

Crustal Sinking

Task Information

Subject: Earth Science

Content:

- NYS Earth Science Syllabus (1970 ed.) - Topic XII - The Dynamic Crust, D Isostasy
- Earth Science Syllabus (Pro. Mod.) - Unit 4 - Surfaces Processes and Landscapes
- Framework (Draft) - Standard 4 - Science - Many of the phenomena we observe on Earth involve interactions among air, water, and land components.
- Middle Level Block - D - Processes II.B - Constructional Forces 1. Earth movements.

Format: Manipulative

Purpose: To measure, record, and graph movement and apply observations of a model to the behavior of the Earth's crust and mantle.

Skills:

Primary: Observing, measuring, interpreting data

Secondary: Generalizing/infering

Time: 25-30 minutes

Materials:

Teacher

- prepare "Glop"
- (store in sealed bags)
- prepare calibrated test tubes
- clear tape

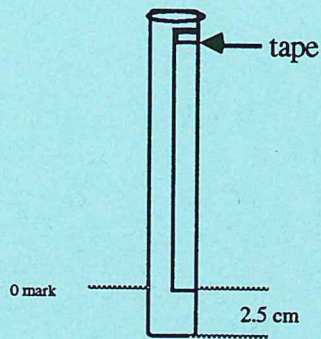
per Student

- 250mL beaker containing "Glop"
- ring stand
- test tube clamp
- test tube with scale
- timer

Preparation:

Recipe for "Glop"

- Dissolve 75mL Borax in one liter of water and set aside.
- Mix equal parts of white glue and water.
- *** Do not use the fluorescent Elmer's Glue. It is not always successful
- Add food coloring to the glue mixture.
- Combine the glue mixture and the Borax mixture in a 3:1 ratio.
 - Mix until the glop has the consistency of silly putty.
 - A more concentrated solution of borax will give you a stiffer mixture.
 - One 200-250mL beaker is approximately 65mL of borax solution and 190mL of glue mixture for each station
 - Store the glop in an airtight container.
 - Refrigerate in sealed plastic bags for long-term storage.



To prepare calibrated test tube:

- Make a transparency of the metric ruler from the Earth Science reference tables (cut to fit test tube used).
- Insert the metric ruler inside test tube to have the zero mark 2.50cm above the bottom of the test tube (refer to diagram).
- Tape transparency to inside of test tube. (These are now ready for use and can be stored for future use.)

Safety:

- The glop mixture contains Borax which is poisonous if ingested. If this material is accidentally eaten, call the poison control center immediately.
- Borax is also an eye irritant. Eyes that may have been contaminated with glop should be flushed with water immediately.
- Students should be cautioned and instructed to wash hands after the task.

Extensions/Modifications:

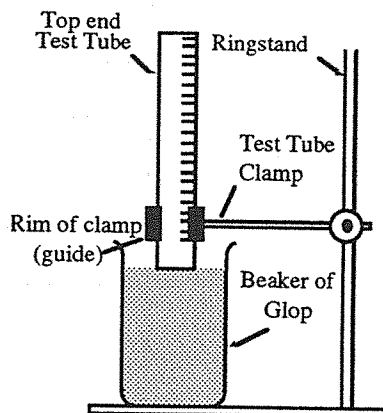
You may change the consistency of the glop to produce different sets of data. You may vary the rate of crustal sinking by varying the type of substances placed inside the test tube.

Crustal Sinking

Task: At this station, you will observe and analyze a model of the interaction between the Earth's crust and upper mantle.

Materials:

- 1 250 mL beaker containing glop
- 1 timer
- 1 ring stand
- 1 test tube clamp
- 1 test tube with scale



Background:

Some geologists believe the theory that there is a semi-fluid layer 100 to 300 kilometers below the Earth's surface. Due to high temperature and pressure, the rock in this region behaves both like a solid and a liquid. Slow movements in this region are thought to be related to changes in the upper crust and to fractures in the Earth's surface. The model in this activity may demonstrate how these changes can occur.

Directions:

1. Set up the equipment exactly as it appears in the diagram above.
2. Before installing the test tube clamp on the ring stand, adjust the opening of the clamp so that the test tube will slide easily through it.
 - ** The clamp will not be used to hold the test tube, but rather to guide its movement. **
3. Place the test tube within the clamp and directly over the glop in the beaker. Hold the test tube above the glop, but do not allow it to rest on the glop yet.
4. Turn the test tube so that the lines and numbers can be read easily.
5. Carefully hold the test tube so that it just touches the surface of the glop. Using the bottom rim of the clamp as your guide, make sure that the scale on the test tube reads zero.
6. Release the test tube and start the timer.
7. Read the level of the test tube to the nearest tenth of a centimeter every half minute. For each reading, record the level using the rim of the clamp as your guide (refer to above diagram). Take readings for a maximum of 5 minutes.

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Crustal Sinking - Scoring Rubric

Maximum score - 16 points

Task 1-7 - Directions

No credit

Task 8A - Data Table

3 points total

Standard: The student will make precise measurements and record them accurately in a data table.

