Creeping
Task Information

Subject: Earth Science

Content:

- NYS Syllabus (1970 ed.) Topic IX - The Erosional Process B 2.1
- Earth Science Syllabus (Pro. Mod.) Unit 4 - Surface Process and Landscape C-2.
- MST Framework Standard 4 Science - Earth and celestial phenomena are governed by principles of relative motion and perspective. Middle Level Block D - 2-A.

Format: Manipulative

Purpose: To determine if students can accurately measure, record, and graph a model of the rate of soil creep.

Skills:

Primary: Applying math, measuring, recording data
Secondary: Interpreting, generalizing, observing

Time: 30-40 minutes

Materials:

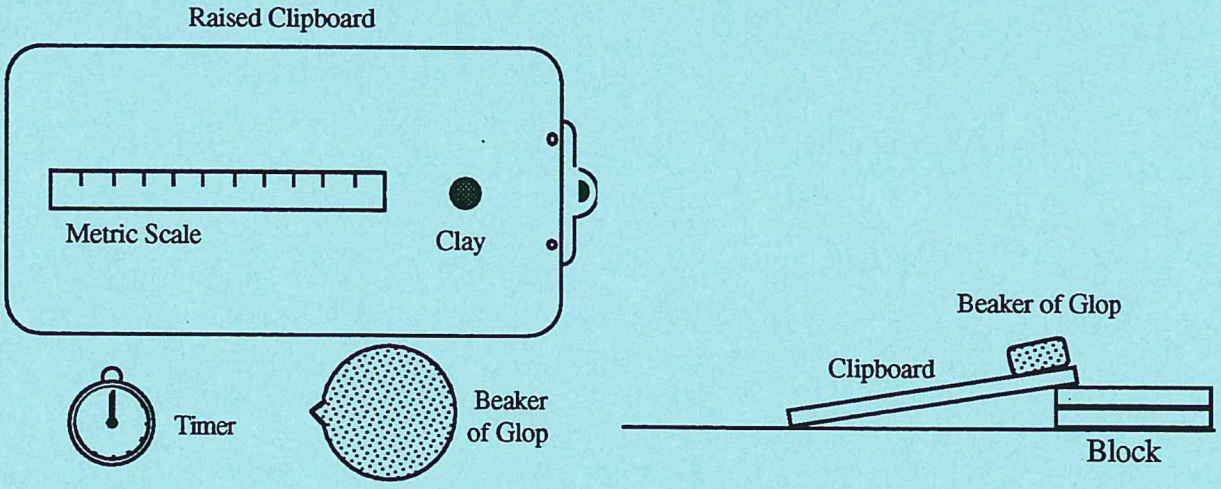
Teacher

- Borax
- water
- food coloring
- white glue
- bucket
- stiff stirring stick
- Ziplock for storage
- laminated photocopy of E.S.R. Table ruler

per Student

- 125 mL "glop"
- beaker for "glop"
- clipboard or student tray
- timer
- blocks
- tape
- calculator (optional)

Preparation:



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- **Recipe for "Glop"**
  - Dissolve 75 ml cup Borax in one liter of water and set aside (1:16 ratio).
  - Mix equal parts of white glue and water.
  - Add several drops food coloring to the glue mixture.
  - Measure 50 mL of borax solution and place in a Ziplock plastic bag.
  - Measure 150 mL of the glue mixture and place in a Ziplock plastic bag.
  - Just before using, combine the glue mixture and the Borax mixture, in a 3:1 ratio, seal the bag again and knead to form "glop".
    - Mix until the glop has the consistency of silly putty.
    - A more concentrated solution of borax will give you a stiffer mixture.
    - Store the glop in the Ziplock bags.
    - Refrigerate in sealed plastic bags for long-term storage.

  *** Do not use the fluorescent Elmer's Glue. It is not always successful
  - "Glop' may be mixed and stored in any sealable container.
  - Make a transparency of the metric ruler on the front cover of the Earth Science Reference Tables. Make sure the metric ruler is in the center of the transparency sheet.
  - Tape the transparency to the back of the clipboard.

