ACTIVITY GUIDE

Rain Shadows

BBC EARTH

WILD ASIA

LIFE AT EXTREMES

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Introduction

Mountains have massive impacts on weather and climate, creating diverse habitats. One of the most influential weather events is called a **rain shadow.**

A rain shadow occurs when water vapor forms over the ocean or another large body of water and is carried over land by wind currents.

If the water vapor is carried towards a mountain, the colder temperatures encouraged by the mountaintop condenses the water vapor into clouds, and then rain. The resulting rainfall can't make it to the other side of the mountain. This creates a lush, moist, green biome, and a dry desert separated by a mountain range.

Sheer mountain face in the Himalaya

From the Film

The Himalayan mountains are a prominent part of the Asian continent and heavily affect the surrounding weather and climate.

The extreme height of this mountain range causes a significant rain shadow effect, which creates dry conditions for the nearby Gobi Desert and highland plateaus.

The ecosystems that form in these climates support a range of biodiversity and include animals such as the Tibetan fox and snow leopard.

Tibetan Fox

Activity Overview

Using a model mountain, participants will experiment with the impact mountains have on weather systems and climate. They will then come together on a larger scale to explore the phenomenon of a **rain shadow.**

NGSS

3-ESS2-1

Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.

5-ESS2-1

Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

Materials:

- Mountain Diagram (1 per participant)

NOTE: there are two different sizes of mountains, and each pair should receive both sizes

- Blank paper for data
- Writing utensils / Coloring utensils (optional)
- Materials for mountain diagrams (books, cups, tissue boxes, water bottles)
- Scissors (1 per participant)
- Bubble solution and wands (one per pair)

Group Materials:

- Support to build a large mountain (tables, chairs, furniture)
- Tarp, blanket, or butcher paper
- Fan
- Bubble solution and wands
- Blank paper for data

Preparation

- Print the **Mountain Diagram** sheets
- Gather the materials as outlined in the list on page 4

Procedure

1. In the film, ***Wild Asia: Life at Extremes*** we saw extreme types of weather and how it affects the habitats and life found in Asia.

What types of weather do you remember seeing in the film?
Note: If participants haven't seen the film yet, ask them to share different types of weather they are familiar with.

A: Freezing winds, monsoons, snow, ice, and drought.

Do we have weather like in the film where we are?

A: Based on location.

2. Mountains have a major impact on the weather and climate around them. Today we are going to experiment with a weather phenomenon known as a **rain shadow.**

A rain shadow is created when the cool air around a mountain encourages rain to fall on one side, leaving a shadow on dry land on the other side.

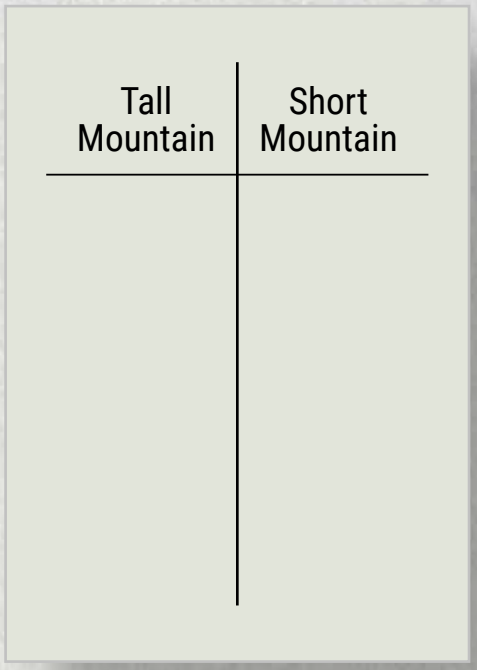
Procedure cont.

3. Divide participants into pairs and give each pair a **Mountain Diagram** sheet, a blank sheet of paper, a writing utensil, and a pair of scissors.

There are two different sizes of **Mountain Diagram** sheets. Each partner should have a different size, so both are represented in the pair.

Explain that participants will cut out their mountain and fold the tabs to prop it up. Each participant should place an object behind their mountain, like a small book, pencil pouch, or paperweight, so the mountain will remain stationary.

Instruct the participants to format their **data sheet** by drawing a "T" chart on their blank paper. Follow the example to the right.



