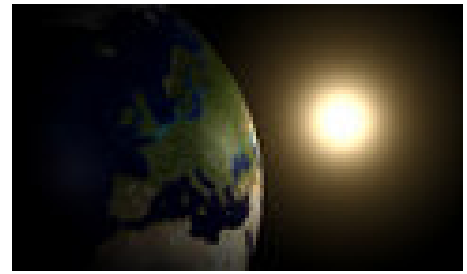# Radiation, Temperature, and Seasons

## Part 1:
## How does the angle of the sun affect the amount of radiation the Earth receives?

To explore the concept of sun angle and seasons, you are given an "Earth" with a solar cell attached.  The solar cell is connected to a multimeter that measures the current flowing through the solar cell.  So, the higher the current, the more energy the cell is receiving.

- Take your Earth outside and point the solar cell directly at the sun, and then towards an area of shade.

  - Do you see a difference in the amount of current?
  - Why do you still measure current in the shade?

- The sun angle is measured in degrees from true south, as pictured in the diagram below.  You are given the approximate sun angle over Fort Collins for the equinox and the summer and winter solstices.  Estimating as best you can, point the Earth so that the solar angle best matches the given angles.

  - Note the current that you read at each angle.
  - How does the amount of radiation that the Earth receives change depending on the sun angle?
  - Is this what you expected?
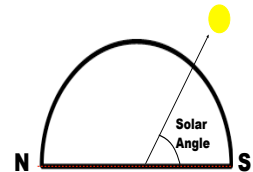
| Date | Max Solar Angle |
|---|---|
| Summer Solstice (June 21st) | 64.5° |
| Equinox (March 20th and Sept 23rd) | 41.5° |
| Winter Solstice (Dec. 21st) | 30° |

## Part 2:
## How does the sun's radiation affect the surface temperature?

Now that you have seen how radiation changes from month to month, it is time for you to plot it, and see how it affects the temperature. You are given monthly maximum solar radiation and average temperature. All of the data have been collected from the Fort Collins weather station on campus and averaged over a 10 year period (2000-2009).

1. Plot both fields and answer the following questions:

   • In what month is solar radiation a maximum in Fort Collins?

   • In what month is temperature a maximum in Fort Collins?

   • Why do you think they are different?

| Month | Solar Radiation ($Wm^{-2}$) | Temperature ($^{o}F$) |
|---|---|---|
| January | 527 | 28 |
| February | 682 | 31 |
| March | 814 | 38 |
| April | 884 | 47 |
| May | 961 | 56 |
| June | 982 | 65 |
| July | 967 | 71 |
| August | 867 | 69 |
| September | 807 | 60 |
| October | 691 | 49 |
| November | 554 | 37 |
| December | 475 | 29 |

2. Now plot the temperature data for <u>one</u> of the following cities: Anchorage, Quito, Seattle, and Sydney.

   • How are the temperature graphs different between Ft. Collins and your city?

   • How are the temperature graphs different between your city and your other group members?

