# Prelab Information

Purpose Explore the effects of multiple variables on the rate of weathering.

Time Approximately 75 minutes over two lab periods with drying time in between

Question What factors influence the rate of weathering?

Hypothesis If the rate of weathering is dependent on factors such as mineral composition, temperature, acidity, and surface area, then the percentage of mass remaining for each rock sample will change because weathering can be a chemical process.

Variables *Independent Variable #1*: acidity of solution

*Independent Variable #2:* mineral composition

*Independent Variable #3:* temperature of solution

*Independent Variable #4:* surface area of sample

*Dependent Variable:* percentage of mass remaining

Summary You will establish a baseline for comparison by placing a sample of limestone in water for 15 minutes and drying it overnight. You will then repeat the procedure for various experimental groups, including treatments for mineral composition, acidity, temperature, and surface area. Each time, you will record the percentage of mass remaining and compare it to your baseline.

# Safety

* Wear appropriate clothing for working in the lab, including a lab coat or apron.
* Wear protective gloves when handling chemicals. Wash your hands thoroughly when the experiment is complete.
* Protect your eyes by wearing safety goggles throughout the experiment.
* Ensure that behavior in the lab is purposeful.
* Report all accidents – no matter how big or small – to your teacher.

# Lab Procedure

1. **Gather Materials**

|  |  |  |
| --- | --- | --- |
| * four small samples of limestone * one sample of crushed limestone * one small sample of granite * tap water * vinegar | * flask * mesh filter * six plastic cups * ice bath * hot plate * hand protector | * balance * thermometer * weigh boats * paper towels * clock * permanent marker |

1. **Label Weathering Containers**
   1. Label six plastic cups with the appropriate sample letter, temperature, solution, and rock type in permanent marker for later use in the experiment.

* Sample A: Room Temperature Water Solution – Limestone
* Sample B: Room Temperature Vinegar Solution – Limestone
* Sample C: Room Temperature Vinegar Solution – Granite
* Sample D: Warm Vinegar Solution – Limestone
* Sample E: Cold Vinegar Solution – Limestone
* Sample F: Room Temperature Vinegar Solution – Crushed Limestone
  1. Place the appropriate rock sample in each of the six plastic cups.

1. **Measure the Mass of Each Sample**
   1. Tare the balance with an empty weigh boat.
   2. Remove Sample A from the plastic cup and place it in the weigh boat.
   3. Determine the mass of Sample A to the nearest tenth of a gram.
   4. Record the mass of Sample A in Table A.
   5. Remove Sample A from the balance and return it to the plastic cup.
   6. Repeat steps 3b-3e for samples B-F.
2. **Examine the Effect of Acidity on Weathering**

**Sample A:**

* 1. Take the plastic cup labeled “Sample A” and add enough room temperature water to the cup to completely submerge the rock.
  2. Record the temperature of the water and the starting time in Table A.
  3. At the end of 15 minutes, remove the rock sample from the cup and record the time in Table A.
  4. Blot the rock dry with a paper towel.
  5. Place the rock on a paper towel marked “Sample A” to air-dry overnight.

**Sample B:**

* 1. Take the plastic cup labeled “Sample B” and add enough room temperature vinegar to the cup to completely submerge the rock.
  2. Record the temperature of the vinegar and the starting time in Table A.
  3. At the end of 15 minutes, remove the rock sample from the cup and record the time in Table A.
  4. Blot the rock dry with a paper towel.
  5. Place the rock on a paper towel marked “Sample B” to air-dry overnight.

1. **Examine the Effect of Mineral Composition on Weathering**

**Sample C:**

* 1. Take the plastic cup labeled “Sample C” and add enough room temperature vinegar to the cup to completely submerge the rock.
  2. Record the temperature of the vinegar and the starting time in Table A.
  3. At the end of 15 minutes, remove the rock sample from the cup and record the time in Table A.
  4. Blot the rock dry with a paper towel.
  5. Place the rock on a paper towel marked “Sample C” to air-dry overnight.

1. **Examine the Effect of Temperature on Weathering**

**Sample D:**

* 1. Take the plastic cup labeled “Sample D” and add enough warm vinegar to the cup to completely submerge the rock.
  2. Record the temperature of the vinegar and the starting time in Table A.
  3. At the end of 15 minutes, remove the rock sample from the cup and record the time in Table A.
  4. Blot the rock dry with a paper towel.
  5. Place the rock on a paper towel marked “Sample D” to air-dry overnight.

