Name: _____ Date: _____

Student Exploration: Comparing Climates (Metric)

[Note to teachers and students: This lesson was designed as a follow-up to the Observing Weather (Metric) *lesson. We recommend doing that activity before trying this one.]*

Vocabulary: adaptation, climate, equator, hot desert climate, humidity, latitude, precipitation, temperature, tropical monsoon climate, weather

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)

1. **Climate** is the average of all **weather** conditions in a location. Climates can be warm or cold, rainy or dry, and windy or calm. What do you think the climate is like where this palm tree grows?

   _____

   _____

2. What is the climate like where you live? _____

   _____

Gizmo Warm-up

In the *Comparing Climates (Metric)* Gizmo™, you will compare weather conditions, landscapes, and wildlife from different parts of the world. To begin, choose **Barcelona** from the **Location 1** menu. Select the LANDSCAPE tab. Barcelona is a city in Spain that is located on the Mediterranean Sea. You are looking at a landscape near Barcelona.

1. Drag the slider from January to December. Based on what you observe, do you think Barcelona has large **temperature** changes throughout the year?

   _____

2. Click on an olive tree and read about it. Based on what you read, do you think the climate of Barcelona is very wet or rather dry? Explain.

   _____

   _____

Activity A: **Describing climate**	Get the Gizmo ready: • On the WORLD MAP tab, select **New York** from the **Location 1** menu.	

Introduction: Climate is the average of weather conditions in a location over many years. In this Gizmo you will focus on four aspects of climate: temperature, wind speed, **precipitation** (rain and snow), and **humidity** (how much moisture is in the air). Other climate characteristics include cloud cover and hours of sunlight.

Question: How do we describe climate?

1. Predict: Look at New York's position on the globe. What do you notice? _____

   _____

   Based on this, what do you think New York's climate will be like? _____

   _____

2. Observe: Select the LANDSCAPE tab. Drag the slider from January to December.

   A. What changes do you see throughout the year? _____

   _____

   _____

   B. How many distinct seasons do you notice? _____

3. Analyze: Go to the DATA tab. Look at the **Avg. temperature** graph and table.

   A. What is the general shape of the graph? _____

   B. What are the highest and lowest monthly temperatures, and what would you estimate is the average temperature for the year? (Hint: The average temperature for the year will be about halfway between the highest and lowest temperatures.)

      Highest temp. _____ Lowest temp. _____ Avg. temp. _____

   C. Select **Two locations** and choose **Barcelona** for the second location. Based on what you see, which location experiences greater seasonal changes? Explain.

      _____

      _____

(Activity A continued on next page)

Activity A (continued from previous page)

4. Observe: Switch to **One location** and look at the **Avg. precipitation** graph for New York.

   A. What is the general shape of the graph? _____

   B. About how many millimeters of precipitation fall in a year? _____

   C. Select **Two locations** and choose **Barcelona** for the second location. Based on what you see, which location has a wetter climate? _____

5. Describe: Plants and animals have structures, behaviors, and other traits called **adaptations** that help them to survive. For example, the gills of a fish are an adaptation for living under water, while lungs are an adaptation to living on land.

   Switch to the LANDSCAPE tab, choose **One location**, and check that **New York** is selected. Click on the deer, squirrel, and oak tree to learn about each organism. Describe one way that each organism is adapted to live in New York's climate.

Organism	Adaptation
White-tailed deer	
Eastern gray squirrel	
Northern red oak	

6. Observe: Return to the DATA tab. For New York only, there are two extra graphs: **Avg. yearly temp** and **Yearly precip.** These graphs give 30-year records for temperature and precipitation. The numbers in the other graphs are averages of data from the last 30 years.

   A. Look at the **Avg. yearly temp.** graph. What do you notice? _____

   _____

   B. How do the average yearly temperatures compare to the estimate you made in question 3B? _____

   C. Look at the **Yearly precip.** graph. What do you notice? _____

   _____

   D. Which year of the last 30 years was the wettest? _____ Driest? _____

Activity B: **Rainforests and deserts**	Get the Gizmo ready: • Select **Two locations**. • On the WORLD MAP tab, select **Manaus** for location 1 and **Cairo** for location 2.	

Question: What are the characteristics of tropical monsoon and hot desert climates?

1. Predict: Look at the positions of Manaus and Cairo on the globe. Based on what you see, what do you predict the climates are like in these locations?

   _____

   _____

2. Observe: Select the LANDSCAPE tab and **One location**. Check that **Manaus** is selected. Drag the slider from January to December. Observe what happens to the landscape.

   A. How many seasons do you observe in Manaus? _____

   B. Click on the leaf-cutter ant, Guyanan red howler monkey, and kapok tree to learn about each organism. Describe one way that each organism is adapted to live in the thick forests that result from the climate of Manaus.

Organism	Adaptation
Leaf-cutter ant Guyanan red howler	
Kapok tree	

3. Analyze: Select the DATA tab. Look at the **Avg. temperature**, **Avg. precipitation**, **Avg. wind speed**, and **Avg. humidity** graphs. (For the **Avg. precipitation** graph, click the **zoom out** [–] button to see the whole graph.)

   A. What is the shape of the temperature graph? _____

   B. What is the shape of the precipitation graph? _____

   _____

   Manaus has a **tropical monsoon climate**. Tropical climates are found near the Earth's **equator**. They are warm and can be wet, dry, or somewhere in between. Monsoon climates have a wet season with abundant rainfall and a dry season with less rain.