Data sheet example

What do you notice about your mountain? How is it different from your partner's?

A: The mountains are different heights and represent different mountain ranges.

Make a prediction. ***Do you think this height difference will affect the rain shadow?*** Participants will record their prediction on their **data sheet.**

Procedure cont.

4. Now that the mountains are formed it is time to introduce the weather component. Give each pair a container of bubbles with a wand.

One participant will blow bubbles at their partner's mountain.

Their partner observes, and records how many bubbles pop in front of the mountain, and how many get to the other side without popping. Then partners will switch jobs and repeat the experiment.

Steep ridges of the Annapurna mountains in the Himalaya

5. Start the experiment slowly by having the partner blowing the bubbles blow them one at a time to make it easier for their partner to observe and count them. They should blow 10 bubbles and then switch roles.

6. During the experiment, participants will record these observations on their data sheet.

7. Make sure when participants are blowing the bubbles they aim at the middle of the mountain cutout and don't inadvertantly blow bubbles over the top of the mountain.

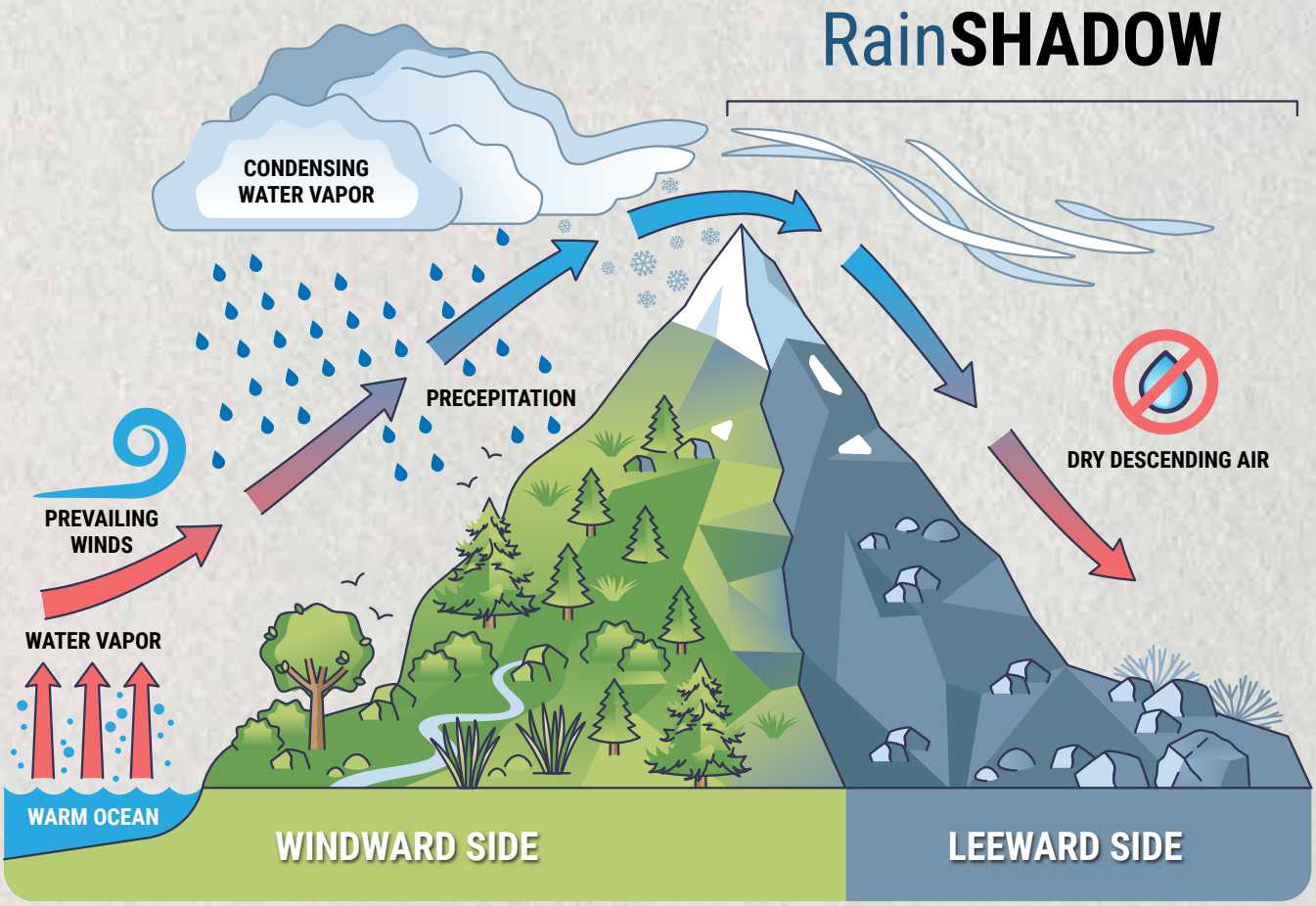
8. Run at least six trials, ten bubbles per trial and three trials per mountain, so that participants can observe and record trends. Once they have completed their trials, the pairs will share and compare their data.