**Sample E:**

* 1. Take the plastic cup labeled “Sample E” and add enough cold vinegar to the cup to completely submerge the rock.
  2. Record the temperature of the vinegar and the starting time in Table A.
  3. At the end of 15 minutes, remove the rock sample from the cup and record the time in Table A.
  4. Blot the rock dry with a paper towel.
  5. Place the rock on a paper towel marked “Sample E” to air-dry overnight.

1. **Examine the Effect of Surface Area on Weathering**

**Sample F:**

* 1. Take the plastic cup labeled “Sample F” and add enough room temperature vinegar to the cup to completely submerge the rock pieces.
  2. Record the temperature of the vinegar and the starting time in Table A.
  3. At the end of 15 minutes, record the time in Table A, then remove the rock sample by pouring the rock sample and vinegar solution through a mesh filter to separate the rock pieces from the vinegar.
  4. Blot the rock pieces dry with a paper towel taking care that none of the pieces stick to the paper towel.
  5. Place the pieces of rock on a paper towel marked “Sample F” to air-dry overnight.

1. **Determine the Percentage of Mass Remaining**
   1. Tare the balance using an empty weigh boat.
   2. Take Sample A from the drying area after at least 18 hours have passed and measure its mass using the balance.
   3. Record the mass in Table A to the nearest tenth of a gram.
   4. Repeat steps 8a-8c for samples B-F.
   5. Calculate the percentage of mass remaining for each sample by dividing the final mass by the initial mass and then multiplying the answer by 100%. Record the results to the nearest tenth of a percent in the bottom row of Table A.
2. **Make an Initial Comparison of Trends in the Data**

Look at the values that were calculated in the bottom row of Table A. Compare the percentage of mass remaining for each sample to determine which factors examined in the lab had an effect on the rate of weathering. Document these initial observations in Table B.

1. **Construct Graphs** 
   1. Follow these directions to construct graphs of your data. Sketch your graphs in your Lab Report Guide, Section 2.
   2. Construct a bar graph to analyze the effect of acidity on the rate of weathering. Compare the percentage of rock remaining that you calculated for rock samples A and B.
   3. Construct a bar graph to analyze the effect of mineral composition on the rate of weathering. Compare the percentage of rock remaining that you calculated for rock samples B and C.
   4. Construct a bar graph to analyze the effect of temperature on the rate of weathering. Compare the percentage of rock remaining that you calculated for rock samples B, D, and E.
   5. Construct a bar graph to analyze the effect of surface area on the rate of weathering. Compare the percentage of rock remaining that you calculated for rock samples B and F.

# Data

Record your data in the tables below.

**Table A: Mass Data for Various Experimental Treatments**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Sample**  **A** | **Sample**  **B** | **Sample**  **C** | **Sample**  **D** | **Sample**  **E** | **Sample**  **F** |
| **Treatment** | Limestone Room Temp Water | Limestone Room Temp Vinegar | Granite Room Temp Vinegar | Limestone Warm Vinegar | Limestone Cold Vinegar | Crushed Limestone Room Temp Vinegar |
| **Start Time** |  |  |  |  |  |  |
| **Stop Time** |  |  |  |  |  |  |
| **Temperature**  **(oC)** |  |  |  |  |  |  |
| **Initial Mass**  **(g)** |  |  |  |  |  |  |
| **Final Mass**  **(g)** |  |  |  |  |  |  |
| **% Mass Remaining** |  |  |  |  |  |  |

**Table B: Comparison of Mass Data**

|  |  |
| --- | --- |
| Compare the mass of samples A and B to see if acidity affects the rate of weathering. Which sample has less mass remaining, the one exposed to water or the one exposed to vinegar? |  |
| Compare the mass of samples B and C to see if mineral composition affects the rate of weathering. Which sample has less mass remaining, the limestone or the granite? |  |
| Compare the mass of samples B, D, and E to see if temperature affects the rate of weathering. Which sample has the least mass remaining, the one in the warm vinegar, the one in the room temperature vinegar, or the one in the cold vinegar? |  |
| Compare the mass of samples B and F to see if surface area affects the rate of weathering. Which sample has less mass remaining, the whole rock or the crushed sample? |  |