ROCK TUMBLING:
An Experimental Investigation of Physical Weathering

Rock tumblers create smooth, polished stones by physically weathering rocks within the tumbler's drum. Rotary rock tumblers are the most common, and include most of the inexpensive tumblers that are sold as toys for children to make polished stones for jewelry and decoration. They consist of a motor that turns a metal cylinder, which in turn rotates a larger drum which holds the rock specimens and water (for lubrication). The tumbler turns very slowly, allowing the rocks to climb the cylinder walls until they become unstable and fall to the bottom of the drum, hitting other rocks and loose grit on their fall. Gradually, the surfaces of the rocks are smoothed away as fragments are broken off of the rocks, resulting in round polished stones.

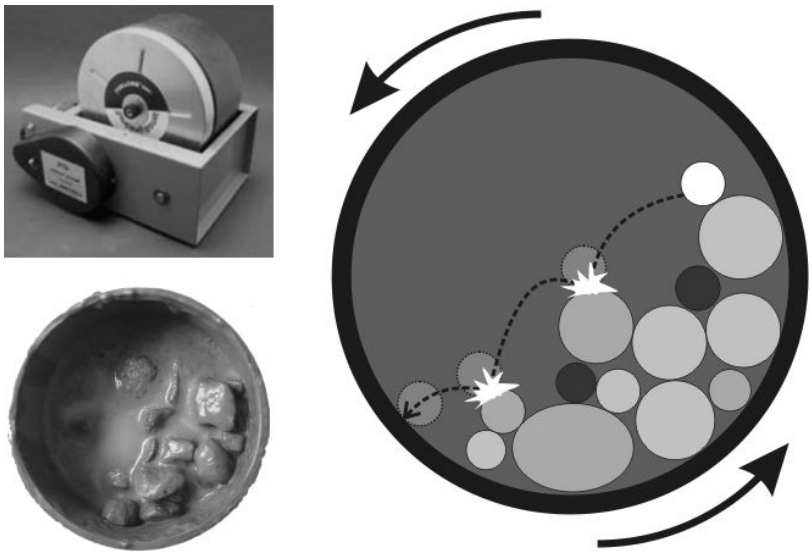

Figure 1. Rock Tumblers and a Schematic Representation of Processes Inside of the Rotating Drum

A tumbler simulates natural processes of physical (mechanical) weathering in a controlled environment (i.e., Which rocks? What shapes? What size? What length of time?). In other words, you can create a laboratory experiment to investigate the effects of physical weathering on a variety of minerals and rocks under a variety of conditions.

Assignment: Week 1 – Set-Up

- Break into groups (one per tumbler) as directed by your instructor. Each group needs to have at least one camera.
- Subdivide each group into three subgroups, each of which will document and describe five rocks from one of the three rock families (igneous, sedimentary, metamorphic).
- Begin to fill in the worksheets by doing the following:
    - Identify each of the 5 rock specimens and enter the sample number in the chart beside the corresponding rock name.
    - Weigh the sample using either a triple-beam balance or an electronic scale
    - Photograph the sample (including a scale) and confirm that the image is complete and in focus.
    - Describe the rock: color, textures (e.g., layering, pores, etc), minerals present. Be detailed enough to be able to identify the rock after it has been tumbled.
    - Document the physical properties of the rock: hardness (ease of scratching), induration (degree to which grains are held together), fissility (ability to split along planes).
    - Based on the physical properties of each rock, predict the degree to which it will weather in the tumbler: low, moderate, high. State the evidence on which your prediction is based.
- Assemble into your full group and share your data, and predict which three rock specimens will weather the most, and which three samples will weather the least. State your reasons for these predictions
- Load all 15 samples into your group's tumbler drum and then fill it approximately half-full with water.
- Load the drum into the tumbler. Label your tumbler with your group number. Plug-in the tumbler.
- ***Homework***: Complete the tables in Word and insert your photos (max size is 2" x 1.5") into the table. (Note: these photos and descriptions may be useful for your rock and mineral guidebook as well.)

Assignment: Week 2 - Results

- Reassemble into your groups and retrieve your group's tumbler drum.
- Wash the mud from the samples and determine the identity of the samples based on the descriptions and properties that you documented in the previous class.
- Photograph the sample (including a scale) and confirm that the image is complete and in focus.
- Weigh each sample using either a triple-beam balance or an electronic scale, record your data.
- For each sample, calculate the percent of weathering that occurred.
- Compare your actual results with your predictions.
- Answer the post-experiment questions.
- ***Homework***: Complete the tables in Word and insert your photos (max size is 2" x 1.5") into the table.

Preparatory Focusing Questions

What type of physical weathering is produced by a rock tumbler? (Circle One)

Abrasion Exfoliation Frost Wedging Pressure Unloading Salt Wedging

For which natural environments does a rock tumbler provide a laboratory analogue?

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Which two mineral properties will control a mineral's resistance to physical weathering in a tumbler?

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Which type of chemical bond is predominant in minerals that are easily weathered in a tumbler?

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Which type of chemical bond is predominant in minerals that are resistant to weathering in a tumbler?

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Which physical properties will control a rock's resistance to physical weathering in a tumbler?

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Igneous Rocks

Rock Name	#	Mass		Photo: Before	Photo: After
		Before	After		
Granite					
Gabbro					
Basalt					
Rhyolite					
Obsidian					

Igneous Rocks

Rock Name	**Description and Properties**	**Predicted Weathering** Low/Mod/High Least /Most	**Support for Prediction**	**Actual Weathering** Low/Mod/High Least /Most
Granite				
Gabbro				
Basalt				
Rhyolite				
Obsidian				

Sedimentary Rocks

Rock Name	#	Mass		Picture: Before	Picture: After
		Before	After		
Shale					
Sandstone					
Limestone					
Alabaster					
Chert					

Sedimentary Rocks

Rock Name	**Description and Properties**	**Predicted Weathering** Low/Mod/High Least /Most	**Support for Prediction**	**Actual Weathering** Low/Mod/High Least /Most
Shale				
Sandstone				
Limestone				
Alabaster				
Chert				

Metamorphic Rocks

Rock Name	#	Mass		Photo: Before	Photo: After
		Before	After		
Slate					
Schist					
Gneiss					
Marble					
Serpentinite (Soapstone)					

Metamorphic Rocks

Rock Name	**Description and Properties**	**Predicted Weathering** Low/Mod/High Least /Most	**Support for Prediction**	**Actual Weathering** Low/Mod/High Least /Most
Slate				
Schist				
Gneiss				
Marble				
Serpentinite (Soapstone)				

Post-Experiment Questions

Discuss any discrepancies between your predicted results and your actual results?

Which rocks would you recommend for indoor sculptures? Why?

Which rocks would you recommend for outdoor sculptures? Why?

From which rocks would artifacts be made that would most likely be preserved for centuries in an environment dominated by abrasion? Why?

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From which rocks would artifacts be made that would least likely be preserved for centuries in an environment dominated by abrasion? Why?

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From which rocks would artifacts be made that would most likely be preserved for centuries in an environment in which both abrasion and chemical weathering occur? Why?

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From which rocks would artifacts be made that would least likely be preserved for centuries in an environment in which both abrasion and chemical weathering occur? Why?

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