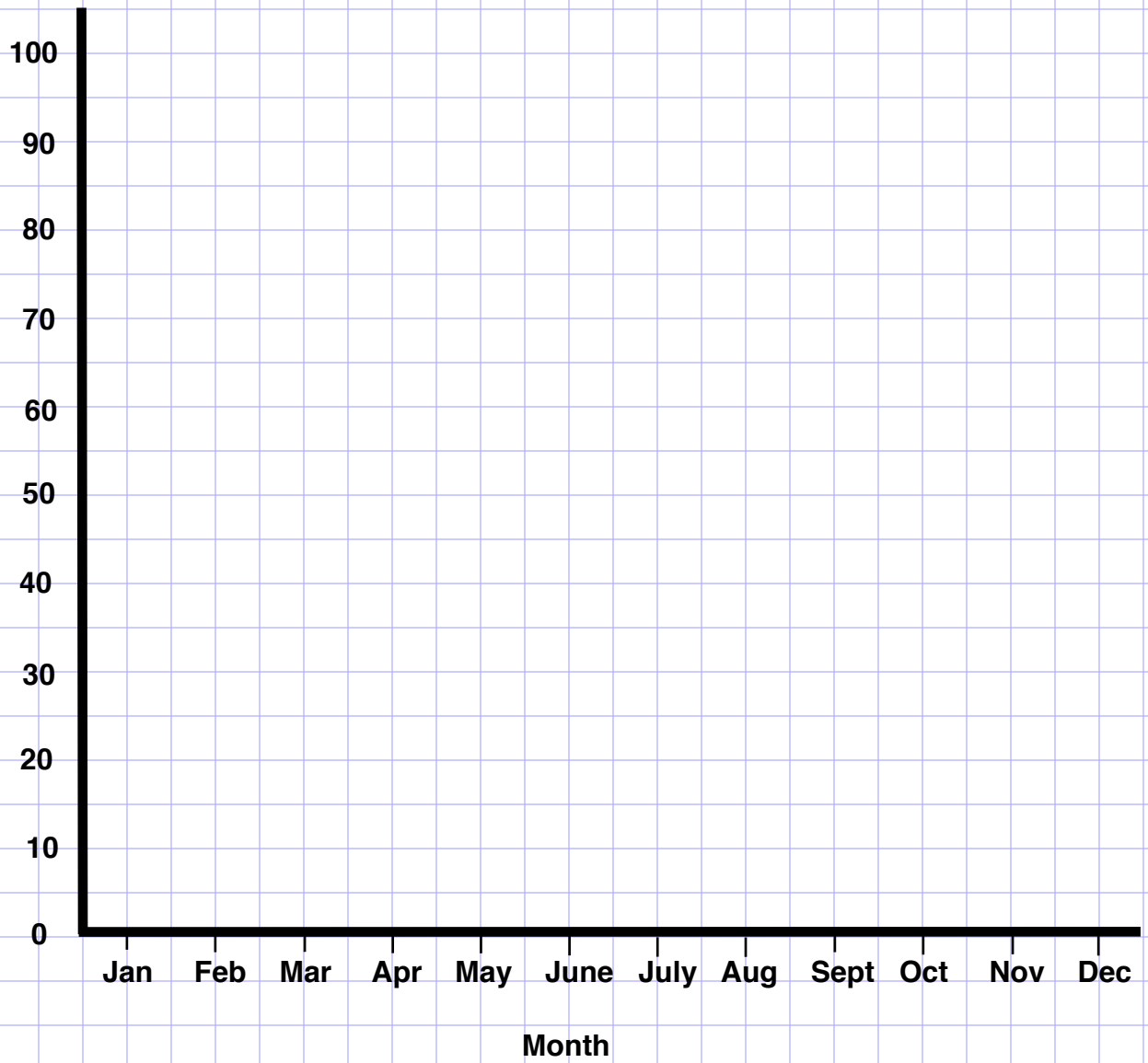   • What reason(s) can you think of to explain this? Discuss this in your group.

| Month | Anchorage, Alaska | Quito, Ecuador | Seattle, Washington | Sydney, Australia |
|---|---|---|---|---|
| January | 16 | 58 | 40 | 72 |
| February | 19 | 58 | 43 | 73 |
| March | 26 | 58 | 45 | 71 |
| April | 37 | 59 | 49 | 66 |
| May | 47 | 59 | 55 | 61 |
| June | 55 | 58 | 60 | 56 |
| July | 58 | 58 | 65 | 55 |
| August | 56 | 58 | 65 | 56 |
| September | 48 | 59 | 60 | 60 |
| October | 34 | 58 | 53 | 65 |
| November | 22 | 58 | 45 | 67 |
| December | 18 | 58 | 40 | 71 |

The data used in this activity were collected from http://ccc.atmos.colostate.edu/ and http://www.ncdc.noaa.gov/oa/ncdc.html.

