

# Chemical Weathering

## Task Information

**Subject:** Earth Science

**Content:**

- NYS Syllabus (1970 ed.) - Topic IX-The Erosion Process - A-1.1 ,A1.2
- Earth Science Pro. Mod. Syllabus (1993) - Unit 4 - Surface Processes and Landscapes
- NYS MST Framework, Standard 4 Science - Many of the phenomena that we observe on Earth involve interactions among air, water, and land components.
- Middle Level Science - Block D-II- Changes in Earth's Surface 26

**Format:** Manipulative

**Purpose:** Using a model, the student will gather data on the effects of weathering.

**SKILLS:**

**Primary:** Design experiment, measure, record data, observing  
**Secondary:** Hypothesizing, interpreting data, generalizing/infering

**Time:** 30-40 minutes

**Materials:**

**Teacher:**

- distribution method for hot H<sub>2</sub>O
- cooler for ice
- hot water supply
- waste buckets

**Per Student:**

- 3 clear plastic cups (100ml line marked)
- 2 Styrofoam cups (approx. 250ml each)  
(for transfer of hot and cold H<sub>2</sub>O)
- 1 thermometer
- 1 timer
- 4 effervescent tablets
- waste bucket
- paper towels
- hot, cold, and room temp. H<sub>2</sub>O

**Preparation:**

- Temperatures above 50° Celsius tend to cause the tablet to dissolve so violently that the beaker will overflow. Also, such temperatures are unlikely to occur in nature.
- Students should be encouraged to use 1-3 tablets.
- The **time** when the tablets dissolve should be carefully observed.
- Teacher needs to mark a 100 ml line on the clear plastic cups.

**Safety:**

- Students should be **cautioned** to be careful using the hot plate and the hot water. Water should not exceed 50° Celsius
- Students **must not** sample the antacid tablets before dissolving them or the solutions that result after the tablets dissolved.

**Extensions/Modifications:**

Try experiment with different sized pieces of tablet. They could vary in rates of weathering.

# Chemical Weathering

**Task:** At this station you will be observing a model of chemical weathering processes.

**Materials:**

- 3 clear plastic cups (with 100 ml line marked)
- hot water (45°-50° Celsius)
- room temperature water
- paper towels
- 1 thermometer
- 4 effervescent antacid tablets
- ice water
- waste container
- 2 Styrofoam or insulated cups (for transfer of hot liquid)

**Background:**

What effect does water temperature have on the rate of a chemical reaction similar to the interaction of a weak acid and carbonate rock, such as limestone or marble? To examine this question, you will observe a model that simulates the interaction of water and limestone. The "limestone" in your model will be an effervescent antacid tablet. This tablet will dissolve in water much more quickly than the limestone in nature, making it possible for you to collect data during this task.

**Directions:**

1. Put 100 mL room temperature water into the marked, clear cup and record its temperature on the data table.
2. Set your timer to zero or watch the wall clock. Place one tablet into the cup of water. Measure the time it takes for the tablet to dissolve completely and record this time on the data table on the next page.
3. Using only the materials listed above, design a controlled experiment to determine the effect of temperature on the rate of chemical weathering.
4. In the space below, write out the steps you will follow in performing a controlled experiment. Be specific enough so that another student could follow your directions and successfully complete the experiment.

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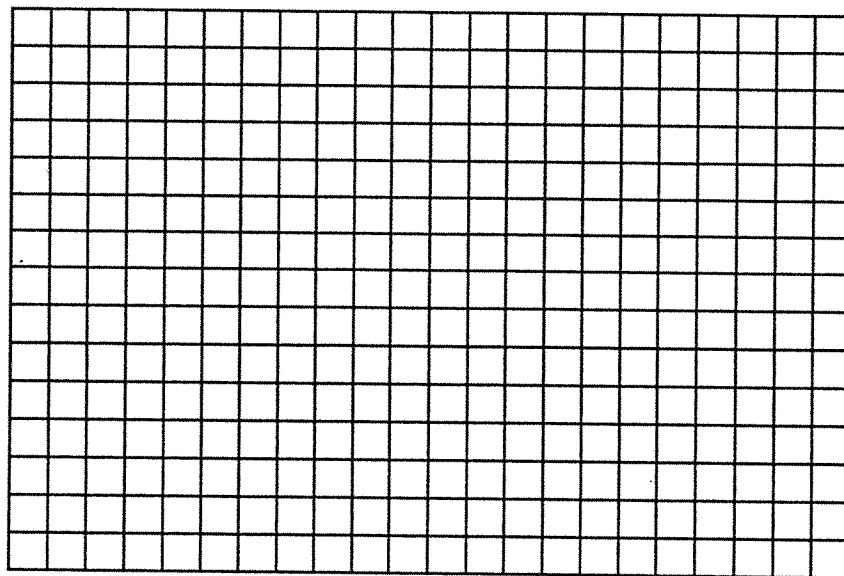
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5. **PERFORM YOUR EXPERIMENT.** However, do not use water with a temperature above 50° Celsius.
6. Summarize all your data on the data table below.

