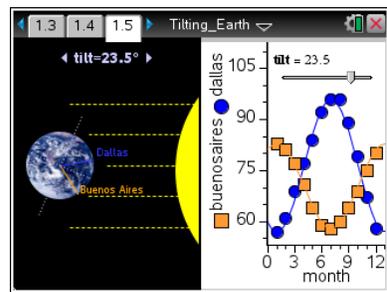




Open the TI-Nspire document *Tilting Earth.tns*.

The Earth's axis is tilted at an angle of  $23.5^\circ$  from the ecliptic (vertical plane) in relation to the sun, but what affect does this tilt have on our climate? Ever wonder what would happen if the Earth's **axis** did not have any tilt and was at  $0^\circ$ ? In this simulation, you will observe the trends in climate for two cities that are approximately the same distance north and south of the equator (Dallas and Buenos Aires). You will then explore the effect of changing the tilt of the Earth's axis.



Move to pages 1.2 and 1.3.

Press **ctrl** **▶** and **ctrl** **◀** to navigate through the lesson.

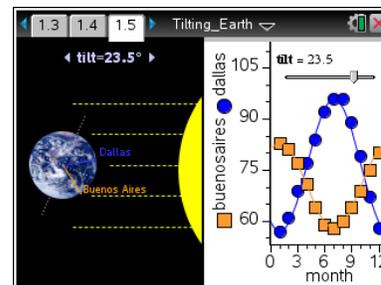
1. Answer the question on page 1.3 before progressing through the rest of the activity.

Q1. Before beginning this simulation, why do you think we have seasons on Earth?

Move to pages 1.4 and 1.5.

2. Read the directions on page 1.4 about navigating the simulation on page 1.5.

3. Page 1.5 contains a split screen. On the left, you will see an image of the Earth, its tilt, and the Sun, while on the right, there is a graph with a tilt slider. The vertical axis, or y-axis, on the graph represents temperature, while the horizontal axis, or x-axis, represents months of the year.



Use the click button to adjust the tilt slider, which will change the tilt of the Earth and the temperature on the graph. You can also press the tab key **tab** to jump to  $23.5$  degrees, or press shift then tab (**⇧shift** **tab**) to jump to  $-23.5$  degrees.

If you want to move to  $0$  degrees, press the esc key **esc**.

Move to page 1.6.

Here you will find a spreadsheet indicating the temperature in two different cities, Buenos Aires in the Southern Hemisphere, and Dallas in the Northern Hemisphere. The spreadsheet shows the average temperature for each location throughout the 12 months of the year using the Earth's natural axis tilt of  $23.5$  degrees.



**Move to pages 1.7 – 1.13. Answer questions 2-8 here and/or in the .tns file on your handheld.**

Q2. When the Earth's axis is tilted at  $23.5^\circ$ , which city receives the most direct sunlight during month 7?

- A. Buenos Aires
- B. Dallas
- C. Both receive the same amount of direct sunlight.

Q3. When the Earth's axis is tilted at  $23.5^\circ$ , what trend do you see in the temperatures for the two cities?

- A. The temperatures are relatively the same throughout all 12 months.
- B. Buenos Aires has a higher overall temperature than Dallas.
- C. The temperatures in the two cities are inversely related.
- D. It is cooler in Dallas during month 6 than in Buenos Aires.

Q4. On page 1.5, set the tilt of Earth's axis to  $23.5^\circ$ . Looking at just the picture of the Earth and the location of the Sun on the left of page 1.5, which season would you conclude that Dallas is currently in?

- A. Fall
- B. Winter
- C. Spring
- D. Summer

Q5. Adjust the tilt from  $23.5^\circ$  to  $-23.5^\circ$ . What changes do you see in the temperatures?

Q6. Looking at Dallas, what happens to the monthly temperatures as you increase the tilt from  $23.5^\circ$  to  $45^\circ$ ?

- A. The temperatures go up.
- B. The temperatures go down.
- C. Some temperatures go up, while others go down.
- D. The temperatures all stay the same.

Q7. Set the tilt of Earth's axis to  $0^\circ$ . What happens to the temperatures in Buenos Aires and Dallas over the 12 month period? Why do you think the temperatures change in this way?

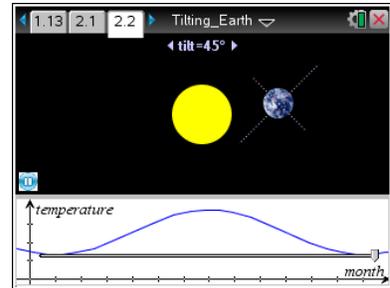


Q8. How would the climate change in your city if the Earth's axis was tilted at  $45^\circ$ ?

**Move to pages 2.1 and 2.2.**

4. Read the directions on page 2.1 about navigating the simulation on page 2.2.

5. On page 2.2 you will find a model of the Earth revolving around the Sun. At the bottom, you will see a graph showing temperature over time.



On the bottom of the page you will see an elongated slider. You will be able to move the slider on this page the same way as the ones on the page 1.5. Use the slider or arrow keys for the tilt, tab to jump to 23.5 degrees (and shift-tab for  $-23.5$  degrees).

As you adjust the tilt by using the slider, the temperature along the bottom will adjust.

You can press **enter**  on your handheld or click the pause button  to pause the simulation at any time. This will allow you to position the Earth in a specific location compared to the sun.

**Move to page 2.3 – 2.7. Answer questions 9-13 here and/or in the .tns file on your handheld.**

Q9. Keeping Earth's axis tilted at  $23.5^\circ$ , when would the Northern Hemisphere experience summer? (Where would the picture of the Earth be in relation to the sun? Remember this is a 2D Model.)

- A. On the top
- B. On the bottom
- C. To the left
- D. To the right

Q10. Keeping Earth's axis tilted at  $23.5^\circ$ , when would the Southern Hemisphere experience summer? (Where would the picture of the Earth be in relation to the sun? Remember this is a 2D Model.)

- A. On the top
- B. On the bottom
- C. To the left
- D. To the right



## Tilting Earth Student Activity

Name \_\_\_\_\_

Class \_\_\_\_\_

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- Q11. At what angle would Earth's axis have to be tilted so that there would be little, if no change in temperature throughout the year?
- Q12. As you increase the tilt of Earth's axis from  $23.5^\circ$  to  $45^\circ$  the temperature not only goes up drastically during a certain time of the year, but it goes down drastically as well. Why do you think the temperatures vary in this way?
- Q13. If a person tells you that the *"seasons are caused by the Earth getting closer to the sun during summer and further away from the sun during winter,"* how might you respond?