Physical Weathering of Urban Building Materials: River Rock Simulation

**Overview:**

A rock tumbler subjects the materials you place in it to moving water, grit and the materials themselves. In this way, it can be used to simulate or model some of the processes involved in weathering of rocks and other materials in the real world. In this activity, you will set up a rock tumbler with different building materials used in cities like Baltimore to answer these questions:

1. How much weathering takes place in a rock tumbler over a period of just one day?
2. Which building materials are most and least resistant to weathering in these conditions?
3. What specific weathering processes take place in a rock tumbler?
4. Where does any material removed (weathered) from the rocks placed in the tumbler go?

**Prelab Question:**

* Define Mechanical Weathering.

**Materials:**

* Rock Samples (Natural and man-made)
  + Granite
  + Marble
  + Brick
  + Cement
* Rock Tumbler
* Grit
* Water
* Balance
* Grit
* Water
* Balance
* Strainer and Basin

**Part 1—The set-up**

1. **Take initial observations and measurements of the rocks, and state a hypothesis**
   1. Rotate through the rock type stations. At each station:
      1. Describe the appearance of each rock sample and record in the observations section of your lab sheet.
      2. Weigh and record the mass of each rock sample and record on your lab sheet.
   2. Based on your prior knowledge of these rock types and their uses rank them in order from most to least resistant to weathering and fill in the hypothesis table at the top of the Lab Worksheet. Be sure to include your explanation for why you ranked the rocks as you did.

**Hypothesis**

Write the four rock types from most to least resistant. Then explain your ranking.

|  |  |  |  |
| --- | --- | --- | --- |
| Most Resistant | Less Resistant | Less Resistant | Least Resistant |
|  |  |  |  |

Explanation:

1. **Assemble the tumbler**.
   1. Place the four rocks in the tumbler chamber.
   2. Add 1-2 scoops of grit [5-8g] to the tumbler.
   3. Pour water into the tumbler until the rocks are just covered.
   4. Seal the tumbler carefully and start it.

**Part 2 – Rock weathering in nature.**

1. **Watch the video** [Why Rocks Are Smoother Near Rivers.](https://www.youtube.com/watch?v=ZC6EaVYdiVo)
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2. **Based on the video, answer the following questions.** 
   1. Describe the process of how a river smooths rocks.
   2. What evidence did the narrator present to support the claim that rocks with different minerals differ in how resistant they are to mechanical weathering?
   3. Please propose an alternative explanation for why the rock the narrator called gneiss (pronounced “nice”) was not as rounded as the other rocks he pointed out?
   4. Where did the “worn off” material from the rocks go? What evidence do you have that supports your statement?

**Part 3 – Gathering and interpreting the results.**

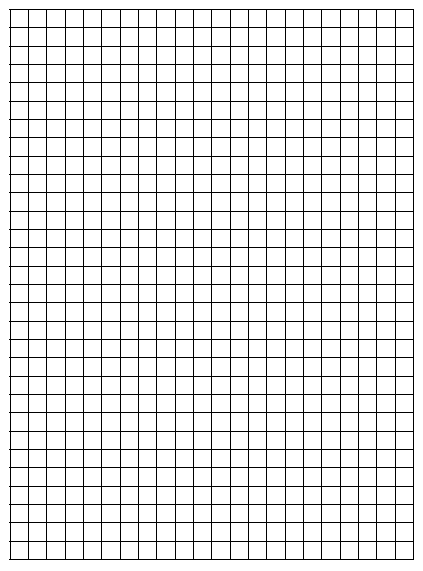
1. **Turn off the tumbler and carefully disassemble the tumbler**.
2. Place the strainer in the basin and empty the contents of the tumbler into the strainer.
3. Pour rinse water over the rocks to clean them.
4. Collect the discarded water in a large beaker and place at its observation station.
5. **Take final observations and measurements.**
   1. Dry the rocks with paper towels.
   2. Sort the rocks by type.
   3. Place each rock type at its own station.
   4. As you rotate through each station:
      1. Describe the appearance of each rock sample and record in the observations section of your lab sheet.
      2. Weigh and record the mass of each rock sample and record on your lab sheet.
      3. Make observations of the “discarded water.”
6. **Analysis and interpretation.**
7. Complete the last column of the Data Sheet. Summarize changes in appearance, and calculate how much mass each rock sample lost (if any).
8. Graph your results (on the provided grid) in a way that helps show how much weathering took place and how the different rock types compared. Be sure your graph includes all appropriate components, including a key for each rock type

**Observations:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Material | Variable | Time 0 | Time 1 | Change |
| Date / Time |  |  |  |
| Concrete | Appearance |  |  |  |
| Mass (g) |  |  |  |
| Brick | Appearance |  |  |  |
| Mass (g) |  |  |  |
| Marble | Appearance |  |  |  |
| Mass (g) |  |  |  |
| Granite | Appearance |  |  |  |
| Mass (g) |  |  |  |
| Total Mass of Rocks | |  |  |  |

**Waste Water Observations:**

**Analysis:**



1. Now make a claim supported by evidence and reasoning for these questions:
   1. How much weathering (%) takes place in a rock tumbler over a period of just one day?
   2. Where did the “lost” materials go? What evidence do you have to support your claim?
   3. Design an experiment we could use to test your answer to question “b.”
   4. Which building materials are most and least resistant to weathering in these conditions? Did the results match your hypothesis?
2. Resistance to wear and hardness

|  |  |
| --- | --- |
| **Rock type** | **Mohs hardness rating** |
| ***Concrete*** | **5-7** |
| ***Brick*** | **5-6** |
| ***Marble*** | **3-5** |
| ***Granite*** | **7** |

* 1. Place the rocks in order from most to least resistant to wear based on your data. Does this match your hypothesis?
  2. Examine the table; does the hardness rating correlate to your results? If so, explain the correlation.

1. Based on your graphic data, predict the mass that would remain after a total of 5 days of tumbling? Explain or show mathematically how you made your prediction.
2. Draw a diagram of the Rock Tumbler “system”, showing its boundaries and all of its components at Time 0 (when you started the tumbler). Then draw a similar diagram of the system at Time 1, being sure to indicate what changed over the course of the tumbling. Then in the Processes part of the chart, explain what happened to cause the changes you show and observed.

|  |  |  |
| --- | --- | --- |
| Time 0 | Processes | Time 1 |
|  |  |  |

* 1. Is the tumbler an open or closed system?
  2. Is it possible that chemical as well as physical weathering took place?
     1. If so, how would this lead you to modify your diagram?
     2. What evidence could you collect to determine if chemical weathering took place?

1. Think about the process of weathering in the rock tumbler.
   1. How is this process similar to what happens in a river? How is it different?
   2. Do you believe that this is a good model for what happens in nature? In CER format state and support your stance.