    O R
  - If using Metric adhesive tape, stick the tape directly onto the back of the clipboard and place a piece of masking tape perpendicular to the metric tape at the place where the lip of the beaker will rest. Record the mark as the starting point.
  - The clipboard rests on a pile of wood blocks. The clip end should be resting on the blocks. .
  - Use masking tape to keep the beaker steady on the clipboard by taping across the beaker onto the clipboard.

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 before task and instructed to wash their hands after completing the task.

Extensions/Modifications:

- Variations in slope; experiment to change the viscosity i.e. temperature change.
- Place toothpicks in "glop" to show change in rate of flow; i.e. glacial movement.
- Teacher Demonstration version - glop and transparent plastic clip board on an overhead.

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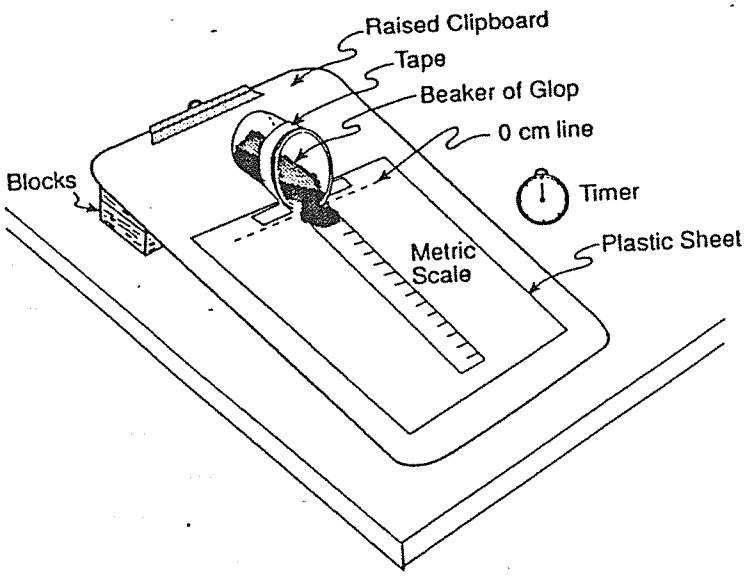
Creeping

Task: At this station, you will observe, measure, and graph a model of slow downslope movement.

Mass wasting is the name for all of the earth processes by which gravity pulls materials down. Some of the processes, like landslides and avalanches, are rapid, while other, like soil creeping, occur so slowly that observations are difficult to obtain.

Materials:

covered 250 mL beaker containing glop
clear plastic sheet with metric scale
clipboard or stiff cardboard
stop watch
tape
blocks



Directions:

1. Set up the equipment exactly as it appears in the diagram above.
2. Uncover and quickly lay the beaker on its side so that the rim of the beaker is exactly on the 0 cm mark on the metric ruler. Use the tape to hold the beaker in the correct location.
   *** * The glop must flow down the metric scale on the ruler. * ***
3. Start the stop watch when the glop flows across the 0 cm line on the ruler.
4. While the glop is moving down the board, take readings every half minute for a maximum of 10 minutes.
5. Read, to the nearest tenth of a centimeter, the location of the front of the glop on the metric scale. Record your observations on the data table.
6. After completing the readings, set the beaker upright on the table, peel the glop from the plastic sheet, return it to the beaker, and cover the beaker.

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Creeping - Scoring Rubric

Maximum score - 21 points

Task 1. Data Table

3 points total

Standard: The student will accurately record data on a data table.

Criteria:

A. Completed Data Table
- Refers to 10 minutes of recorded data **or** the time it takes for the glop to flow 30 cm. (Note that the rate of flow will depend on your glop recipe.)
- Allow 1 point for recording the data at each interval.
- Allow 1 point for sequential and consistent data at each interval. **(See Comment 1.)**

B. Recorded Accurate Data
- Allow 1 point for all data accurately recorded to the nearest tenth of a cm.

Task 2. Graph

6 points total

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

Criteria:

A. Axes Labeled
- Allow 1 point for **both** of the axes correctly labeled (naming variable).

B. Correct Units
- Allow 1 point for units recorded on **both** axes.

C. Appropriate Scale
- Allow 1 point for use of appropriate scale for the data.

D. Data correctly plotted
- Allow 2 points for plotting 15 or more points correctly (or to the end of 10 minutes).
- Allow 1 point for plotting 7 - 14 points correctly (50% of points plotted correctly).
- No credit is given for fewer than 7 points plotted correctly.

