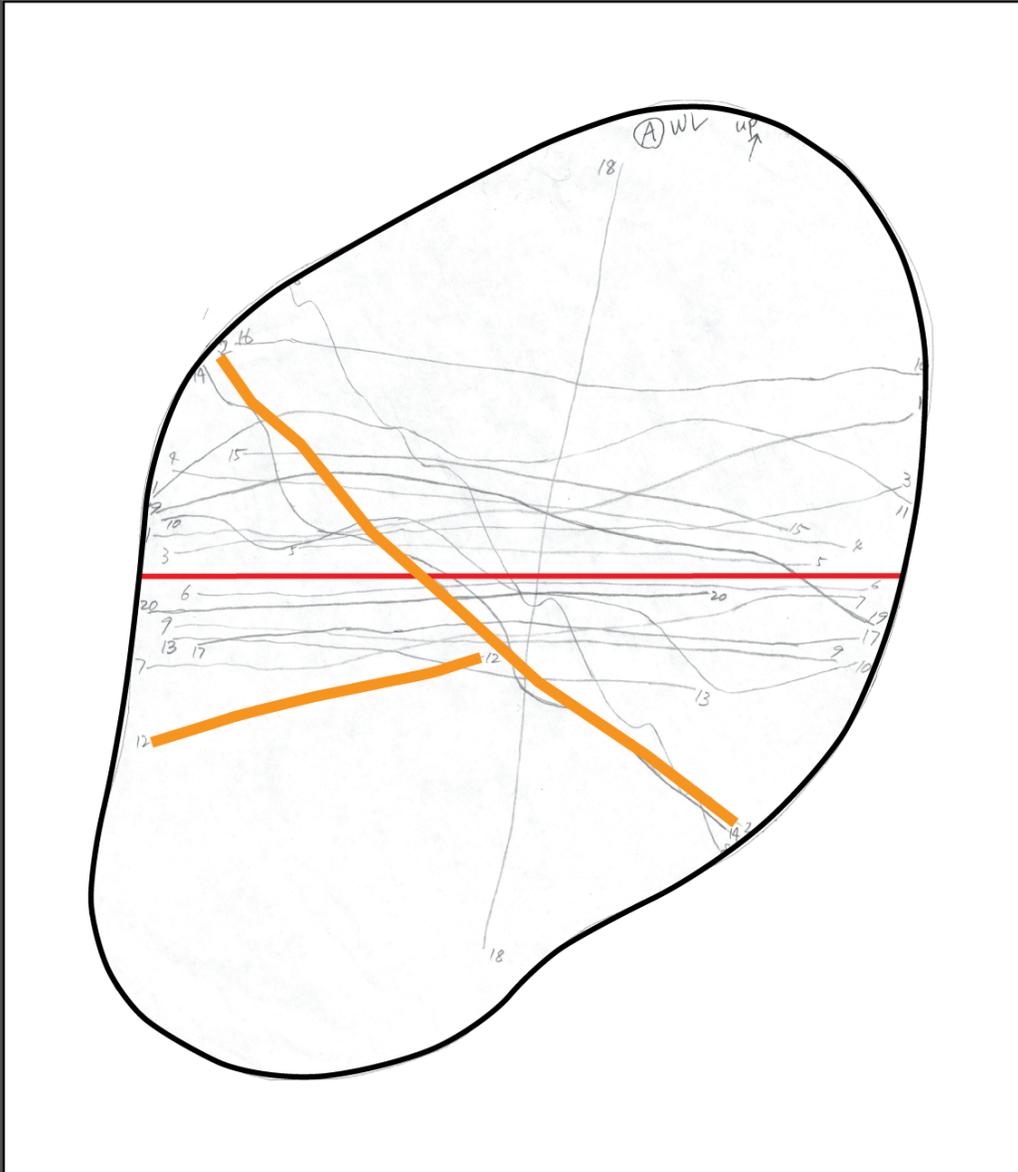
Shoreline task – estimating horizontal



Some student answers are fine

Data from Liben & Kastens

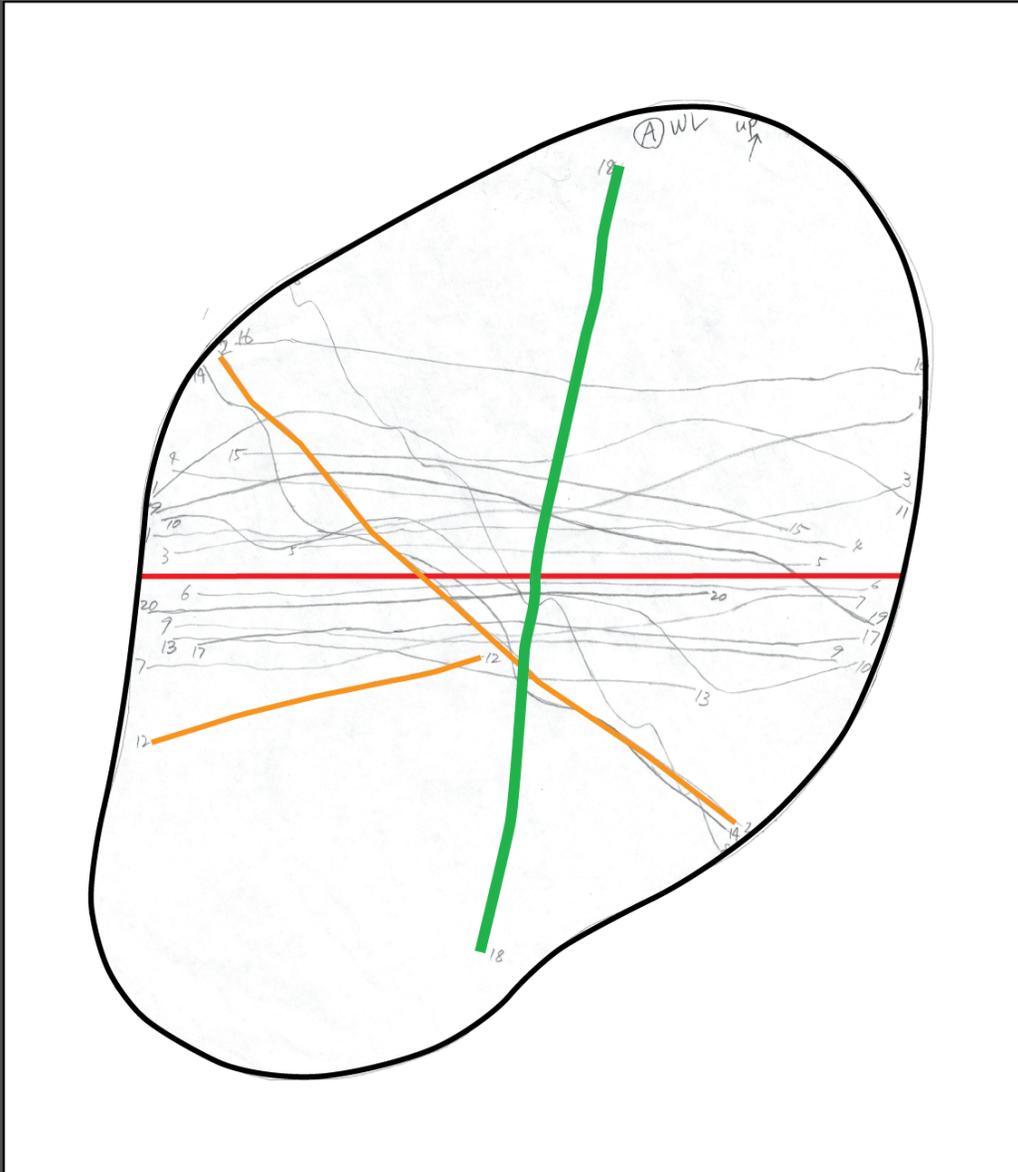
Shoreline task – estimating horizontal



