NAME _____ DATE _____

Activity 3B:
SUNLIGHT THROUGHOUT THE YEAR

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NOTICE: This activity consists of two parts:

1. This packet (complete first)
2. Internet files obtained from Mr. Nap's meteorology course page ***(staple internet files to this packet)***

http://www.napscience.com/weather

Educational Outcomes:

All weather and climate begins with the sun. Solar radiation is the only significant source of energy that determines conditions at and above the Earth's surface.

The average rate at which solar radiation reaches the Earth at the top of the atmosphere and falls on a flat surface perpendicular to the Sun's rays is about 2 calories per square centimeter per minute. The amount of solar radiation that actually reaches the Earth's surface is quite different.

The nearly-spherical Earth, rotating once a day on an axis inclined to the plane of its orbit, presents a constantly changing face to the Sun. Wherever there is daylight, the path of the Sun through the local sky changes through the course of a year. Everywhere on Earth, except at the equator, the number of hours of daylight also changes through the year. In addition, the atmosphere reflects, absorbs, and scatters the solar radiation passing through it. Clouds, especially, can block much of the incoming radiation.

The purpose of this activity is to investigate the variability of sunlight received at different latitudes over the period of a year.

After completing this activity, you should be able to:

- Describe the variation of solar radiation received at equatorial, mid-latitude, and polar locations over the period of a year.
- Estimate and compare the amounts of sunlight received at equatorial, mid-latitude, and polar locations during the different seasons of the year.

Materials: Hard copies of the Activity File plus designated Image(s).

Investigations:

1. Examine the accompanying graph (next page). Data points plotted on the graph represent monthly averages of measurements of actual solar radiation received daily on a horizontal plane at the Earth's surface at near equatorial (Singapore), midlatitude (Brockport, NY), and polar (Antarctica) locations. On the graph, month of the year is plotted along the horizontal axis and average daily incident radiant energy in calories per square centimeter per day is plotted vertically.

2. Construct an annual solar radiation curve for each of the three locations. Do this by drawing a smooth curved line connecting the radiation values plotted for each location. Note that at the South Pole (90 degrees S latitude) the sun rises on or about September 23 and sets on or about March 21. Draw each curve to the edges of the graph. December values are plotted twice to more clearly illustrate the annually repeating radiation cycles.

3. According to the curves you have drawn, at which latitude shown does average daily solar radiation vary the least over the period of a year?

   _____

4. The variation in average daily solar radiation that does occur at the latitude identified in question 3 is primarily due to changes in the daily ***(period of sunlight) (path of sunlight through the atmosphere)***.

5. The pattern of sunlight received at the equator over the course of a year indicates that the seasonal contrast there is ***(similar to) (different from)*** the seasonal contrast experienced in midlatitudes.

6. The graph shows that there is a six-month period during which there is no sunlight at the ***(equatorial) (midlatitude) (polar)*** location.

7. According to the graph, there are months when both the midlatitude and polar locations receive more solar radiation than the equator. For both midlatitude and polar locations, the major factor that causes this difference is the greater ***(local noon solar altitude (length of daylight)***.

8. Comparison of the three annual radiation curves indicates that the annual range (difference between maxima and minima) of solar radiation received daily ***(increases) (decreases)*** as latitude increases.

9. Based on how solar radiation received varies with latitude, it can be inferred that the seasonal temperature contrast ***(increases) (decreases)*** as latitude increases.

10. Mark the equinoxes and solstices on the graph by drawing vertical lines at approximately March 21, June 22, September 23, and December 22. On the equinoxes the noon sun is directly above the equator, whereas on the solstices the noon sun is directly above 23.5 degrees North or South latitude. When the noon sun is directly overhead, the solar altitude is ***(10) (45) (90)*** degrees. Label the intervals between the lines as the Northern Hemisphere's winter, spring, summer, and fall seasons.

11. Two maxima and two minima appear in the annual solar radiation curve for the equatorial location. Maxima occur near the ***(solstices) (equinoxes)***.

12. The area enclosed under the curve in each of the seasonal segments is directly proportional to the total solar radiation received during that season. According to the "seasonal" areas under each curve, all seasons at the ***(equatorial) (midlatitude) (polar)*** location receive about the same total amount of solar radiation.

13. At the midlatitude location, the season(s) of _____ receive(s) the most solar radiation whereas the season(s) of _____ receive(s) the least.

14. During the Northern Hemisphere's spring and summer, the South Pole ***receives (its maximum) (zero)*** solar radiation. In the Southern Hemisphere, these are the seasons of _____ and _____.

STAPLE ACTIVITY 3B (FROM THE INTERNET) TO THE BACK OF THIS PACKET