E. Line Correctly Drawn
- Allow 1 point for either a "best fit curve" or "dot to dot."

Task 3. Rate of Flow

6 points total

Standard: The student will apply mathematics to calculate rate of flow and show the procedures used. **(See Comment 2.)**

Criteria:

A. Calculation of rate: First three minutes
- Allow 1 point for the correct substitution in formula.
- Allow 1 point for the correct calculation.

B. Calculation of rate: Last three minutes.
- Allow 1 point for the correct substitution in formula.
- Allow 1 point for the correct calculation.

C. Correct Units
- Allow 1 point for correct units in both A and B

D. Recorded to the nearest tenth
- Allow 1 point if both A and B are rounded to the nearest tenth of a cm/second,

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Task 4. Comparison — 4 points total

Standard: The student will write an inference based on an observation of a change in the rate of flow for the material.

Criteria:

A. Reasons
- Allow 2 points for a logical response based on the student's data, using complete sentences.
- Allow 1 point for a logical response not in a complete sentence.

B. Graph Interpretation
- Allow 2 points for an accurate description in a complete sentence of how the graph shows the similarity or difference in rates of movement.
- Allow 1 points for an accurate description not in a complete sentence.

Example:

A steeper slope indicates faster movement; a gentle slope indicates slower movement.

Task 5. Prediction — 2 points total

Standard: The student will make a prediction based on the model and apply this to nature.

Criteria:

A. Graph
- Allow 1 point for showing a more rapid rate of motion of glop on the graph. (Consistent with student data.) If distance is on the vertical axis, then the correct answer would be above the line.

B. Model Application
- Allow 1 point for a reasonable answer. Refer to the examples below. These are possible answers but not the only answers.
- heavy precipitation; man's influence on changing slope; flooding; increased amount of water that influences sediment; removal of vegetation, etc.

Comments:

Comment 1: Correction for error: If a student has accounted for an interruption in his/her data, and noted this, full credit should be awarded. (ex. If a student misses a reading, and indicates this in place of a reading, credit should be given.)

Comment 2: Double jeopardy: The student should not be penalized twice for the same error. Answers should be consistent with, and based on, data recorded in earlier parts of the question.

Highest possible score - 21 points

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Student ID _____ **Creeping - Scoring Form**

Male / Female (circle one)

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.

1. Data table	(3 points)			
A. completed data table		0	1	2
B. recorded accurate data to the nearest tenth		0	1	
2. Graph	(6 points)			
A. axes (variables) labeled		0	1	
B. correct units		0	1	
C. appropriate scale		0	1	
D. data correctly plotted		0	1	2
E. line graph correctly drawn according to data table		0	1	
3. Rate of Flow	(6 points)			
A. calculation for the first three (3) minutes		0	1	2
B. second (last 3 minutes) calculation		0	1	2
C. units		0	1	
D. answer to the nearest tenth		0	1	
4. Comparison	(4 points)			
A. reasons		0	1	2
B. Graph Interpretation		0	1	2
5. Prediction	(2 points)			
A. graph		0	1	
B. model application		0	1	

TOTAL SCORE _____

Total possible score - 21 points

Student ID ES-Cr-1 **Scoring Form - Creeping**

Male / Female (circle one)

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.