Some drew straight lines 10-45° from correct answer

Data from Liben & Kastens

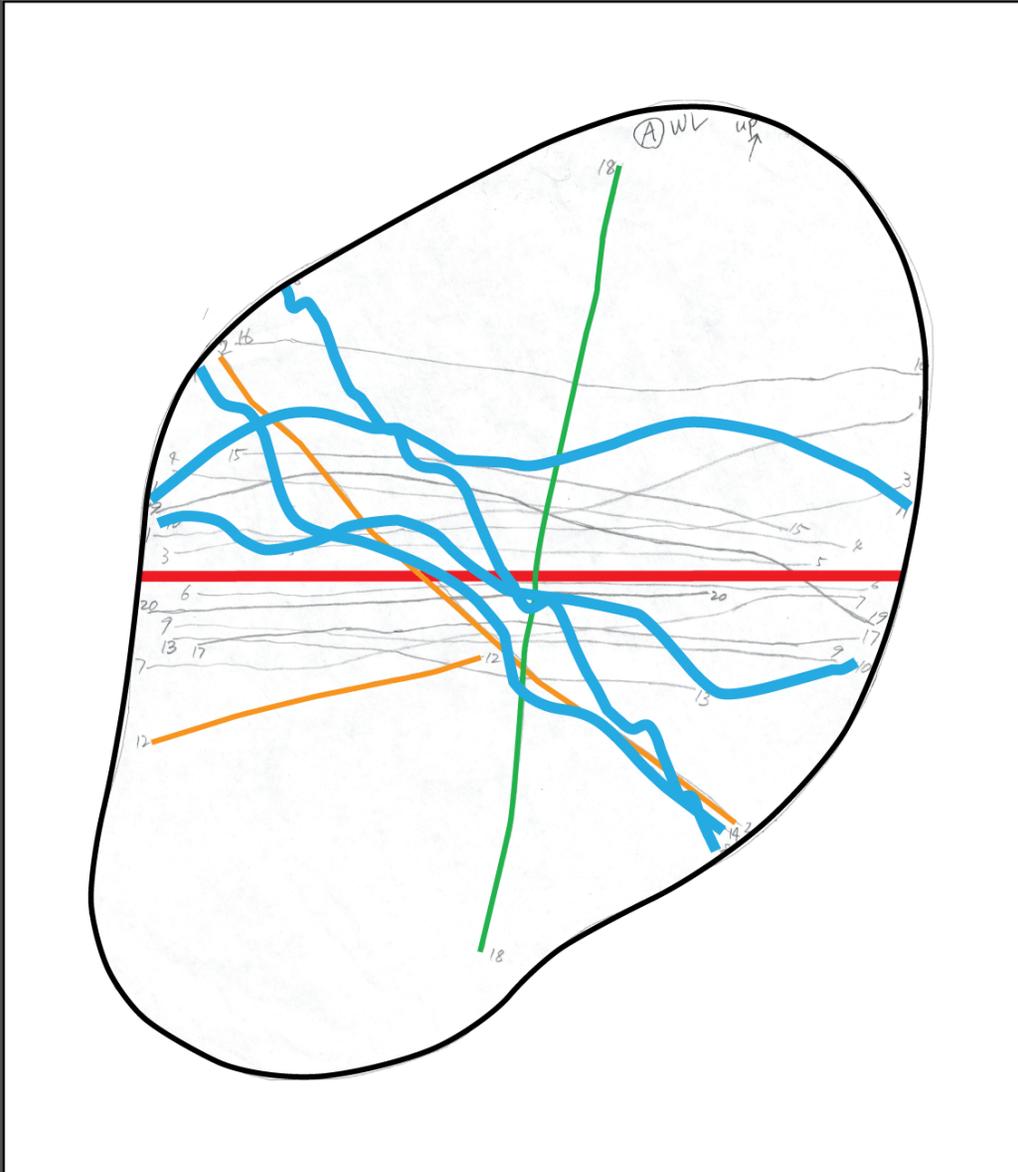
Shoreline task – estimating horizontal



Line drawn parallel
to long axis of
surface?