Criteria:

- A. 2 points for a completed data table
 - refers to five minutes of data recorded every half minute
 - 1 point for recording data at all intervals
 - 1 point for sequential and consistent data at all intervals
- B. 1 point for accurately recorded data
 - data must be recorded to the nearest tenth of a centimeter

Task 8B - Graph

6 points total

Standard: The student will correctly set up graph axes, plot data points, and draw a line graph.

Criteria:

- A. 1 point for correct labeling of both axes.
- B. 1 point for correct units recorded on both axes
- C. 1 point for appropriate scale on both axes
- D. Data correctly plotted
 - 2 points for 7 - 10 points accurately plotted
 - 1 point for 3 - 6 points accurately plotted
 - 0 points for 2 or fewer points accurately plotted
- E. 1 point for accurately drawn line graph

Task 9 - Relating Model

2 points total

Standard: the student will relate the model to his or her knowledge of geologic processes.

Criteria:

- 2 points if the student indicates a change of the rate of sinking consistent with his or her graph in a complete sentence. Student should refer to the rate of sinking of mountains or land masses.
- 1 point if answer is consistent with their graph but not a complete sentence.

Task 10 - Crust Thickness

2 points total

Standard: The student will explain how and why geologic processes occur based on his or her observations of the model.

Criteria:

- 2 point for a reasonable explanation which relates a knowledge of mountains to the model.
- 1 point for a reasonable explanation but not in a complete sentence.

Samples:

- The crust is usually pushed deeper beneath old mountains because they have existed for a longer time. The test tube settles deeper over time.
- The crust would be pushed deeper under older mountains but might be sinking at a slower rate, as time goes on this is similar to what is shown by the slope of the graph.

Task 11 - Other factors**3 points total**

Standard: The student will identify two or more factors not addressed by the model.

Criteria:

- 3 points for three reasonable factors
- 2 point for two reasonable factors
- 1 point if only one factor is given

Samples:

- Erosion
- Weathering
- Volcanism
- Differing materials
- Faults

Highest possible score - 16 points

Student ID _____
Male or Female (Circle one)

Crustal Sinking - Scoring Form

Circle the student's score for each question. Add the points for each question and write the total score at the bottom of the scoring form.

Task 1-7

No credit

Task 8A - Data Table

- | | | | |
|------------------------------|---|---|---|
| A. completed data table | 0 | 1 | 2 |
| B. data to the nearest tenth | 0 | 1 | |

Task 8B - Graph

- | | | | |
|---------------------------|---|---|---|
| A. axes labeled | 0 | 1 | |
| B. correct units | 0 | 1 | |
| C. appropriate scale | 0 | 1 | |
| D. data correctly plotted | 0 | 1 | 2 |
| E. line graph drawn | 0 | 1 | |

Task 9 - Relating Model

0	1	2
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Task 10 - Explanation of crust thickness

0	1	2
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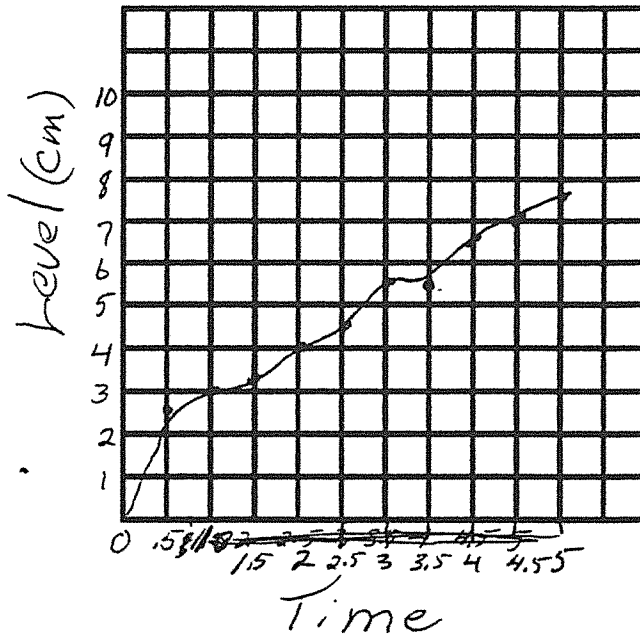
Task 11 - Other Factors

0	1	2	3
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Total Score _____
(Total possible score - 16)

8. Record your observations regarding the level of the graduated test tube in the table below. Make a line graph of your data using time and change in level as your variables. Label both axes. Include proper units.

Time (in minutes)	Change in Level (in centimeters)
0.0	0.0
0.5	2.5
1.0	3
1.5	3.2
2.0	4
2.5	4.5
3.0	5.5
3.5	5.5
4.0	6.5
4.5	7.0
5.0	7.5



9. Assume that your data is an accurate model for the behavior of a mountain range such as the Himalayas or the Adirondacks. How would the rate of sinking of the mountains early in their formation compare with the rate late in their development? Answer in complete sentences.

- The mountains would sink ~~slower~~ ^{slower} in the beginning

10. Based on your observations of this model, explain one possibility why the crust is usually pushed deeper into the earth below old mountains than under newly formed mountains. Answer in complete sentences.

- In newly formed mountains there is still pressure from the two plates hitting.

11. List at least three factors in the natural world that have not been accounted for in this model?

- The crust and mantle were included every thing else wasn't.