**Solar Radiation (W/m^2)**

1000

900

800

700

600

500

400

300

200

100

0

| Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec |

**Month**

**Temperature (F)**

100

90

80

70

60

50

40

30

20

10

0

Jan   Feb   Mar   Apr   May   June   July   Aug   Sept   Oct   Nov   Dec

**Month**
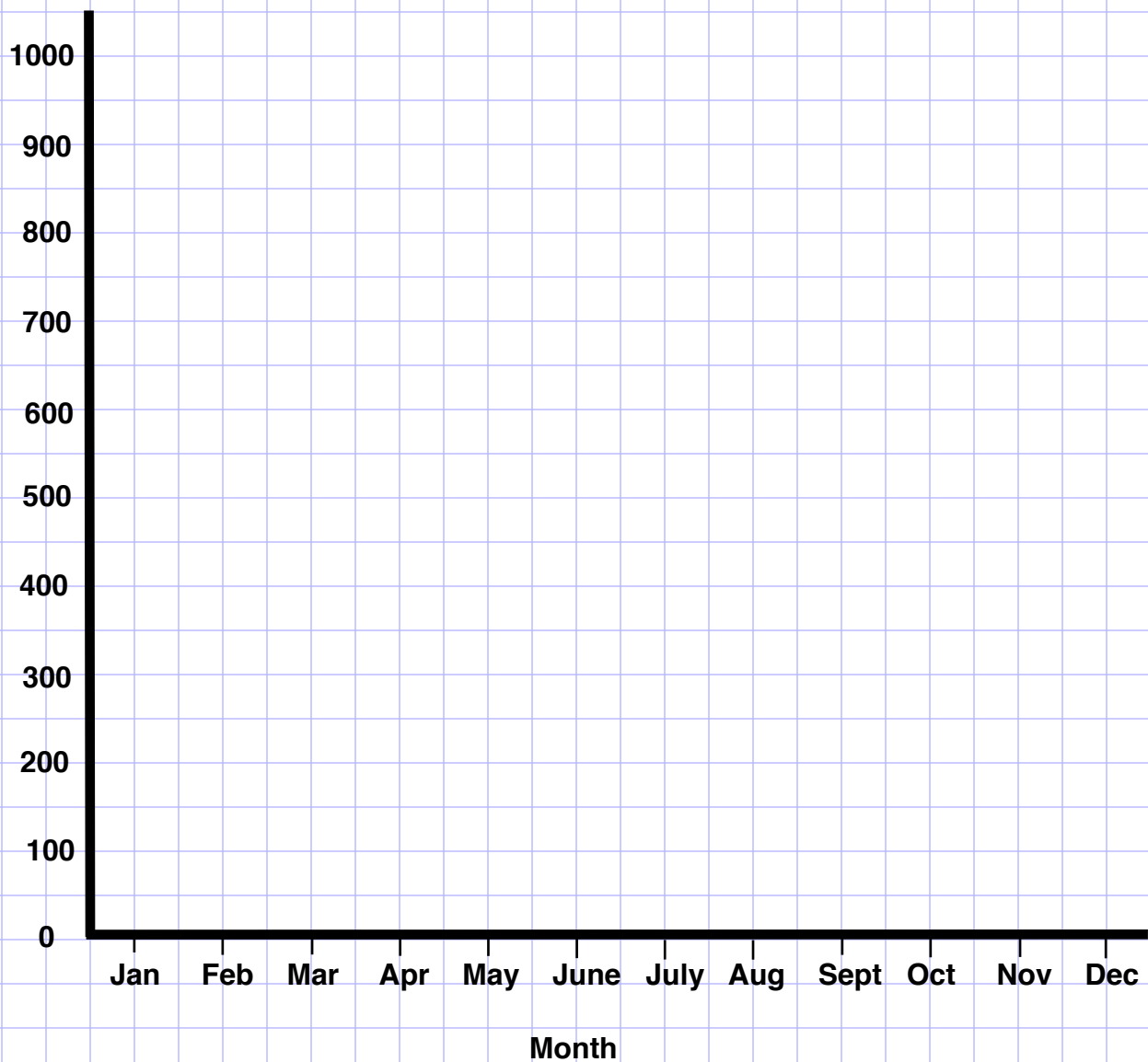
Answer Key
Solar Radiation and Temperature Plots

**Fort Collins - Solar Radiation**

**Quito - Temperature**

**Fort Collins - Temperature**

**Sydney - Temperature**

**Anchorage - Temperature**

**Seattle - Temperature**

Temperature