Data from Liben & Kastens

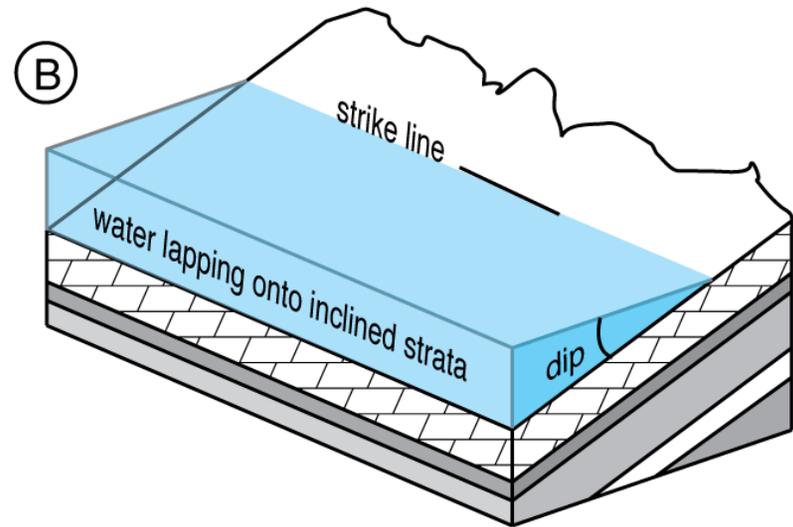
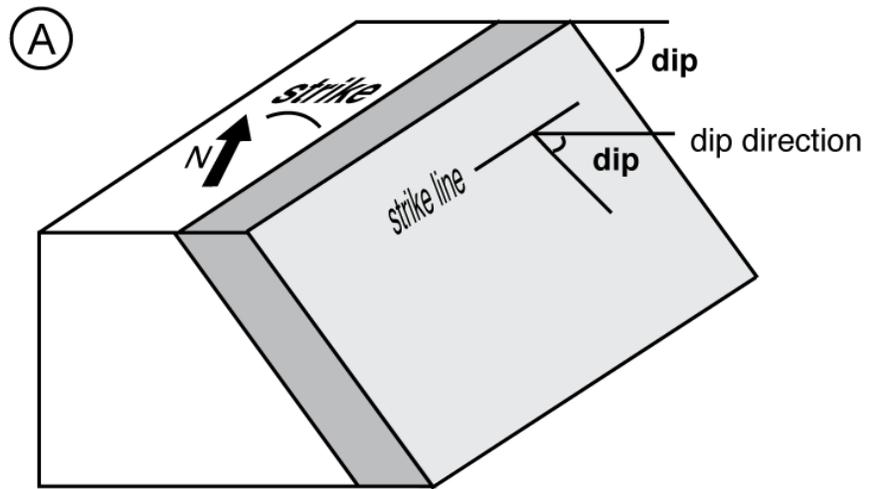
Shoreline task – estimating horizontal



**Wavy lines or
compound curves**

Data from Liben & Kastens

Why does it matter?



