

Hazards of the Tilt-a-World

Overview:

In this activity, students learn that the four seasons result from the tilt of Earth on its axis. Because of this tilt, the amount of sunlight reaching the Polar Regions differs drastically across the year, while the amount of sunlight reaching the equator is relatively constant. The amount of sun reaching a region is the main influence on its weather patterns. In turn, weather patterns can influence volcanic hazards.

Objectives:

The student will:

- model the amount of sunlight reaching different Earth regions in winter vs. summer;
- describe how the amount of sun reaching these regions leads to different weather patterns;
- compare weather in Alaska with weather in Hawai‘i by reading and interpreting charts; and
- describe how weather across the seasons might affect volcanic hazards in each region.

Materials:

- *Ola Ka Honua: Volcanoes Alive* interactive DVD
- Styrofoam balls, 5 inches in diameter
- Pencils
- Compasses
- Table lamp with bare bulb (use a clear, not frosted, bulb)
- Student Worksheet: “Tilt-a-World”
- Student Worksheet: “Hazards of the Tilt-a-World”

Answers to Student Worksheets:

Tilt-a-World:

Hypothesis: Answers will vary

Analysis of Data:

1. No, the amount is about the same
2. None. Students might answer “a little bit” depending on how they hold the globe.

Conclusion: Answers will vary but should indicate that the equator experiences the most consistent amount of sunlight throughout the year.

Further Questions:

1. The temperature should not differ much throughout the year
2. Winter should be cold in the north.
3. Winter

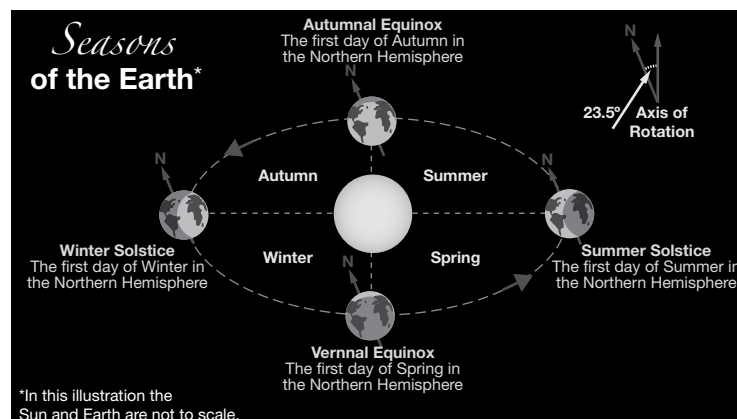
Hazards of the Tilt-a-World:

- | | |
|---|---|
| 1. Kahului | 8. pyroclastic flow, falling ash, lahars |
| 2. July and August | 9. pyroclastic flow, falling ash |
| 3. December and January | 10. explosive eruption, slow flowing lava |
| 4. January | 11. gas, slow flowing lava |
| 5. January | 12. December |
| 6. January, February, March, November, December (possibly April or October) | |
| 7. Answers may vary but should at least include January and December | |

Hazards of the Tilt-a-World

Activity Procedure:

1. Ask students if they know why there are different seasons. Students may respond that Earth is closer to the sun in the summer and further away in the winter; however, this is not what causes the seasons. Explain that the seasons are caused by the tilt of Earth on its axis.
2. Ask students to create a model to show how seasons are caused by Earth's tilt. They will use a light source and a Styrofoam ball to model the amount of sunlight reaching different parts of Earth during the four seasons.
3. Stick a pencil through a Styrofoam ball, and show students how to draw the Arctic Circle, the Equator, and the Antarctic Circle on "Earth." Show how to tilt "Earth" by 23.5 degrees relative to the vertical plane.
4. Demonstrate how to rotate "Earth" halfway around the light, stopping 180 degrees from the starting point. Emphasize that students need to hold the ball at the same angle as they move the ball around the light (see diagram below) and at the same distance from the light.
5. For best results, students should hold the ball about five inches from the light bulb. Show the differences in shadow strength that result when the ball is placed different distances from the light.
6. Distribute the Student Worksheet: "Tilt a World."
7. When the students are finished with the worksheet, discuss the questions and answers. If necessary, review that the sun is the major source of heat for Earth, so the lack of sunlight in the northern hemisphere during winter is responsible for lower temperatures. Emphasize that the seasons are reversed at the poles.
8. Point out that the amount of light reaching the Equator is fairly constant all year round; thus, there is less variation in temperature from season to season.
9. Distribute the Student Worksheet: "Hazards of the Tilt a World, and ask students to complete it."