1. Data table (3 points)

A. completed data table	0	1	(2)
B. recorded accurate data to the nearest tenth	0	(1)	

2. Graph (6 points)

A. axes (variables) labeled	0	(1)	
B. correct units	0	(1)	
C. appropriate scale	0	(1)	
D. data correctly plotted	0	1	(2)
E. line graph correctly drawn according to data table	0	(1)	

3. Rate of Flow (6 points)

A. calculation for the first three (3) minutes	0	1	(2)
B. second (last 3 minutes) calculation	0	(1)	2
C. units	0	(1)	
D. answer to the nearest tenth	0	(1)	

4. Comparison (4 points)

A. reasons	0	1	(2)
B. Graph Interpretation	0	1	(2)

5. Prediction (2 points)

A. graph	0	(1)	
B. model application	0	(1)	

TOTAL SCORE 20

(Total possible score - 21 points)

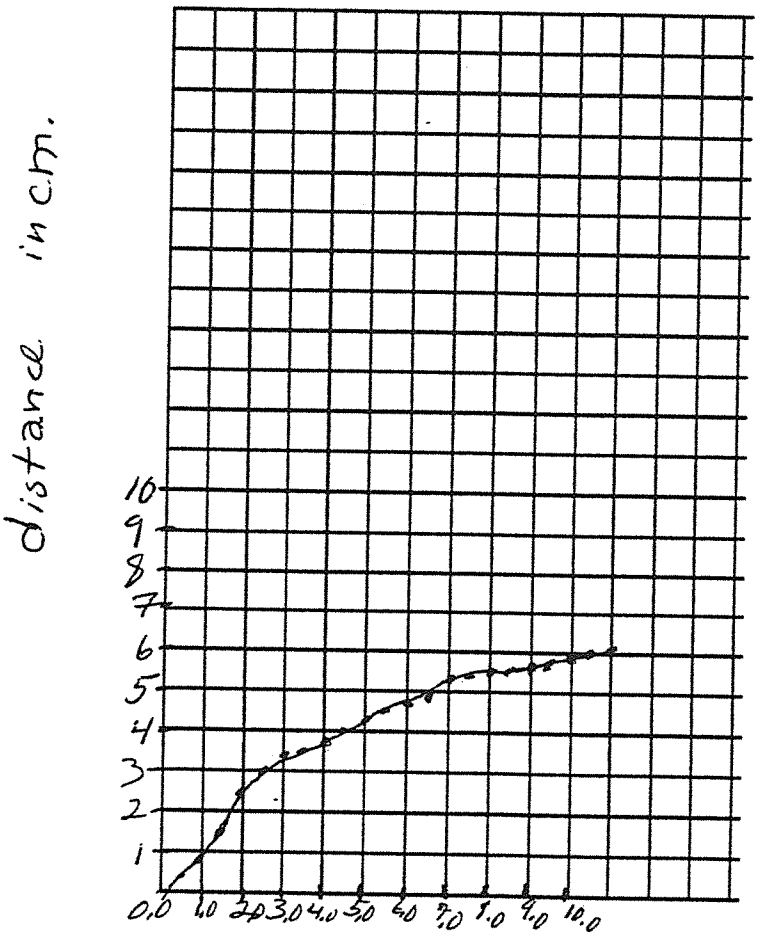
ES-Cr-1

Student Answer Sheet

1. Use the data table to record your observations to the nearest tenth of a centimeter per half minute.
2. Draw a line graph of the data using time and distance as your variables. Label both axes.

+20/21

Time (in minutes)	Distance (in centimeters)
0.0	0.0
0.5	.4 cm
1.0	.9 cm
1.5	1.5 cm
2.0	2.5 cm
2.5	3 cm
3.0	3.4 cm
3.5	3.5 cm
4.0	3.8 cm
4.5	4.0 cm
5.0	4.2 cm
5.5	4.5 cm
6.0	4.7 cm
6.5	4.9 cm
7.0	5.2 cm
7.5	5.4 cm
8.0	5.5 cm
8.5	5.6 cm
9.0	5.8 cm
9.5	6 cm
10.0	6.1 cm



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6
×.1
5.2
.7

34
0.0.

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3. a. Calculate the rate of movement of the glop during the first three minutes of observation to the nearest tenth of a cm/min. Show your work. Rate = $\frac{\text{distance}}{\text{time}}$

$$\text{Rate} = \frac{\text{Distance}}{\text{Time}}$$

$$\text{Rate} = \frac{3.4\text{ cm}}{3\text{ min}} = 1.1\text{ cm/min}$$

Answer 1.1 cm/min.

b. Calculate the rate of movement of the glop during the last three minutes to the nearest tenth of a cm/min. Show your work. Rate = $\frac{\text{distance}}{\text{time}}$

$$\text{Rate} = \frac{\text{Distance}}{\text{Time}}$$

$$\text{Rate} = \frac{.7\text{ cm}}{3\text{ min}} = 0.2\text{ cm/min}$$

Answer 0.2 cm/min

4. a. Compare the rates of movement for the first three minutes and the last three minutes of observation. Using complete sentences explain why they are or are not the same.