Summary

There are different component skills for spatial visualization.

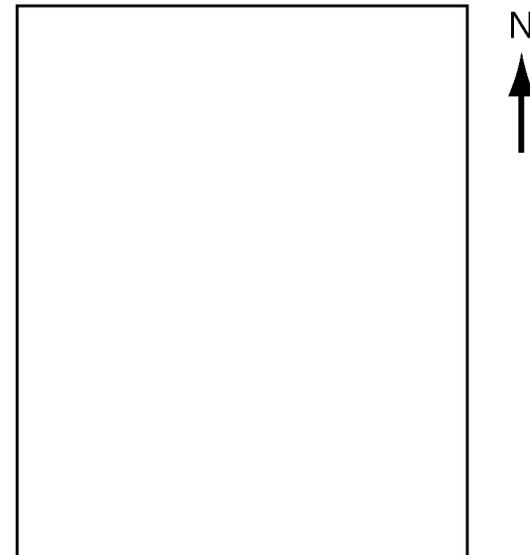
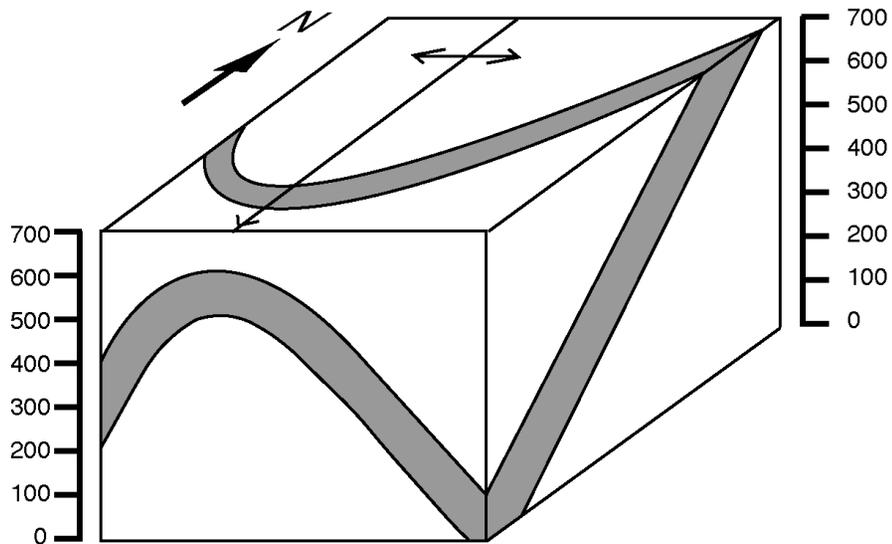
Peoples' spatial abilities vary - it is important to recognize that your students may not be as good as you.

Practice seems to help everyone, regardless of their starting ability.



Lab section: T W

The block diagram on the left shows a folded bed. Elevations are provided along the sides of the block. Please complete the structure contour map on the right for the **top** of the gray unit using 100 m contour intervals.

