

## Rocks and Weathering

Name: \_\_\_\_\_ Date: \_\_\_\_\_

# Rocky Shores Beach Resort

Weathering is the process by which the surface of the Earth changes through mechanical and chemical processes. In this activity, we are going to experience the effects of mechanical abrasion weathering by conducting research using a weathering model.

### Introduction:

### Engineering Design Scenario

An island exists in a tropical region of the Pacific Ocean. The island has nutrient-rich soil, tropical plant life, abundant wildlife, and pristine views in all directions. From the perspective of beachgoers, the island is perfect in every way, but one: no beaches! The island has three shorelines composed of rocks and boulders. Each shoreline is composed of a different rock type.

The owner of the island hired a developing company to build a beautiful resort property on one shoreline—but which one? The developer’s main goal for the resort is to provide sandy beaches. As civil engineers, your task is to create the beautiful beaches from the existing rock material. In order to be environmentally responsible, engineers take into consideration the potential for displacing a variety of tidal zone species and so make any effort possible to rehome organisms prior to construction. Again, to consider the potential ecosystem impact of this project, the engineers must consider that the island is a great distance from the mainland and resources are limited and expensive. Before your team creates the beach, you need to determine which shoreline is the easiest, simplest, and least expensive to transform into a beautiful, sandy beach.

If your “civil engineering firm” (your group) is able to complete the project on time and under budget, it receives a bonus of \$1,000,000 and unlimited use of the resort.

*Your engineering challenge:* Apply your knowledge of rocks and mechanical weathering to determine which shoreline is best for creating a beach from the existing rock and developing the beach resort.

1. We often hear about engineers, but most of us don’t really know what engineers really do. Watch the following video “[Engineering Design Process](https://youtu.be/b0ISWaNoz-c)” ( <https://youtu.be/b0ISWaNoz-c>) and explain what engineers do on your lab write up.

## **Part I. Experimental Laboratory: Chemical and Mechanical Weathering**

### **1. How does water affect carbonate rocks?**

The rock at Beach #1 on Rocky Shores Island is made of carbonate rock. Carbonate rocks form at the bottom by shells of organisms piling up over hundreds of thousands or millions of years. Shells are full of calcium carbonate and as they slowly dissolve, they turn into tiny sediments that undergo compaction and cementation which turns them into rock. A common type of carbonate rock is limestone which exists at Site #1.

We will investigate how water affects the carbonate rocks at Site #1. To model this we will use antacid tablets (Alka-Seltzer is one brand of antacid tablets) that contain carbonates.

#### **Materials:**

- 2 antacid tablets
- A small beaker
- Water
- Pair of tweezers to remove the tablet for observation
- Timer or clock

#### **Procedure:**

- 1) Take a look at the Alka-Seltzer tablet and record your careful observations.
- 2) Place one tablet in a small beaker and cover it with water.
- 3) Make careful observations for 3 minutes. Use the timer or a clock to watch the time.
- 4) After 3 minutes, use the tweezers to remove the tablet and then record your observations of the surface of the tablet. Compare the tablet to an unused one to make sure your observations are accurate.
- 5) Write down your thoughts about how water might alter carbonate rocks.
- 6) Record whether you think this exploration demonstrated chemical weathering, mechanical weathering, or erosion.
- 7) Will this method be useful for making a nice sandy beach on the island?

When you're all finished, make sure you rinse out the beaker and leave it ready for the next group to use.

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## 2. How does acid rain and acidified ocean water affect limestone rocks?

At this lab station you will investigate how acid rain and acidified ocean water affect limestone rock. To model limestone you will use chalk or egg shells which are both composed of calcium carbonate which is the same as limestone. To model acid rain and acidified ocean water, you will use vinegar.

### Materials:

- 2 pieces of chalk or egg shell
- A mortar and pestle
- Water
- Vinegar
- 2 small beakers
- Pair of tweezers to remove the chalk for observation
- Tape and a marker to label the beakers

### Procedure:

- 1) You need to have pebble-sized pieces of chalk or the shell from one egg for this experiment. If you need to, use a mortar and pestle to break the chalk into smaller pieces.
- 2) Record your observations of the chalk or egg shell after crushing it. How does it feel? What does its surface look like?
- 3) Place half of the chalk pieces in one beaker and label it "Acid Rain".
- 4) Place the other half of the chalk pieces in the other beaker and label it "Water".
- 5) In the beaker labeled "Acid rain" cover the chalk with vinegar.
- 6) In the beaker labeled "Water" cover the chalk with water.
- 7) Record your observations. After waiting about 3-5 minutes, you can try to take the chalk pieces out of the beakers if you want to make additional observations. Otherwise, record your final observations.
- 8) Write down your thoughts about how water and acid rain might affect limestone rocks.
- 9) In your lab notebook, record whether you think this exploration demonstrated chemical weathering, mechanical weathering, or erosion.
- 10) Will this method be useful for making a nice sandy beach on the island?

When you're all finished, make sure you rinse out the mortar and pestle and the beakers and leave the station ready for the next group to use.

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**3. How does mechanical weathering affect limestone rocks?** At this lab station you will explore how rocks are altered by vigorous movement such as ocean waves, falling down a rocky mountain slope in a rock or snow avalanche, or tumbling down a turbulent river. To model rocks of different hardness you will use gravel (a harder rock) and a softer rock from the Island (which we will simulate using sugar cubes). Shaking them will mimic the vigorous motion that occurs in ocean waves, rock avalanches, or riverbeds.

**Materials:**

- Sugar cubes (4)
- One jar with lid
- Gravel (a small handful)

**Procedure:**

- 1) Pick out 4 sugar cubes and record your observations of the sugar cubes.
- 2) Pick out a handful of gravel and record your observations of the gravel.
- 3) Put both the sugar cubes and gravel in a jar and close the lid tightly. Then shake the contents of the jar vigorously for about 5 minutes. You and your partner may need to take turns so you don't get tired.
- 4) After five minutes open the jar and look carefully at the sugar cubes and gravel. Record your observations.
- 5) Write down your thoughts on how abrasion (whether tumbling down a mountain, being tossed around in waves, or washed down a riverbed) might affect different types of rocks.
- 6) Record whether you think this exploration demonstrated chemical weathering, mechanical weathering, or erosion.
- 7) Will this method be useful for making a nice sandy beach on the island?

When you've finished, clean out the jar so that the station is ready for the next group.

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## **Part II. Laboratory Analyses:**

Now that you have performed tests on the different rock types and weathering processes that may occur on the island, it is time to put together a report to share with the developers and see if you've earned your \$1,000,000 bonus for coming up with a plan to make a perfectly sandy beach that will not cost too much and won't take too long.

1. Describe the types of chemical weathering you performed on the samples. What was the outcome?
2. Describe the types of mechanical weathering you performed on the samples. What was the outcome?
3. Explain how each of the following "rocks" changed from the beginning to the end of each test.
  - a. Antacid tablet
  - b. Egg Shell
  - c. Sugar Cube

## **Conclusion**

Write a paragraph with your team that explains the following based on your research results of the three types of "rocks" you weathered and the data you collected. This is the "report" that you would present to the developers explaining your recommendations (write a good paragraph!).

### **Introduction sentence**

#### **Body** (Minimum of three sentences addressing)

- Which rock type you would use and why.
- What process you would use and why.
- Any creative solutions that will make the best beach possible (combining rock types and/or processes)

### **Conclusion sentence**