In the first 3 minutes the glob moved faster than it did in the last 3 minutes. because there is more glob to push it down.

b. How does your graph show the similarities or differences in rates that you calculated in question 3? In complete sentences, explain how your graph displays the rates.

In the first part of the graph the line is steeper and shows that it went faster and at the end it's slope is gentle.

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5 a. Material that is more liquid will move downhill faster than material which is "stiffer", (less fluid or more viscous). Where would the line for a more liquid material be located on the graph?

It would be located higher on the graph

b. This activity presented a model for downslope movements like mudflows, soil creep, or glacier activity. In nature, what could happen to increase the rate of a sediment or ice in these earth features?

The water cut in and make the stream faster or the ice could melt making it more watery and less solid.

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Student ID ES-Cr-2 **Scoring Form - Creeping**

Male / Female (circle one)

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.

1. Data table (3 points)

A. completed data table	0	1	(2)
B. recorded accurate data to the nearest tenth	(0)	1	

2. Graph (6 points)

A. axes (variables) labeled	0	(1)	
B. correct units	0	(1)	
C. appropriate scale	(0)	1	
D. data correctly plotted	0	(1)	2
E. line graph correctly drawn according to data table	0	(1)	

3. Rate of Flow (6 points)

A. calculation for the first three (3) minutes	(0)	1	2
B. second (last 3 minutes) calculation	(0)	1	2
C. units	0	(1)	
D. answer to the nearest tenth	(0)	1	

4. Comparison (4 points)

A. reasons	0	1	(2)
B. Graph Interpretation	0	1	(2)

5. Prediction (2 points)

A. graph	0	(1)	
B. model application	0	(1)	

TOTAL SCORE 13

(Total possible score - 21 points)