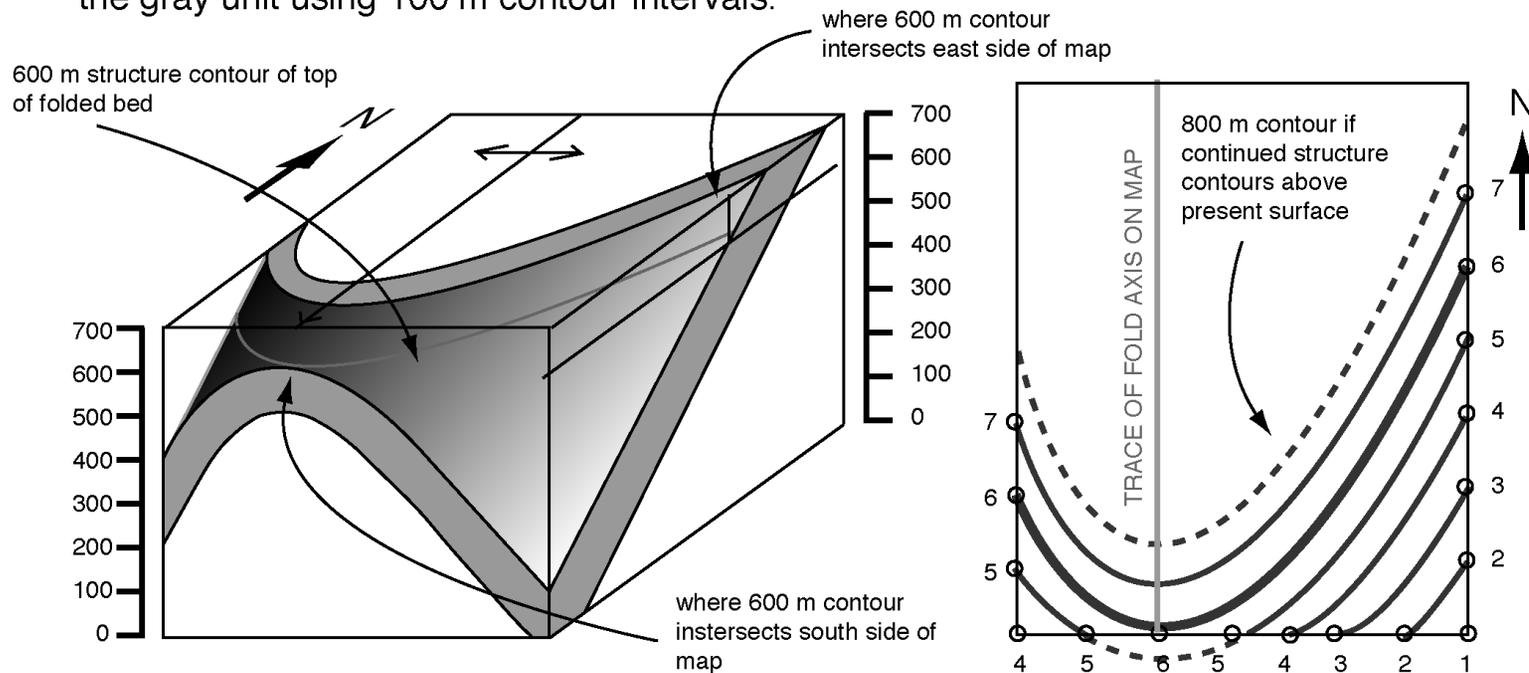


Please describe the structure contours in words:
(spacing, shape of contours etc.)

skill puzzles: in-class exercises for practice

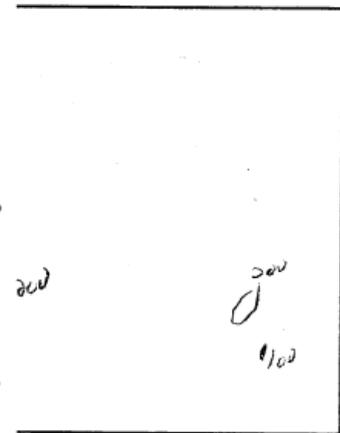
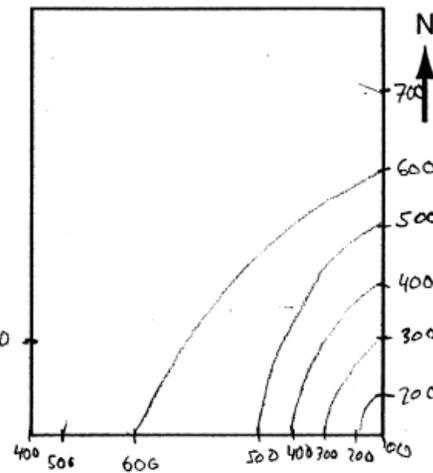
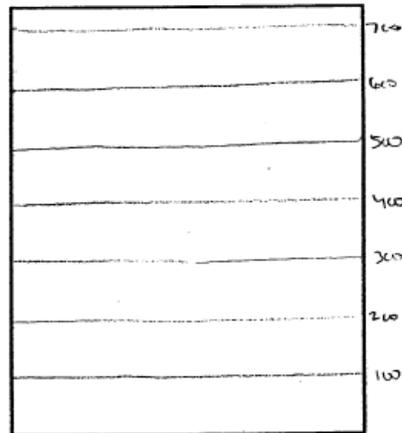
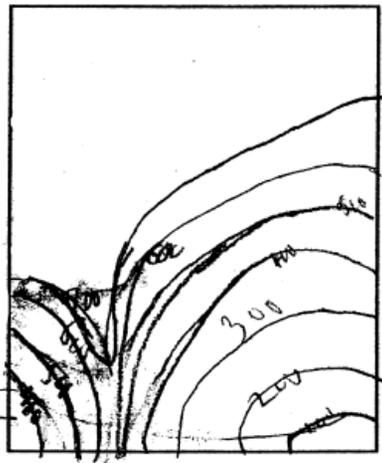
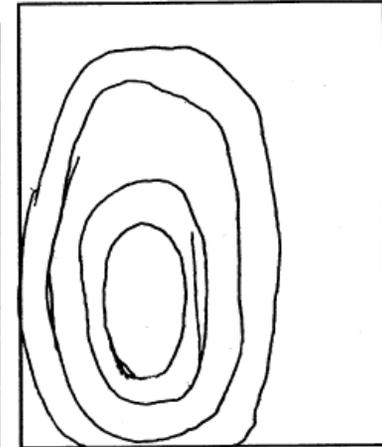
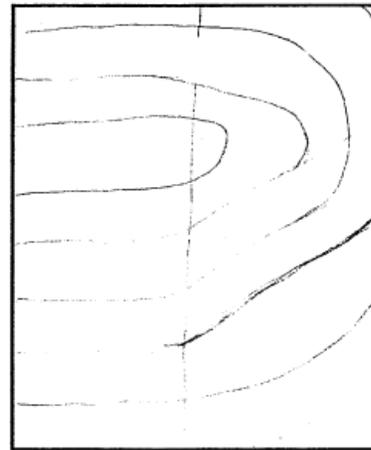
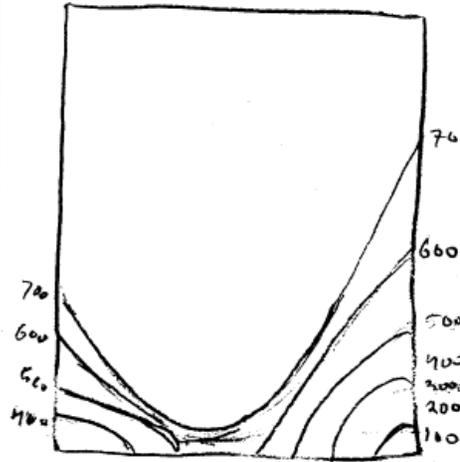
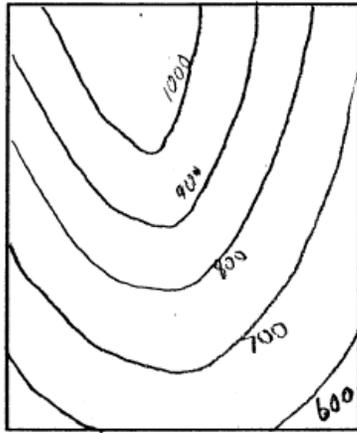
Lab section: T W

