Exercise 3: Earth-Sun Relations (**Due June 16th, 2021**)

Instructions – This exercise is designed to help you review your understanding of Earth-Sun relations and related concepts. Fill in all answers in the spaces below. You may use Microsoft Excel to complete the plot in section 2.

**Part 1:**

Based on the explanations of Earth-Sun relations in class, complete the following table to indicate the day length you would expect at different latitudes through the year. In order to save yourself lengthy calculation, simply use one of the following choices to fill in each blank: **0 hours**; between **0-12 hours**; **12 hours**; between **12- 24 hours**; or **24 hours (https://www.shsu.edu/~dl\_www/bkonline/131online/f02latitude/02index.htm)**.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | December  Solstice | March  Equinox | June  Solstice | September  Equinox |
| North Pole | 0 hours | 12 hours | 24 hours | 12 hours |
| Article Circle | 0 hours | 12 hours | 24 hours | 12 hours |
| Tropic of Cancer | 0-12 hours | 12 hours | 12- 24 hours | 12 hours |
| Equator | 12 hours | 12 hours | 12 hours | 12 hours |
| Tropic of Capricorn | 12- 24 hours | 12 hours | 0-12 hours | 12 hours |
| Antarctic Circle | 24 hours | 12 hours | 0 hours | 12 hours |
| South Pole | 24 hours | 12 hours | 0 hours | 12 hours |

Fill in the following chart to indicate the solar altitude (sun angle) at different latitudes throughout the year. This time use one of these choices for each entry: **00** (on or below the horizon); between **00-900**; or **900** (straight overhead)

http://www.physicalgeography.net/fundamentals/6h.html

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | December  Solstice | March  Equinox | June  Solstice | September  Equinox |
| North Pole | 0-90 | 0 | 0-90 | 0 |
| Article Circle | 0 | 0-90 | 0-90 | 0-90 |
| Tropic of Cancer | 0-90 | 0-90 | 90 | 0-90 |
| Equator | 0-90 | 90 | 0-90 | 90 |
| Tropic of Capricorn | 90 | 0-90 | 0-90 | 0-90 |
| Antarctic Circle | 0-90 | 0-90 | 0 | 0-90 |
| South Pole | 0-90 | 0 | 0-90 | 0 |

**Part 2:**

On the graph below or with the help of Microsoft Excel, plot the following data for solar energy reaching the top of the atmosphere at different latitudes through the year. You should end up with four curves, one for each latitude. The values in the tables are given in calories per square centimeter.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Latitude | Jan. | Feb. | Mar. | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
| 700 N | 7 | 71 | 259 | 560 | 847 | 1021 | 947 | 686 | 378 | 137 | 10 | 1 |
| 450 N | 295 | 440 | 608 | 802 | 947 | 1010 | 983 | 869 | 688 | 502 | 335 | 257 |
| 350 N | 440 | 570 | 724 | 877 | 971 | 1011 | 993 | 912 | 781 | 628 | 481 | 407 |
| 200 N | 651 | 749 | 844 | 923 | 955 | 962 | 957 | 931 | 873 | 784 | 682 | 625 |

Average Daily Solar Radiation (cal/sq.cm)

Why is there so much more difference in energy received between latitudes in the winter than in the summer?

In **winter**, some polar **latitudes** receive no light at all (black). The Southern Hemisphere **receives more energy** during December (southern **summer**) **than** the Northern Hemisphere does in June (northern **summer**) because Earth's orbit is not **a** perfect circle and Earth is slightly closer to the Sun during **that** part of its orbit.

What conclusion does this graph suggest about how the annual range of radiation varies across latitudes?

If we were to draw a similar graph for the same latitudes in the Southern Hemisphere, we would find that they receive just slightly more radiation in their summer and slightly less radiation in their winter than their Northern Hemisphere counterparts do. Can you recall something from the lecture that might explain why?