ON THE RELATIVE INTENSITY OF THE HEAT AND LIGHT OF THE SUN UPON DIFFERENT LATITUDES OF THE EARTH pdf

1: Latitude & Climate Zones - The Environmental Literacy Council

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Energy and Matter i. Changes in the location of the Sun have a direct effect on the intensity of solar radiation. This causes the rays to be spread out over a larger surface area reducing the intensity of the radiation. Effect of angle on the area that intercepts an incoming beam of radiation. We can also model the effect the angle of incidence has on insolation intensity with the following simple equation: Let us compare this maximum value with values determined for other angles of incidence. Note the answers are expressed as a percentage of the potential maximum value. Longest days occur during the June solstice for locations north of the equator and on the December solstice for locations in the Southern Hemisphere. The equator experiences equal day and night on every day of the year. Day and night is also of equal length for all Earth locations on the September and March equinoxes. Figure 6i-2 describes the change in the length of day for locations at the equator, 10, 30, 50, 60, and 70 degrees North over a one-year period. The illustration suggests that days are longer than nights in the Northern Hemisphere from the March equinox to the September equinox. Between the September to March equinox days are shorter than nights in the Northern Hemisphere. The opposite is true in the Southern Hemisphere. The graph also shows that the seasonal winter to summer variation in day length increases with increasing latitude. Figure 6i-3 below describes the potential insolation available for the equator and several locations in the Northern Hemisphere over a one-year period. The values plotted on this graph take into account the combined effects of angle of incidence and day length duration see Table 6h Locations at the equator show the least amount of variation in insolation over a one-year period. These slight changes in insolation result only from the annual changes in the altitude of the Sun above the horizon, as the duration of daylight at the equator is always 12 hours. The peaks in insolation intensity correspond to the two equinoxes when the Sun is directly overhead. The two annual minimums of insolation occur on the solstices when the maximum height of the Sun above the horizon reaches an angle of The most extreme variations in insolation received in the Northern Hemisphere occur at 90 degrees North. During the June solstice this location receives more potential incoming solar radiation than any other location graphed. At this time the Sun never sets. In fact, it remains at an altitude of From September 22 September equinox to March 21, March equinox no insolation is received at 90 degrees North. During this period the Sun slips below the horizon as the northern axis of the Earth has an orientation that is tilted away from the Sun. The annual insolation curve for locations at 60 degrees North best approximates the seasonal changes in solar radiation intensity perceived at our latitude. Maximum values of insolation are received at the June solstice when day length and angle of incidence are at their maximum see Table 6h-2 and section 6h. During the June solstice day length is 18 hours and 27 minutes and the angle of the Sun reaches a maximum value of Minimum values of insolation are received during the December solstice when day length and angle of incidence are at their minimum see Table 6h-2 and section 6h. During the December solstice day length is only 5 hours and 33 minutes and the angle of the Sun reaches a lowest value of 6.

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2: Energy Difference between the Equator and the Poles

*On the Relative Intensity of the Heat and Light of the Sun Upon Different Latitudes of the Earth [L. W. MEECH] on www.enganchecubano.com *FREE* shipping on qualifying offers. On the Relative Intensity of the Heat and Light of the Sun Upon Different Latitudes of the Earth: L. W. MEECH: www.enganchecubano.com: Books.*

Energy and Matter h. The opposite is true if the Earth is viewed from the South Pole. One rotation takes exactly twenty-four hours and is called a mean solar day. At any one moment in time, one half of the Earth is in sunlight, while the other half is in darkness. The edge dividing the daylight from night is called the circle of illumination. The movement of the Earth about its axis is known as rotation. From the North Pole the rotation appears to move in a counter-clockwise fashion. The orbit of the Earth around the Sun is called an Earth revolution. This celestial motion takes On January 3, perihelion, the Earth is closest to the Sun The Earth is farthest from the Sun on July 4, or aphelion The average distance of the Earth from the Sun over a one-year period is about Seasons are appropriate only for the Northern Hemisphere. Annual change in the position of the Earth in its revolution around the Sun. In this graphic, we are viewing the Earth from a position in space that is above the North Pole yellow dot at the summer solstice, the winter solstice, and the two equinoxes. However, its position relative to the Sun does change and this shift is responsible for the seasons. The red circle on each of the Earths represents the Arctic Circle During the June solstice, the area above the Arctic Circle is experiencing 24 hours of daylight because the North Pole is tilted The Arctic Circle experiences 24 hours of night when the North Pole is tilted During the two equinoxes, the circle of illumination cuts through the polar axis and all locations on the Earth experience 12 hours of day and night. This phenomenon keeps all places above a latitude of The North Pole is tilted On this date, all places above a latitude of

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3: The Sun Provides Energy

On the relative Intensity of the Heat and Light of the Sun Upon Different Latitudes of the Earth.