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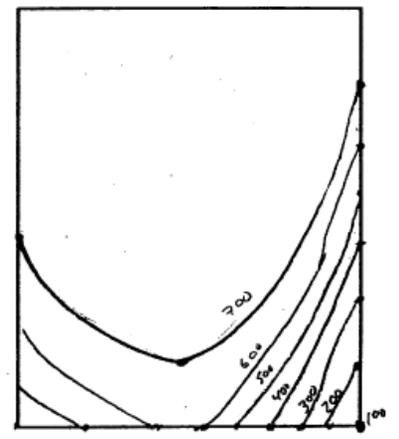
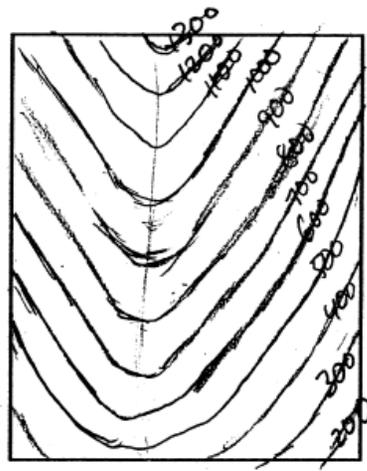
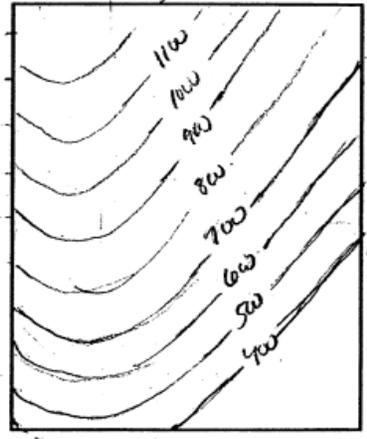
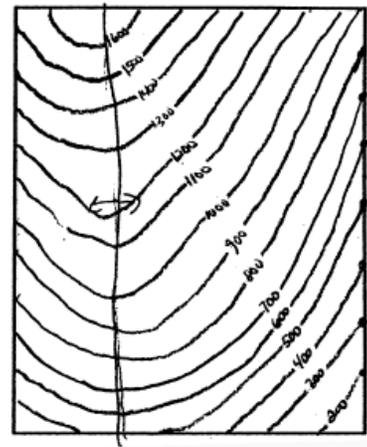
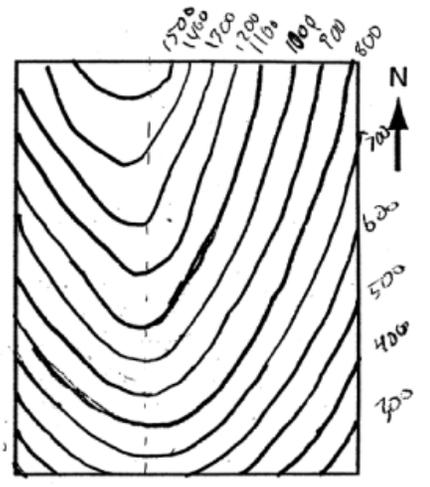
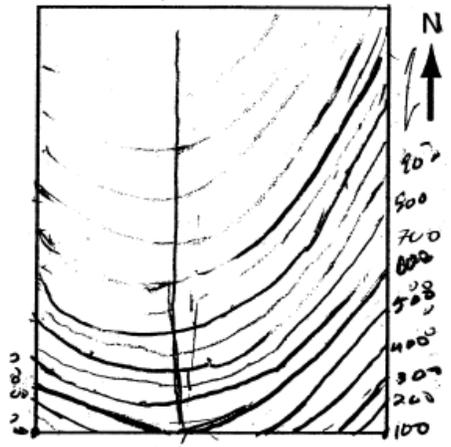
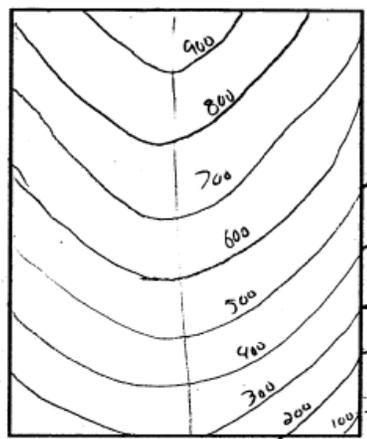
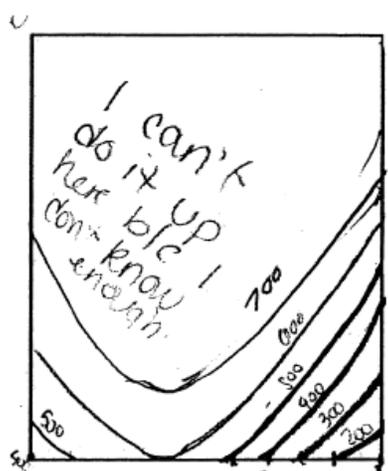