(Activity B continued on next page)

Activity B (continued from previous page)

4. Observe: Select the LANDSCAPE tab and change the location to **Cairo**. Drag the slider from January to December.

   A. What changes do you notice, if any? _____

   B. Click on the dorcas gazelle, Egyptian cobra, and date palm tree to learn about each organism. Describe one way that the organism is adapted to live in Cairo's climate.

Organism	Adaptation
Dorcas gazelle	
Egyptian cobra	
Date palm tree	

5. Observe: Go to the DATA tab. Select **Two locations**, and set location 2 to Manaus. View the **Avg. temperature**, **Avg. precipitation**, **Avg. wind speed**, and **Avg. humidity** graphs.

   A. How do the highest monthly temperatures compare in each location? _____

   _____

   B. In which location does the temperature change more throughout the year? _____

   C. Estimate the total yearly rainfall in Cairo. _____ How does this compare to Manaus? _____

   D. How do wind speeds and humidity compare in the two locations? _____

   _____

Cairo has a **hot desert** climate. In a hot desert, daytime temperatures are very high and nighttime temperatures are cool. Precipitation is very rare and is less than 200 mm per year. Cairo is unusually humid for a desert because it is close to the Mediterranean Sea.

Activity C: **Climate factors**	Get the Gizmo ready: • On the WORLD MAP tab, select **Two locations**. • Select **Yellowknife** and **Miami**.	

Introduction: The climate of a location is influenced by many factors. These include **latitude** (how far north or south a location is), position relative to oceans, and motions of large air masses. In this activity you will see how some of these factors affect climate.

Question: What factors influence climates around the world?

1. Predict: How do you think climates near the equator compare to climates near the north and south poles? _____

2. Gather data: From the WORLD MAP tab, find the latitude of each city. Then go to the DATA tab and find the highest and lowest monthly average temperature. List these below.

Location	Latitude	Highest temp.	Lowest temp.
Yellowknife			
Miami			

3. Analyze: Miami is located much closer to the equator than Yellowknife.

   A. How does the latitude affect the average temperature of each location? _____

   Locations closer to the equator receive more direct sunlight than locations near the poles, so they tend to be warmer.

   B. In which location was there a bigger difference between the highest temperature and lowest temperature? _____

   In locations closer to the equator, the length of a day does not change as much as it does near the poles. In fact, north of 66.5 °N (and south of 65 °S) the sun doesn't rise at all during parts of the winter. In the summer, very long days can lead to some surprisingly mild temperatures.

   C. For location 2, select **Manaus**. Manaus is very close to the equator. How much does the monthly average temperature vary near the equator? _____

(Activity C continued on next page)

Activity C (continued from previous page)

4. Predict: On the WORLD MAP tab, select **San Francisco** and **Kansas City**. In which city do you expect a greater change between summer and winter? _____

5. Analyze: On the DATA tab, view the temperature graphs of San Francisco and Kansas City.

   A. What do you observe? _____

   _____

   Because San Francisco is located near the cool Pacific Ocean, it doesn't get as warm in the summer or as cold in the winter as Kansas City.

   B. Change **Location 1** to **New York**. What do you notice about the temperature graph of New York? _____

   While New York is also located near an ocean, the air masses that affect its weather tend to come from the land to the west rather than from the ocean. Thus New York's climate is less affected by the ocean than the climate of San Francisco.

6. Explore: Select the WORLD MAP tab. For each location, the climate classification is listed. Find the climate classification for each of the locations listed below. Then, using the LANDSCAPE and DATA tabs, describe the characteristics of each location's climate.

Location	Climate classification	Climate characteristics
Yellowknife		
Kansas City		
Miami		
Barcelona		
Ulaanbaatar		
Sydney		

Extension activity: **Adaptations and climate**	Get the Gizmo ready: • On the LANDSCAPE tab, select **One location** and **Ulaanbaatar**.	

Question: How are animals and plants adapted to the climate?

1. Predict: Based on what you have seen so far, what are some adaptations you would expect animals and plants to have to cold climates? Hot climates? Wet climates? Dry climates? Write some possibilities into each of the boxes below.

Cold climate adaptations	**Hot climate adaptations**
Wet climate adaptations	**Dry climate adaptations**

2. Describe: Using the Gizmo, find an example of an animal adaptation to a cold climate, a warm climate, a wet climate, and a dry climate. Write the locations, animal names, and adaptations below.

   Remember, adaptations can be physical features or behaviors.

Climate	Location	Animal	Adaptation
Cold			
Hot			
Wet			
Dry			

(Extension activity continued on next page)

Extension activity (continued from previous page)

3. Describe: Now do the same thing, but look at the plant adaptations. Give one example of a plant adaptation to each climate characteristic.

Climate	Location	Plant	Adaptation
Cold			
Hot			
Wet			
Dry			

4. Challenge: The climate helps to determine if a landscape is a forest, a grassland, a swamp, or a desert. Therefore, adaptations to the type of landscape are often related to the climate. For example, on the open grasslands of Mongolia, it is helpful for an eagle to see very far because it can spot its prey from a great distance. Long-distance vision may be less helpful in the rainforest, where trees will block the view.

   In the Gizmo, try to find other examples of adaptations that relate to the type of landscape the animal (or plant) lives in. Describe them in the space below. If possible, share your examples with your classmates and teacher.