Many forms of energy that humans use ultimately derive from solar radiation, such as food, hydrocarbons such as oil and natural gas , wind energy, hydroelectric power, and of course, solar energy. The bottom curve shows the cycles of recent ice ages. This image was produced by Robert A. Rohde from publicly available data, and is incorporated into the Global Warming Art project. Throughout most science education programs and standards, the role of the sun in providing energy to the Earth system is included, but often in a disjointed way. The seasons and their importance in driving seasonal weather patterns and animal migration may be taught in primary school and then not revisited for many years, if at all. Moreover, students of all ages, including college students and adults, have difficulty understanding what causes the seasons. Annual Total Solar Irradiance thin light blue with 11 year moving average thick dark blue. Image by John Cook, who granted specific permission to re-use on this page. If you wish to use this item outside this site in ways that exceed fair use see http: This can be addressed by examining records of solar output and comparing them to global temperature records. Excellent explanations for this can be found at Skeptical Science: Moving in Opposite Directions and with a graphic from Bloomberg: This engaging graph is made with NASA data and model output. Bringing these ideas into your classroom Solar radiation is the fundamental energy driving our climate system, and nearly all climatic and biologic processes on Earth are dependent on solar input. Energy from the sun is essential for many processes on Earth including warming of the surface, evaporation, photosynthesis and atmospheric circulation. Thus, examining how the sun fuels different processes on Earth can be a part of many types of science courses. Integrating Solutions - The science concepts that relate to solar radiation can be expanded to include solar energy engineering and technology, including solar ovens, passive solar design, solar thermal energy and solar electricity. This can help raise awareness for alternatives to the use of fossil fuel and create a forum for discussions about solutions to climate change that our society can adopt. This is called albedo, or reflectivity. This item is in the public domain and maybe reused freely without restriction. Effects of Distance and Inclination. High school The Climate: Students can learn how orbital cycles and ice ages are well correlated with the Milankovitch Cycles Climate Applet. This Seasons Interactive visualization tool can become the basis for open-ended exploration of how solar radiation varies with location and season. Climate Change video from the National Academies can help reinforce the evidence that solar activity is not causing global warming. Motions of the Sun Lab uses an animated simulator to enable students to manipulate variables to understand the apparent motion of the sun in the sky. Find activities and visuals for teaching this topic Search by grade level: See also the FAQ brochure pdf which is less technical. Moving in Opposite Directions This page from the Skeptical Science website provides clear answers to common questions and misunderstandings about climate change.

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4: Sunlight - Wikipedia

On Earth, the Sun passes directly overhead at 25 degrees north latitude _____ times a year. 0 While standing at the Tropic of Cancer, Emma's shadow points north at noon (sun time).