Please describe the structure contours in words:
(spacing, shape of contours etc.)

In-class discussion - reinforcement of concept

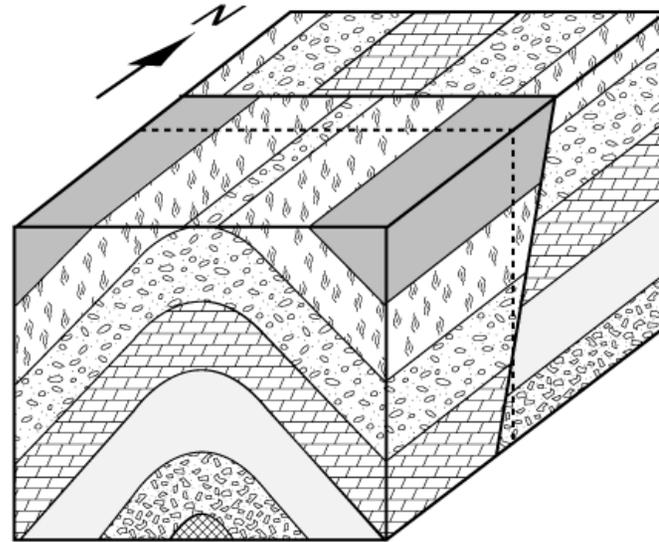
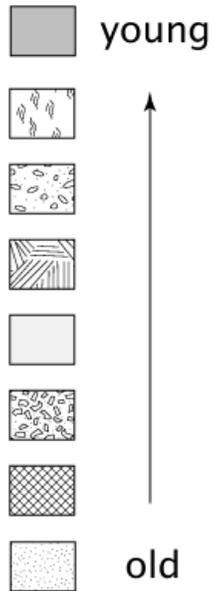


start of semester 2005

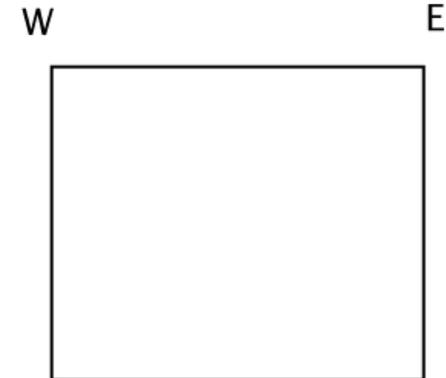


end of semester 2005

strat column



Lab section: T W

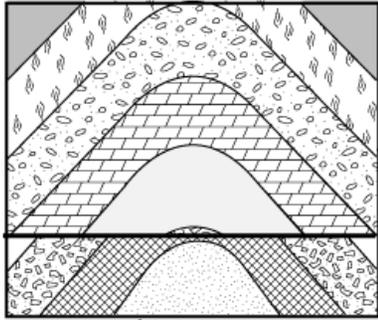


cross section

The block diagram shows some folded stratigraphy that has been faulted. Notice that the fold hinge is horizontal - the fold is not plunging. Please sketch in the box on the right a cross section through the block - the dotted line indicates the location of the cross section. The area's stratigraphy is shown in the stratigraphic column.