Tilt-a-World

Testable Question:

Which regions of Earth receive the most consistent amount of sunlight throughout the year?

Background Information:

The sun is the major source of heat for Earth. Because Earth is tilted, different regions of Earth receive different amounts of sunlight at various times of the year. This phenomenon is the reason for the seasons.

Hypothesis:

Please complete the Hypothesis.

If Earth rotates around the sun at a 23.5° tilt, then the regions near Earth's _____ will receive the most consistent amount of sunlight throughout the year.

Materials:

- Styrofoam ball
- Pencil
- Compass
- Light with bare bulb

Procedure:

1. Hold a Styrofoam ball in one hand. Stick a pencil straight up through the center of the ball, from bottom to top. Be sure to get as close to the center of the ball as possible. The ball represents Earth and the pencil represents Earth's axis.
2. Draw a circle around the middle of the ball, perpendicular to the "axis." This line represents the Equator. Pull the pencil out of the ball. Using a compass, draw a circle on the top of the ball about 1 inch in diameter, using the hole from the pencil as the center of the circle. This circle represents the Arctic Circle.
3. Draw a second circle on the bottom of the ball using the same method. This circle represents the Antarctic Circle.
4. Re-insert the pencil into the hole in the ball. Using Figure 1 on the worksheet as a guide, tilt "Earth" 23.5 degrees relative to the vertical plane. Hold the ball at this angle for the remainder of the activity.
5. Now, bring the ball parallel to the light bulb, holding it about 5 inches away from the bulb. Be sure to maintain the tilt of the ball! The top of the pencil should be pointing a little away from the light, while the bottom of the pencil should be pointing a little toward the light. This configuration represents winter in the Northern hemisphere.
6. Is the Arctic Circle in the light or the dark? How about the Antarctic Circle? Estimate how much of the Equator is in the dark, and how much is in the light. Record observations in the "Data" section on this worksheet.
7. Now, holding the ball at the same angle, carefully move the ball 180 degrees around the light from its starting point. The top of the pencil should now be pointing a little towards the light. This position represents summer in the Northern hemisphere. Record the light conditions at the Equator, the Arctic Circle, and the Antarctic Circle now.
8. Using collected data and the graph, answer the questions below.

Tilt-a-World

Data:

	Winter in the North	Summer in the North
Arctic Circle	Light or dark? _____	Light or dark? _____
Antarctic Circle	Light or dark? _____	Light or dark? _____
Equator	About what percentage of the line representing the equator is in the light? _____	About what percentage of the line representing the equator is in the light? _____

Conclusion:

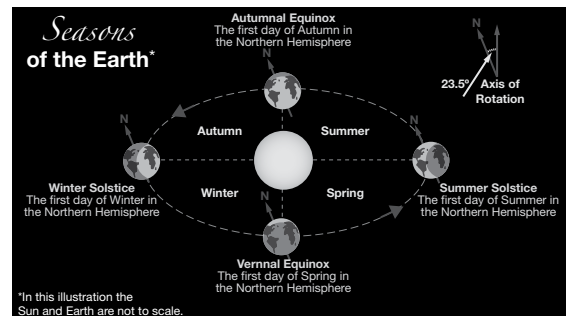
1. Compare your data to that of your classmates. Write your conclusion as a complete sentence.