Before discussing terrestrial radiation, the following facts about radiation are worth noting. Temperature and wavelength are inversely proportional. Hotter the object, shorter is the length of the wave. This is what we call as terrestrial radiation. This energy heats up the atmosphere from bottom to top. It should be noted that the atmosphere is transparent to short waves and opaque to long waves. The long-wave radiation is absorbed by the atmospheric gases particularly by carbon dioxide and other greenhouse gases. Thus, the atmosphere is indirectly heated by the terrestrial radiation. The atmosphere, in turn, radiates and transmits heat to space. Conduction transfer of heat by contact Conduction is the process of heat transfer from a warmer object to a cooler object when they come in contact with each other. The flow of heat energy continues till the temperature of both the objects become equal or the contact is broken. Conduction is important in heating the lower layers of the atmosphere. Convection vertical transfer of heat Transfer of heat by the movement of a mass or substance from one place to another, generally vertical, is called convection. The heating of the air leads to its expansion. Its density decreases and it moves upwards. The continuous ascent of heated air creates a vacuum in the lower layers of the atmosphere. As a consequence, cooler air comes down to fill the vacuum, leading to convection. The cyclic movement associated with the convectional process in the atmosphere transfer heat from the lower layer to the upper layer and heats up the atmosphere. The convection transfer of energy is confined only to the troposphere. Advection horizontal transfer of heat The transfer of heat through horizontal movement of air wind is called advection. Winds carry the temperature of one place to another. The temperature of a place will rise if it lies in the path of winds coming from warmer regions. The temperature will fall if the place lies in the path of the winds blowing from cold regions. Horizontal movement of the air is relatively more important than the vertical movement. In the middle latitudes, most of diurnal day and night variations in daily weather are caused by advection alone. Heat Budget of the Earth The earth as a whole does not accumulate or lose heat. It maintains its temperature. This can happen only if the amount of heat received in the form of insolation equals the amount lost by the earth through terrestrial radiation. This balance between the insolation and the terrestrial radiation is termed as the heat budget or heat balance of the earth. This is why the earth neither warms up nor cools down despite the huge transfer of heat that takes place. Albedo Albedo can be simply defined as a measure of how much light that hits a surface is reflected back without being absorbed. It is a reflection coefficient and has a value less than one. When the solar radiation passes through the atmosphere, some amount of it is reflected, scattered and absorbed. The reflected amount of radiation is called as the albedo of the earth. The value of albedo will be different for different surfaces. The higher average temperature can be attributed to less vegetation, higher population densities, and more infrastructures with dark surfaces asphalt roads, brick buildings, etc. As we have discussed earlier, there are variations in the amount of insolation received at different latitudes. In the tropical region, the amount of insolation is higher than the amount of terrestrial radiation. Hence it is a region of surplus heat. In the polar region, the heat gain is less than the heat loss. Hence it is a region of deficit heat. Thus the insolation creates an imbalance of heat at different latitudes. This imbalance is nullified to some extent by winds and ocean currents, which transfer heat from surplus heat regions to deficit heat regions. This process of redistribution and balancing of latitudinal heat is commonly known as Latitudinal Heat Balance. Topics like Temperature, Factors controlling Temperature and Distribution of Temperature will be covered in the next article.

5: Solar irradiance - Wikipedia

"On the relative intensity of the heat and light of the Sun upon different latitudes of the Earth.". "Relative intensity of the heat and light of the Sun upon.

If we could somehow build a gigantic ball around the Sun that completely enclosed it, and lined that ball with perfectly efficient photovoltaic solar panels, we could capture all of that energy and convert it to electricity However, a very small fraction of that energy collides with planets, including our humble Earth, before it can escape into the interstellar void. The fraction of a fraction that Earth intercepts is sufficient to warm our planet and drive its climate system. Yes, these are the same watts we use to describe the energy usage of light bulbs and other household appliances. Recall our hypothetical gigantic ball surrounding the Sun. The surface area of a sphere varies as the square of the radius of the sphere; so the energy per unit area received varies inversely as the square of the distance from the Sun. If Earth were a flat, one-sided disk facing the Sun The surface of a sphere has an area four times as great as the area of a disk of the same radius. The spherical Earth actually "intercepts" the same amount of incoming solar EM radiation as would a flat disk of the same radius, as shown here. Original atrwork by Windows to the Universe staff Randy Russell. Note that the values for average solar insolation the term scientists use for the solar EM energy delivered to an area reaching Earth that have been discussed so far are at the top of the atmosphere. As you can imagine, as sunlight passes through our atmosphere, some of it is scattered and absorbed, reducing the amount that actually reaches the ground. Whenever you glance up at the full moon, you get an eyeful of the subject of our next topic. The moonlight we see on Earth is reflected sunlight. So, not all of the energy in the form of sunlight that reaches the Moon stays there; some is reflected back into space. Likewise, not all of the energy from the Sun that reaches Earth sticks around here to warm our planet; some is reflected back into space. Take a look at these two images of our planet that were captured by the Galileo spacecraft in December Earth as viewed from space in December South America is near the center of the lefthand picture, while Africa is near the top of the righthand image. Antarctica is visible near the bottom of both images. Note how much sunlight is reflected back into space by clouds and by snow and ice. Note also how light the deserts of northern Africa appear as compared to the Amazon forests of South America and the jungles of central Africa. Obviously, quite a bit of the sunlight that reaches Earth is reflected back into space. The white clouds that cover much of both images, and the white ice of Antarctica, both reflect most of the sunlight that falls upon them. You can also see how the oceans, the deserts of northern Africa, and the jungles of central Africa and of South America reflect or absorb varying amounts of sunlight. Albedo Astronomers use a quantity called "albedo" to describe the degree to which a surface reflects light that strikes it. Fresh snow has an albedo somewhere around 0. Forests have albedos near 0. The albedo of a planet or a locale on it! Oceans and forests are quite dark, while deserts are lighter, and clouds, snow, and ice are very bright. We assume Earth is in a steady state, neither warming or cooling rapidly. So how is Earth shedding energy? Any object that has a temperature above absolute zero emits electromagnetic radiation. Objects much less warm than a stovetop, including our planet, also emit EM radiation, generally in the infrared range. It turns out that there is a mathematical relationship between the temperature of an object and the amount of energy it radiates the Stefan-Boltzmann law. This next section delves into the math of that energy balance calculation. These calculations are supplied for those who are interested in them, but this is not required knowledge for this course. Feel free to skim over this section, and to take our word for it with regards to the results if you are not interested in the details of the mathematics. We need to balance:

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6: Lab 1: Solar Radiation & Seasons |

The differences in reflectivness (albedo) and solar illumination at different latitudes lead to net heating imbalances throughout the Earth system. At any place on Earth, the net heating is the difference between the amount of incoming sunlight and the amount heat radiated by the Earth back to space (for more on this energy exchange see Page 4).

The only significant weather phenomena on Mars are dust storms and strong winds. These dust storms can obscure the sun for very long periods of time, sometimes exceeding several weeks. Will there be enough natural sunlight on Mars to grow crops such as tomatoes, if they are housed in a suitable greenhouse, or will artificially heated greenhouses be required? The two images below illustrate the solar spectrum as seen from the Earth and Mars respectively. This value is highly variable depending upon such things as the amount of dust and water vapor in the atmosphere. All the above measurements are taken with the incident light perpendicular to the absorbing surface. If the sunlight falls on the surface at an angle, less energy will be incident per square metre on the surface. The two most important features of these images are: The shapes of the spectra are identical. They only differ in their height. The total area of each spectrum is proportional to the total energy of the sunlight. In other words, the area of the images is proportional to the irradiance. For example, the maximum intensity of the Sun, to local noon on Mars, with the Sun directly overhead, is approximately the same intensity as the Sun on Earth at noon on February 15 in Minneapolis, MN or Portland, Oregon. Download image The chart above compares the intensity of the Sun on Mars to the intensity of the Sun at your location on Earth, using the date and latitude of specific locations. For any latitude and any date you can determine if the intensity of sunlight on Earth is less than, or greater than, the intensity of the sunlight on Mars. Being so far north, Devon Island has solar irradiance similar to the solar irradiation on the Martian Equator. Will there be enough sunlight to grow tomatoes outside on Devon Island? On Mars, near the equator, the duration of daylight is about 12 hours, followed by approximately 12 hours of darkness. A Martian greenhouse will need to be well insulated to avoid huge temperature drops at night. Perhaps a combination of passive greenhouse heating during the day, supplemented by electrical heating and lighting at night will be required to provide a suitable growing environment for plants to be grown on Mars. Collecting and storing solar energy is an extremely inefficient process. A major fraction of the energy is lost as heat long before it is made available as light energy for plant growth.

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7: Insolation and Heat Balance of the Earth - Clear IAS

-a characteristic of earth's axis wherein it always points toward Polaris (the north star) at every position in Earth's orbit around the sun Circle of illumination The edge of the sunlit hemisphere that is a great circle separating Earth into a light half and dark half.