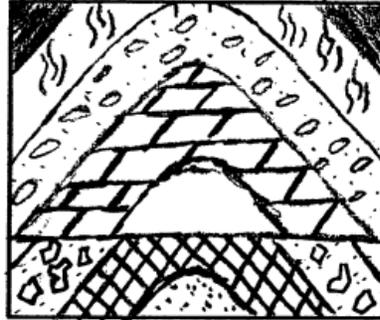
In-class exercises for diagnosis

W E



NOTE: bed thickness down here is unknown so this part is open to a little interpretation

W E



W E



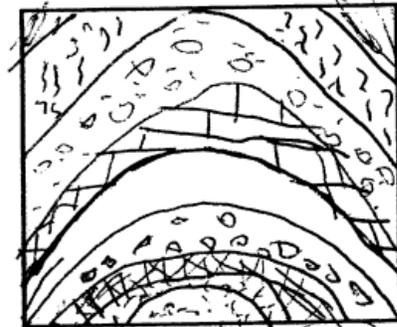
W E



W E



W E



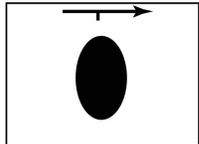
In-class exercises - penetrative thinking

You've found a deformed conglomerate in your field area and are understandably excited to conduct some strain analysis immediately. You measured the average aspect ratio of deformed clasts on three faces, summarized below. But you want to know even more - in order to tackle this problem, you have divided the analysis into three parts. The first part involves using a stereonet, and the second and third parts rely somewhat upon your answer to the first. Please note that even if you doubt your answer to the first part, carry on to the second two parts with the answer you have - you won't be penalized.

ASSUME YOU'RE LOOKING AT PRINCIPAL PLANES.



This is a strike and dip symbol. The arrow points in the strike direction.



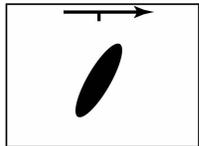
face 1:
strike/dip = 135/30SW
aspect ratio = 1.6
pitch: _____

(a) Determine values for S1, S2, and S3

S1 _____

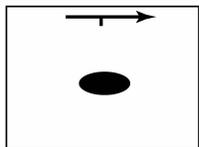
S2 _____

S3 _____

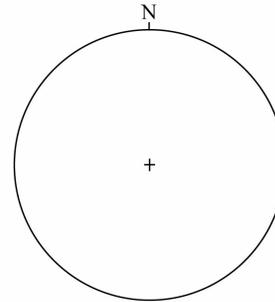


face 2:
strike/dip = 045/90
aspect ratio = 3.6
pitch: _____

(b) Estimate the pitch of the long axis of the strain ellipse on each face to the nearest 30 degrees (i.e. call it 0, 30, 60, or 90 degrees).

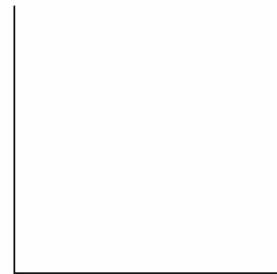


face 3:
strike/dip = 315/60NE
aspect ratio = 2.2
pitch: _____



(c) Plot and label the orientation of each of the three principal strain axes on the stereonet.

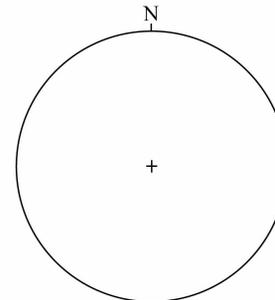
(d) If there is a foliation in this rock, plot and label the pole to the foliation plane.



(e) Please label the axes and origin of the Flinn diagram.

(f) Plot the rock's finite strain on the diagram. What is the name for the 3D shape of the finite strain ellipsoid?

(g) What kind of tectonite is this rock?



(h) Scenario 1: Assuming the rock got deformed a second time and S1 doubled in length with respect to S2 and S3, plot the rock on both stereonet (adjacent) and the Flinn diagram again.

What kind of tectonite is this rock?

(h) Scenario 2: Assume the rock got caught up in a rotating fault block and rotated 30 degrees clockwise around a vertical axis. Please plot the rock on the stereonet (adjacent) and Flinn diagram yet again.

What kind of tectonite is this rock?

Exam questions designed in similar manner

Summary

Skill puzzles may be one way to address disparate spatial skills.

Provide additional practice with component skills on geologically meaningful problems.

Helps me break class into different sections (less lecture).

Pictures are often much easier to grade than words.