Questions / Answers

What was happening in this experiment?

A: **This experiment simulates a rain shadow.** Each bubble represented a cloud, and when it popped, that means it had rained and released the moisture inside the cloud. The air around a mountain is cooler than air in flat areas, which can make water vapor in clouds condense faster and cause more rain to fall.

Examine the diagram below for a real-world comparison.



Questions / Answers

What trends did you notice?

A: Will vary. Encourage discussion.

Which mountain had the most bubbles popping on the windward side?

A: The big/taller mountain.

Why does the taller mountain make it rain more often?

A: The taller mountains are colder. The colder air makes the water vapor in clouds condense faster.

What is a good example of a real-life mountain range for each size of mountain?

A: Large: Himalayas, Rockies Medium: Appalachians, Alps

Do you think foothills or piedmont regions affect the weather?

A: Foothills can affect some weather patterns like wind speed but aren't cold enough to cause a rain shadow effect.

Group Experiment

1. Now that we've seen the impact size has on a small scale, let's take our experiment to the Himalayas where you'll find the world's tallest mountain, Mount Everest.

2. Work together to form a large mountain about four feet tall. This can be done using chairs, desks, bookshelves, to make a base structure and then cover the structure with a cloth or tarp. This covering will ensure that the bubbles don't go through the mountain.

3. Separate participants into three groups and assign each group one of three roles.

Cloud Team: This group will blow bubbles into the fan aimed at the mountain. If you are not using a fan some individuals from this team will need to use sheets of paper to help direct the bubbles toward the mountain.

Front Team: This group will count and record how many bubbles pop on the *windward* side of the mountain.

Back Team: This group will count and record how many bubbles pop on the *leeward* side of the mountain.

A majestic sunset on Mt. Everest

Group Experiment cont.

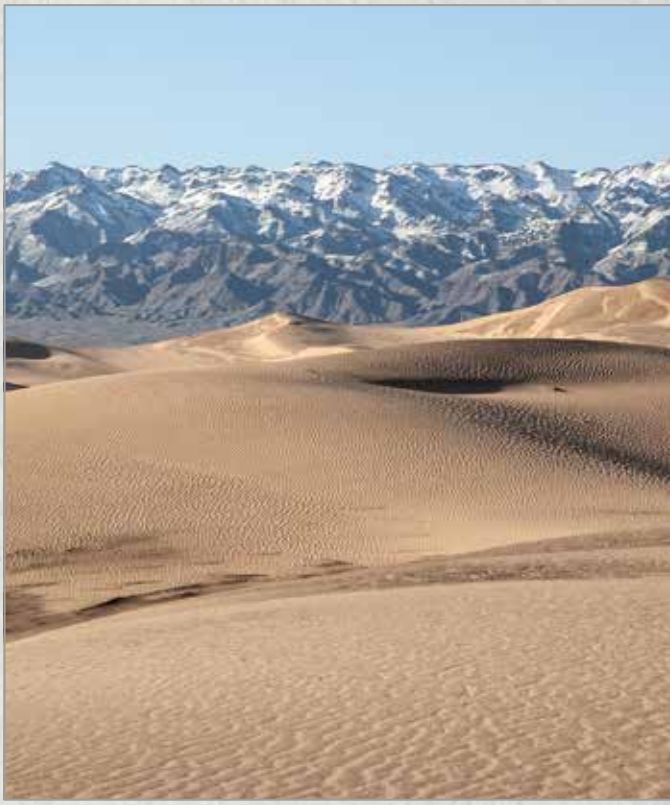
4. Position the **Cloud Team** and **Front Team** counters on the windward side of the mountain with a fan aimed at the mountain. Position the **Back Team** on the leeward, or opposite side.

