How the sun produces heat and light essays example

Environment, Earth

What is sunlight?

The sun provides tirelessly every square meter of the earth's surface, which it attacks, with an average of about 1370 watts of power (in the form of electromagnetic radiation). We say that the sun burns, but actually it does not. Instead, the sun is a giant nuclear reactor (Layton & Freudenrich, 2000). This solar energy is called the solar constant, since it does not change, except for minor fluctuations. Solar energy is sent in the form of light waves. Light is an electromagnetic wave. The frequency of light - or how fast the waves vibrate - determines the differences in color. Blue light waves vibrate stronger than red light waves. Since the waves of blue light vibrate faster, they are closer to each other. If the waves come closer to each other, it is said that they have a shorter wavelength. Blue light has shorter wavelength than red. The light that is falling on the ground is a mixture of sunshine visible light and invisible infrared and ultraviolet components of the spectrum. The sun produces poem-worthy sunsets and approximately 1 trillion megaton bombs every second (Dr. Knowledge, 2005).

Compositions of light, which are falling on the earth.

Majority of the light energy, which is falling on the Earth from the Sun is located in the central part of the spectrum between blue and red light. There is more green than blue or red light in the spectrum of the incoming sunlight to the earth. Since its density is about 150 g/cm3 and a temperature is close to 13, 600, 000 K., it is heating up - not quite white hot, but usually to a yellowish tinge (Coffey, 2010). For comparison, the heating element may be an electrical furnace heated up to 800 ° C and and it glows with red color. As the Earth warms, it also starts to glow. However, the Earth is much cooler than the Sun, its temperature varies from 14, 4 ° C at the surface to -19 ° C in the upper atmosphere. For this reason, the flame of the earth is in the infrared spectrum. (Joseph Fourier called this: dark energy emitted by the Earth warm). This radiation can not be called the light reflected from the Earth. To tell the truth, it is the light that has been absorbed by it, and then re-emitted. All objects, whose temperature is above absolute zero are producing radiation of this type. The distribution of the infrared radiation from the earth, according to satellite measurements, is not quite smooth and equal.

Life in a greenhouse. Greenhouse idea arises by analogy with light passing through the glass. This light is then absorbed by the objects on which it falls. Heated objects, in turn, emit infrared light, which cannot penetrate the glass. In 1827, French chemist and physicist Joseph Fourier developed a theory about how Earth-like planets, maintain the constant temperature. He postulated that the planet does not only get energy from the sun, but also radiates heat back into space. Suggesting that the gases in the atmosphere contribute to the Earth's temperature, Fourier expressed the idea that became known to us as the greenhouse effect. Like a greenhouse, the Earth receives energy from the sun. The atmosphere acts as a transparent window glass, and majority of the light passes through it without being absorbed. British physicist John Tyndall, who was conducting his research in the 60’s of the XIX century, studied the absorption characteristics of light of different gases, including carbon monoxide, carbon dioxide and water vapor. Tyndall showed that visible light easily passes through carbon dioxide, but the infrared light is very much absorbed by it. Scientists saw a possible cause of climate change and possible explanation for advancement and retreat of glaciers in this. Two gases that make up most of our atmosphere - oxygen and nitrogen practically do not absorb light of any visible or infrared spectrum. Carbon dioxide and other gases that absorb infrared light allow visible light to pass there through, but retain exothermic infrared rays.