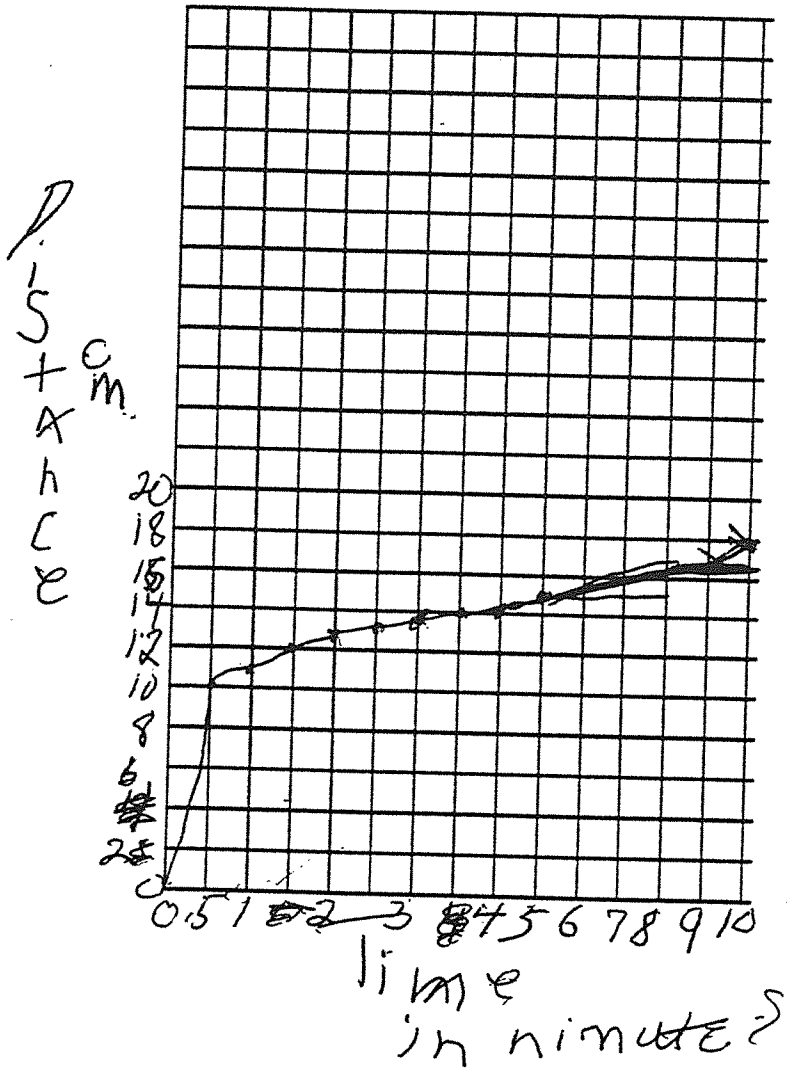
ES- Cr-7

Student Answer Sheet

1. Use the data table to record your observations to the nearest tenth of a centimeter per half minute.
2. Draw a line graph of the data using time and distance as your variables. Label both axes.

Time (in minutes)	Distance (in centimeters)
0.0	0.0
0.5	10
1.0	11
1.5	12
2.0	12.5
2.5	13
3.0	13.5
3.5	14
4.0	14
4.5	14.5
5.0	15
5.5	15.5
6.0	16
6.5	16
7.0	16.5
7.5	16.5
8.0	17
8.5	17
9.0	17
9.5	17.5
10.0	18

+13
21



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3. a. Calculate the rate of movement of the glop during the first three minutes of observation to the nearest tenth of a cm/min. Show your work. Rate = $\frac{\text{distance}}{\text{time}}$

Answer almost 1cm every min.

b. Calculate the rate of movement of the glop during the last three minutes to the nearest tenth of a cm/min. Show your work. Rate = $\frac{\text{distance}}{\text{time}}$

Answer .5cm every 30 sec.

4. a. Compare the rates of movement for the first three minutes and the last three minutes of observation. Using complete sentences explain why they are or are not the same.

The first Three Min were faster than the last Three. This was because the glop was piled up more.

b. How does your graph show the similarities or differences in rates that you calculated in question 3? In complete sentences, explain how your graph displays the rates.

The line is going up steadily in the first part and then it levels off.

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5 a. Material that is more liquid will move downhill faster than material which is "stiffer", (less fluid or more viscous). Where would the line for a more liquid material be located on the graph?

farther to the top

b. This activity presented a model for downslope movements like mudflows, soil creep, or glacier activity. In nature, what could happen to increase the rate of a sediment or ice in these earth features?

water, wind, slope,

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Student ID ES Cr-3 **Scoring Form - Creeping**

Male / Female (circle one)

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.

1. Data table (3 points)

A. completed data table	0	1	(2)
B. recorded accurate data to the nearest tenth	0	(1)	

2. Graph (6 points)

A. axes (variables) labeled	0	(1)	
B. correct units	(0)	1	
C. appropriate scale	(0)	1	
D. data correctly plotted	(0)	1	2
E. line graph correctly drawn according to data table	(0)	1	

3. Rate of Flow (6 points)

A. calculation for the first three (3) minutes	(0)	1	2
B. second (last 3 minutes) calculation	(0)	1	2
C. units	(0)	1	
D. answer to the nearest tenth	0	(1)	

4. Comparison (4 points)

A. reasons	(0)	1	2
B. Graph Interpretation	(0)	1	2

5. Prediction (2 points)

A. graph	(0)	1
B. model application	(0)	1

TOTAL SCORE 5

(Total possible score - 21 points)