2. Was your hypothesis proved or disproved? Explain your answer.

Analysis of Data:

1. Is the amount of sunlight reaching the Equator different in the summer vs. the winter?

2. How much sunlight reaches the Arctic Circle during winter in the north?



Further Questions:

1. How might the amount of light reaching the Equator affect the weather in areas near the Equator?

2. How might the amount of sunlight reaching the Arctic Circle during winter affect weather for people living near the Arctic Circle?

3. What season is it in the Antarctic Circle when it is summer in the north? _____

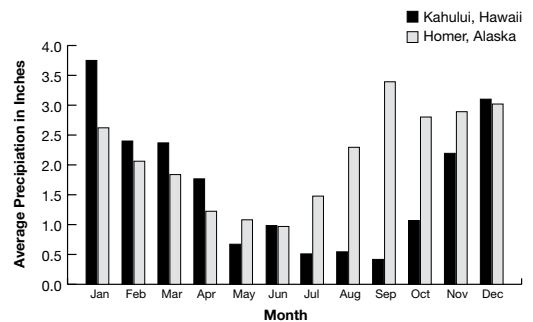
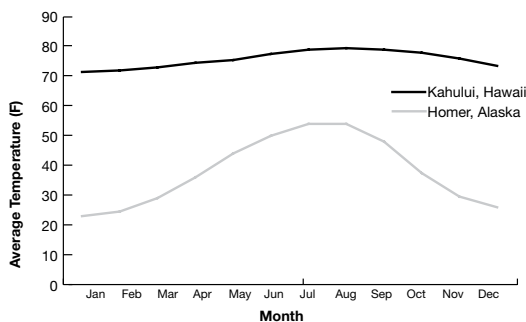
Hazards of the Tilt-a-World Part 1

Directions: Use the graphs at the bottom of this worksheet to answer the following questions.

Background Information: The tilt of Earth causes different amounts of sunlight to reach the Equator than the Polar Regions during winter and summer. This causes differences in weather patterns on different parts of Earth.

Two volcanoes, Augustine near Homer, Alaska, and East Maui (or Haleakala) near Kahului, Hawai‘i, experience different weather conditions, in part, because of their location. The volcanic hazards associated with each volcano may vary throughout the year because of these weather patterns. Both volcanoes are considered active. Although East Maui volcano has not erupted for a number of years, scientists believe it will erupt again in the future.

1. Which location has more consistent temperatures throughout the year, Kahului, Hawai‘i or Homer, Alaska? _____
2. What are the two warmest months in Homer, Alaska? _____
3. What are the two coolest months in Homer, Alaska? _____
4. Does Kahului, Hawai‘i receive more precipitation in January or July? _____
5. Does Homer, Alaska receive more precipitation in January or July? _____
6. Based on average temperatures, in which month or months might Homer, Alaska’s precipitation fall as snow? _____
7. Based on average temperatures, in which month or months is ice likely to occur on Augustine volcano? _____



Hazards of the Tilt-a-World Part 2

Directions: Use the information on the *Ola Ka Honua: Volcanoes Alive* DVD and the answers on the previous page to answer questions about volcanic hazards at Augustine Volcano near Homer, Alaska and East Maui Volcano near Kahului, Hawai‘i. Note: *East Maui is a shield volcano, and Augustine is a composite volcano.*

- 8. Using the hazard simulator, pick the magma type that would create Augustine volcano. Pick the water conditions that Augustine volcano might experience in January. What are the hazards that might occur in these conditions?

- 9. Using the hazard simulator, pick the magma type that would create Augustine volcano. What are the hazards that might occur during a month with little to no precipitation?

- 10. Using the hazard simulator, pick the magma type that would create East Maui volcano. What are the hazards that might occur during a month of heavy rainfall?

- 11. Using the hazard simulator, pick the magma type that would create East Maui volcano. What are the hazards that might occur during a month of little to no rainfall?

- 12. Look at the precipitation graph again. For East Maui volcano, is an explosive eruption more likely in June or December? _____