5. Begin the first trial by starting the 60 second timer as you announce **GO!**

There will be lots of bubbles, so encourage counters to do their best. It is ok if there are slight differences in the totals.There are multiple people counting and teams can compile the data to get an average.

6. Run two additional 60 second trials and rotate teams, so that each participant experiences all three roles.

7. Once trials are completed, share and compare the data as a group.



Gobi Desert (Mountain range in background)

Debrief

How was this experiment different than the earlier experiment with the smaller mountains?

A: Will vary based on individual results, but should include a more dramatic difference of where the bubbles are popping.

Why do you think the front side (windward side) of the mountain gets more rain?

A: As air moves up a mountain it cools, which causes the air to be unable to hold onto water vapor, resulting in precipitation like rain or snow.

What effect do you think the rain shadow has on the leeward side of the mountain?

A: Rain shadows cause dry habitats and drought-like conditions on the leeward side, since the air releases most of its moisture on the windward side of the mountain.

Large Mountain

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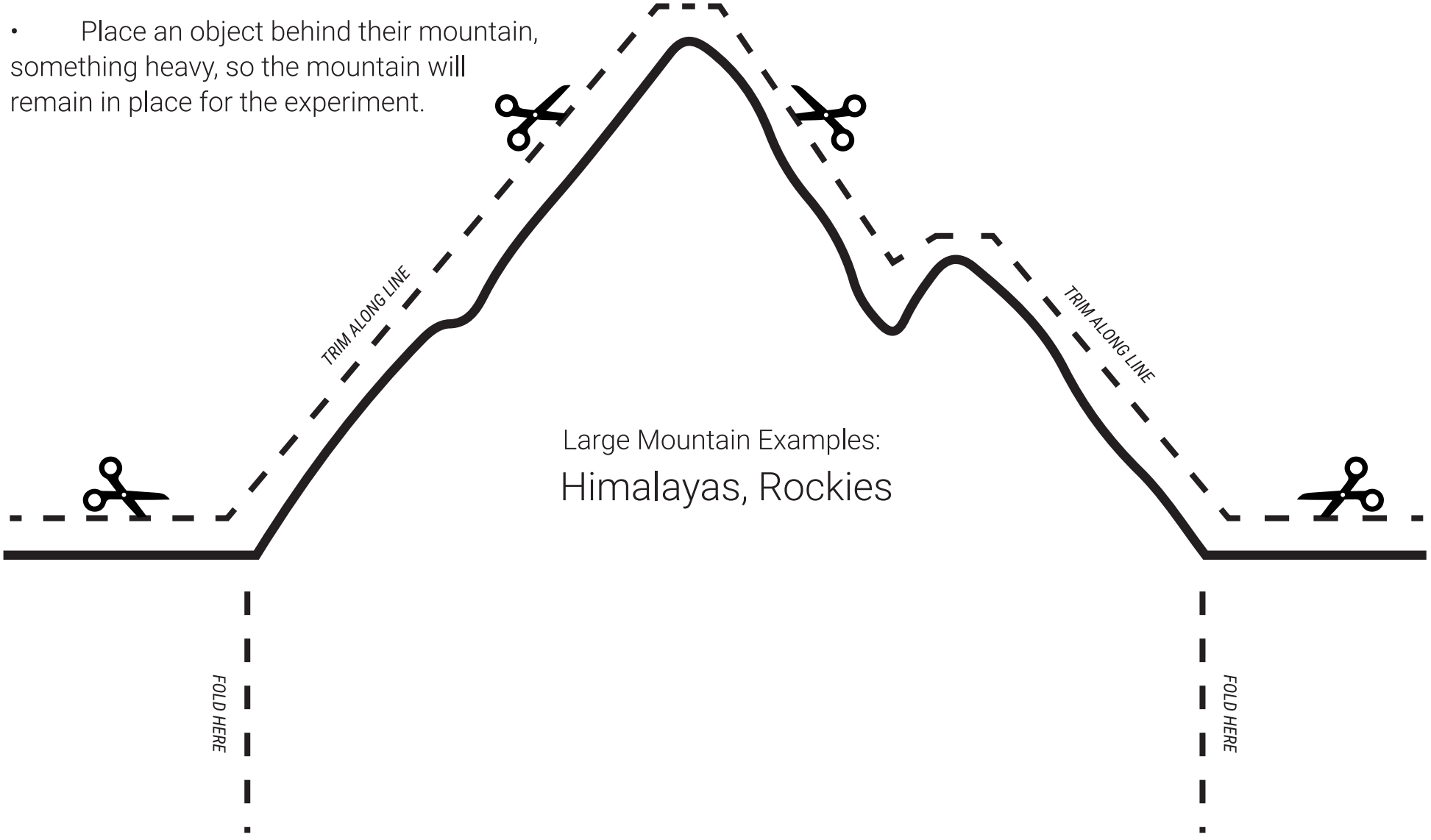
- Cut out the mountain from the sheet and fold the tabs to stand it.