E.S. Cr-3

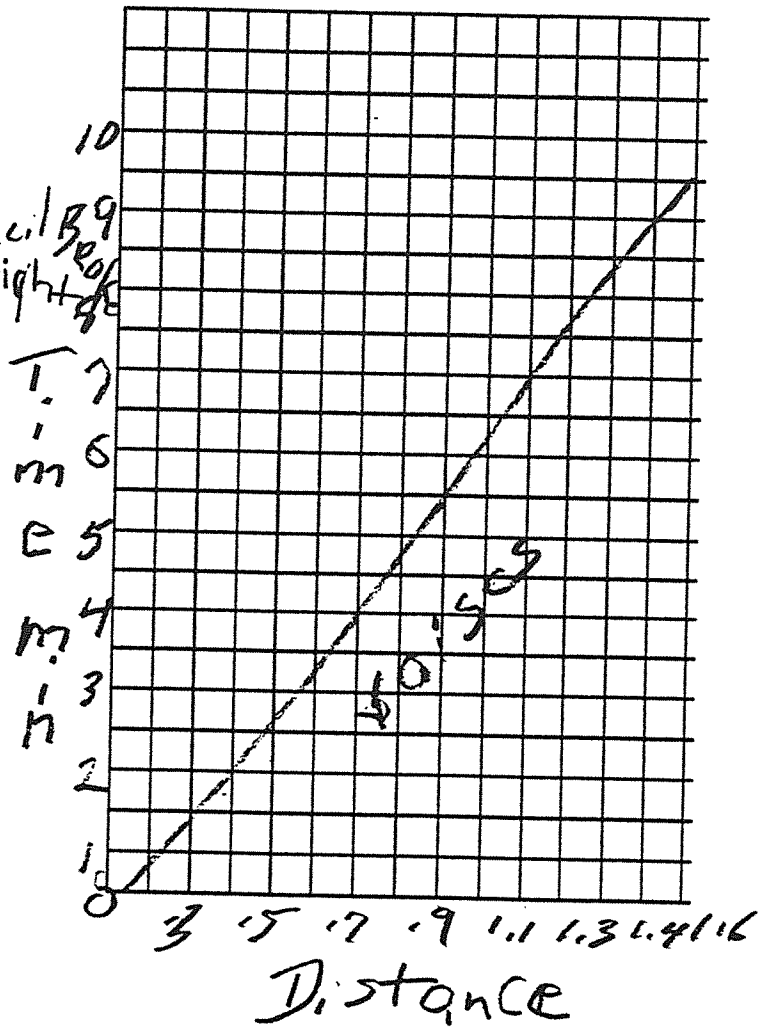
Student Answer Sheet

1. Use the data table to record your observations to the nearest tenth of a centimeter per half minute.
2. Draw a line graph of the data using time and distance as your variables. Label both axes.

5/21

Time (in minutes)	Distance (in centimeters)
0.0	0.0
0.5	.3
1.0	.5
1.5	.7
2.0	.9
2.5	1.1
3.0	1.3 Not right
3.5	1.4
4.0	1.6
4.5	1.7
5.0	1.8
5.5	1.9
6.0	2.0
6.5	2.1
7.0	2.2
7.5	2.3
8.0	2.4
8.5	2.5
9.0	2.6
9.5	2.7
10.0	2.8

Pencil Box



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3. a. Calculate the rate of movement of the glop during the first three minutes of observation to the nearest tenth of a cm/min. Show your work. Rate = $\frac{\text{distance}}{\text{time}}$

Answer 3min/4.8cm,

b. Calculate the rate of movement of the glop during the last three minutes to the nearest tenth of a cm/min. Show your work. Rate = $\frac{\text{distance}}{\text{time}}$

Answer 7-10 min/17.5cm

4. a. Compare the rates of movement for the first three minutes and the last three minutes of observation. Using complete sentences explain why they are or are not the same.

At first the glop moved .2cm every 30 sec, and at the end it changed to .1cm every 30secs.

b. How does your graph show the similarities or differences in rates that you calculated in question 3? In complete sentences, explain how your graph displays the rates.

The first three minutes the CM was shorter than the last 3min,

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5 a. Material that is more liquid will move downhill faster than material which is "stiffer", (less fluid or more viscous). Where would the line for a more liquid material be located on the graph?

At 8 min or past

b. This activity presented a model for downslope movements like mudflows, soil creep, or glacier activity. In nature, what could happen to increase the rate of a sediment or ice in these earth features?

lava down the side of a Volcano

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