What type of radiation does the Sun primarily emit? The next lab, Stratospheric Ozone, focuses on the absorption of solar radiation by a gas, ozone, in a layer of the atmosphere known as the stratosphere. Note that the incoming solar radiation is The solar constant is averaged across the entire surface of Earth; therefore, the value is divided by four. For the Earth as a whole, what percentage of the incoming solar radiation is reflected by clouds and other parts of the atmosphere? You need to examine the figure above. For the Earth as a whole, what percentage of the incoming solar radiation is absorbed by the atmosphere? This is what causes changes in solar radiation received by locations on Earth over the course of a year. Examine the image below to visualize this tilt. It takes one day for Earth to complete a full rotation, and the Earth orbits around the Sun, which is typically million kilometers away, once every The axis remains tilted in the same direction towards the stars particularly the North star Polaris throughout a year. The tilt causes day to day changes in the duration and intensity of solar radiation at all latitudes. To what celestial body is the tilt axis always pointed throughout the year? The images below show the position of the Earth relative to the Sun on two dates: January 3 and July 4. The distance from the Earth to the Sun on January 3, which is known as perihelion, is ,, km. The distance from the Earth to the Sun on July 4, which is known as aphelion, is ,, km. Throw in the fact that aphelion occurs during the Northern Hemisphere summer and it becomes obvious that the changing distance from the Earth to the Sun is not the cause of seasons. The images you looked at above are derived from screenshots from the tool. Take your time and play around with the interactive graphic on the left-hand side. What hemisphere is tilted towards the Sun on June 21? What hemisphere is tilted towards the Sun on December 21? When solar radiation hits a portion of Earth at a low angle i. Examining the image below will help you visualize the effect of this beam spreading. A location with the Sun directly overhead i. Below is a graph showing the change in the intensity of solar radiation with a change in Sun altitude. At what Sun altitude is the intensity of solar radiation maximized? When the Sun altitude is low, there is considerable beam depletion along with the aforementioned beam spreading. Examples of minimum Sun altitude on a daily basis at a single location are sunrise and sunset. At sunrise and sunset, solar radiation has to pass through an atmosphere that is up to 40 times thicker than the depth at noon. Sun altitude is maximized at noon, and later in the exercise this angle is referred to as the noon altitude of the Sun. The locations are evenly spaced along a transect that extends from the Arctic Circle to the Antarctic Circle. Make sure Grid located under View is turned off. The transect is the thick red line and each location is denoted by a shaded white circle. Latitude, longitude, and elevation of the location of your cursor is shown at the bottom of Google Earth. Notice that if you move your cursor to the Southern Hemisphere it will have a negative latitude and if you move your cursor to the Western Hemisphere it will have a negative longitude. What are the approximate latitudes i. Zoom in on each circle to get the most accurate latitude. Tropic of Cancer, Atlantic Ocean: Tropic of Capricorn, Argentina: How do you think the intensity of sunlight and daylight hours will vary among the stations on 20 March and 22 September ? How do you think the intensity of sunlight and daylight hours will vary among the stations on 21 June ? How do you think the intensity of sunlight and daylight hours will vary among the stations on 21 December ? Click Equinoxes to open the file in Microsoft Excel. For all seven locations, you will be examining the noon altitude of the sun i. The higher the noon altitude of the Sun the more intense the solar radiation. You are going to convert that data into a bar chart within Excel using the following steps: The resulting chart shows the noon altitude of the Sun on March 20 and September 22 at the seven latitudes i. Feel free to make the graph large and change its shape. Where was the noon altitude of the Sun highest and lowest on the equinoxes? Make a bar chart with the data in the Daylight Hours worksheet tab. Look at the tabs on the bottom of Excel.

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Approximately how many hours of daylight did each of the locations receive on the two equinoxes? You answered this in Question 5. How would you define an equinox? For all seven latitudes, you will be examining the noon altitude of the sun i. Make a bar chart with the data in the Noon Altitude of the Sun worksheet tab. What locations had the most and fewest daylight hours on June 21? What locations had the most and fewest daylight hours on December 21? You answered this in Questions 5 and

8: 6(i). Earth-Sun Relationships and Insolation

Sun intensity refers to the amount of incoming solar energy that reaches the Earth. The angle at which the rays from the sun hit the Earth determines this intensity. The sun's angle varies significantly depending on a particular spot's geographic location, the time of year, and the time of day.

9: 6(h). Earth-Sun Geometry

The surface of the Sun has a temperature of about 5, Kelvin (about 5, degrees Celsius, or about 10, degrees Fahrenheit). At that temperature, most of the energy the Sun radiates is visible and near-infrared light.

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