Temperature (Celsius)	Time to Dissolve (in seconds)

7. Use the data from the table to construct a graph. Graph your data using temperature and time as your variables. Label both axes.



8. If this experiment was repeated with the antacid tablets ground into a fine powder, **draw dashed line on the graph** that you think would show the result. In the space below, use complete sentences to explain why you placed the line where you did.

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9. If this activity was an accurate model of the actual chemical weathering of rock material on the Earth, how would climate temperatures affect the rate of chemical weathering of rock surfaces? Answer in a complete sentence.

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10. Describe how you would design an experiment to explore the effects that variations in the strength of weak acid solutions would have on the rate of chemical weathering? Include at least 4 variables that you would consider.

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# Chemical Weathering - Scoring Rubric

## Maximum score - 21 points

**Tasks 1-3 - Directions** **No Credit**

**Task 4. - Design** **5 points total**

Standard: The student will design an experiment to show effect of temperature on chemical weathering.

Criteria:

Allow 1 point for each of the following:

- the use of two or more water temperatures tested
- a controlled amount of water used for each test
- the same number of tablets used for each test
- some form of timing of the reactions at the different set-up tested
- laboratory safety is reflected in the procedure

**Task 5 - Experiment** **No Credit**

**Task 6. - Recording of Data** **3 points total**

Standard: The student will record data that were collected.

Criteria:

Allow 1 point for each of the following:

- recording initial time/temp. data
  - recording each experimental value (up to 2 pts.)
- 2 points if all data are accurately recorded  
1 point if some data are inaccurate or missing

**Task 7. - Graph** **4 points total**

Standard: The student will graph data that were collected.

Criteria:

Allow 1 point for each of the following:

- both axes are labeled properly
- both axes have proper units
- two or more correctly plotted points on the graph
- properly drawn line connecting data points

**Task 8. - Prediction** **3 points total**

Standard: The student will show an appropriate line on the graph.

Criteria:

- Allow 1 point for a line drawn that shows a faster dissolving rate. Either above or below line, but with a steeper slope.
- Allow 2 points for an answer that reflects a faster dissolving rate, using complete sentences.
- Allow 1 point for a correct answer that is not in a complete sentence.
- Allow 0 points for incorrect answer.

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**Task 9. - Relating Information****2 points total**

Standard: The student will relate data from the model to natural materials on Earth.

Criteria:

- Allow 2 points for an answer that reflects that warmer climates increase the rate of weathering, and uses complete sentences.
- Allow 1 point for a correct answer that is not in a complete sentence.
- Allow 0 points for incorrect answer.

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**Task 10. - Generalizing/Inferring****4 points total**

Standard: The student will describe an experiment.

Criteria:

The experimental design should receive 1 point for each appropriate variable that is included. (temperature, tablet amounts, liquid volumes, laboratory safety, and solution type (weak acid).

- Allow 1 point for each variable (up to a total of 4 points)

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**Highest Score Possible - 21 points**

Student ID \_\_\_\_\_

# Chemical Weathering - 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.

**Tasks 1-3.** Directions

No credit

**Task 4.** Design

0    1    2    3    4    5

**Task 5.** Experiment

No credit

**Task 6.** Recording Data

Initial (room) temp.

0    1

Experimental data

0    1    2

**Task 7.** Graph

Axes labeled

0    1

Proper units

0    1

2 or more correctly plotted points

0    1

Properly drawn line connecting data points

0    1

**Task 8.** Prediction

Line drawn (prediction)

0    1

Reason

0    1    2

**Task 9.** Relating Information

0    1    2

**Task 10.** Generalizing/Inferring

0    1    2    3    4

**TOTAL SCORE** \_\_\_\_\_

Total possible score - 21 points

C.W. E.S. MB

Student ID C.W.E.S.MB Scoring Form - Chemical Weathering

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.

Tasks 1-3. Directions

No credit

Task 4. Design

0 1 2 3 (4) 5

Task 5. Experiment

No credit

Task 6. Recording Data

Initial (room) temp.

0 (1)

Experimental data

0 (2)

Task 7. Graph

Axes labelled

0 (1)

Proper units

0 (1)

2 or more correctly plotted points

0 (1)

Properly drawn line connecting data points

0 (1)

Task 8. Prediction

Line drawn (prediction)

0 (1)

Reason

0 1 (2)

Task 9. Relating Information

0 1 (2)

Task 10. Generalizing/Inferring

0 1 2 3 (4)

TOTAL SCORE + 20  
(Total possible score = 21 points)