- Place an object behind their mountain, something heavy, so the mountain will remain in place for the experiment.



Large Mountain Examples:
Himalayas, Rockies

Medium Mountain

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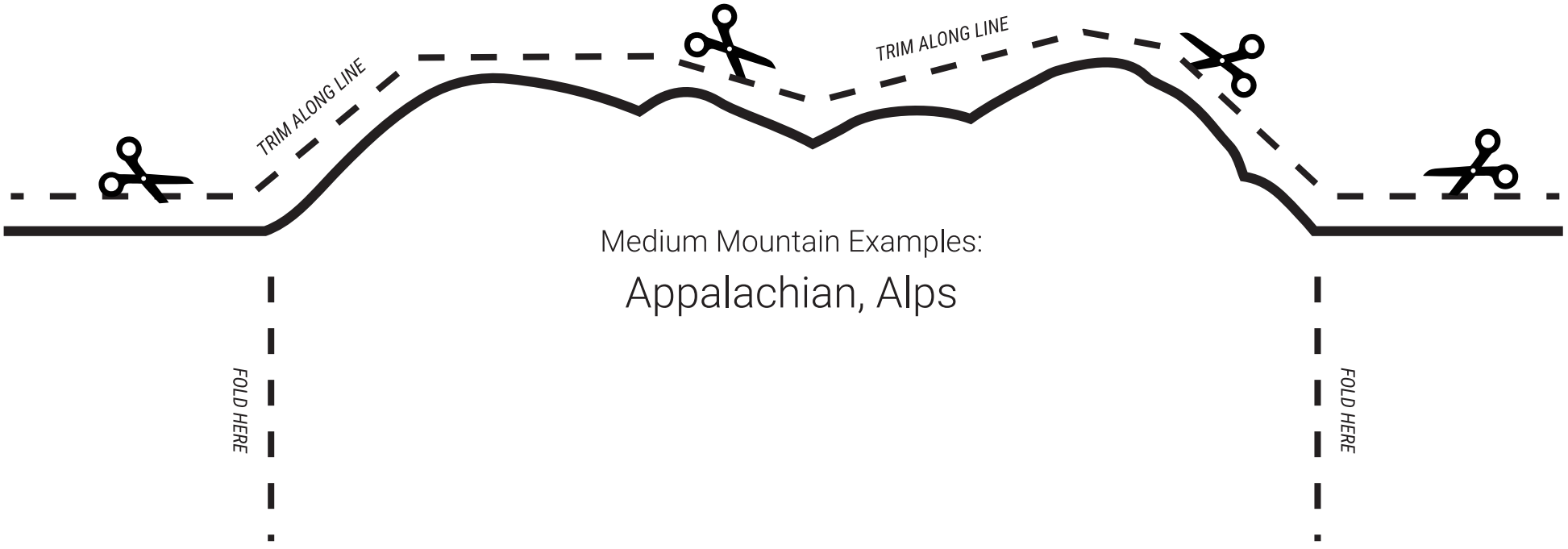
- Cut out the mountain from the sheet and fold the tabs to stand it.

- Place an object behind their mountain, something heavy, so the mountain will remain in place for the experiment.



Medium Mountain Examples:

Appalachian, Alps

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