In 1896, Nobel Prize-winning Swedish chemist Svante Arrhenius began to study the question of what could be the cause of glacial periods, which advanced and retreated over the earth's geological past. As the results of the study of fossil remains of plants and animals of past geological epochs, not more than 12 thousand years ago the glacier covered the earth's surface down to the south of Germany and the US state of Illinois. Relying on opening of Tyndall and Fourier, Arrhenius proposed that carbon dioxide is ejected by ancient volcanoes and helped to raise the temperature on Earth on 20-30 ° C as a result of the greenhouse effect. According to his theory, the reduction of carbon dioxide in the atmosphere between the periods of volcanic activity led to periods of cooling, which in their turn led to the onset of ice ages. Arrhenius calculated that if the amount of carbon dioxide is reduced by half (assuming that the water vapor content in the air at such low temperatures is also reduced) this would lead to a decrease of global temperature by 4, 5 ° C. Similarly, if we twice increase the level of carbon dioxide he predicted the increase in global temperature for 5-6 ° C. If we compare the estimates of the Arrhenius with more complex climate models that are used today, the results would be slightly higher than current projections on the most pessimistic scenario. According to current estimations, a doubling of the carbon dioxide in the atmosphere will cause the temperature to rise to 2-4. 5 'C. Arrhenius was able to establish the relationship between carbon dioxide and global warming, which is the main principle of the so-called greenhouse effect. And although scientists did not accurately explain the causes of the ice ages, he laid the foundations for the development of a quantitative model, which determines how the change in concentration of carbon dioxide can affect the temperature of the air. In 1938, a British engineer Guy Steward Callendar analyzed data from weather stations of the air temperature, and concluded that there is an increase in average global temperature. He explained that increase is caused by carbon dioxide emissions into the atmosphere by burning fossil fuels.

What happens with solar energy as it enters the earth? Here is how it works.

1. Light energy comes from the sun. Each square meter of the surface (on which the light beam falls perpendicularly) gets about 1370 watts of power. At any time, half of the Earth's surface is turned away from the sun. Furthermore, because the planet is spherical, its surface reaches an average of only one fourth of the entire solar energy, which is permanently attacking Earth. As a result, every square meter of the Earth's surface gets an average of 342 watts.

2. The upper layers of the atmosphere, clouds and the Earth's surface reflect a little more than 30% of the incoming light. The amount of reflected light can be increased if because of the volcanic activity, the amount of suspended particles in the air will increase. Anthropogenic emissions may also increase the proportion of reflected light. The remaining 70% (or

thereabouts) of the incoming sunlight passes through the atmosphere.

3. The stratospheric ozone layer absorbs some (short-wave) ultraviolet radiation. The water vapor and other gases of the troposphere also absorb some of the colors of the spectrum (specific wavelength) of the incoming visible light.

4. The remaining part of the light energy is absorbed by the earth's surface. It heats the land and after that - the atmosphere. It drives the process of photosynthesis in plants. It warms the oceans. It leads to the melting of ice and water evaporation.

5. If the temperature of the Earth is equal to absolute zero, it would not radiate heat. However, the temperature is slightly above 14 C. This is hot enough for the planet to light a bit, but it makes it‘ s thermal energy invisible, which emits infrared light back through the atmosphere. Atmosphere, which temperature is about -19 C, also emits infrared light.

6. Part of the emitted infrared light is absorbed by the Earth’s troposphere. Carbon dioxide absorbs light of a certain wavelength. Water vapor, nitrous oxide and other gases as well absorb light of a particular wavelength. Greenhouse gases of the troposphere absorb infrared energy, and this leads to an increase of the temperature. By maintaining a balance in the sunny day, the temperature on Earth usually reaches a certain maximum level above which it does not rise. This happens because the Earth, just like any other object, which is heated, emits heat. The energy that is not returned back into space is absorbed by the climate system of our planet. However, if the Earth will continue to receive warm, it will gradually warm. To maintain a constant temperature it must radiate back into space the same amount of

energy that was received. By doing so, the planet maintains thermal equilibrium.

Insolation (incoming solar radiation). Currently, each square meter of the earth's surface, on which the sun's rays fall almost at right angles, receives an average of 342 watts of power. Number of incoming radiation can vary with changes because of solar activity or because of changes in the Earth's orbit.

Reflection. Currently, about 30%, or 107 W / m2. The amount of reflected light can be varied depending on the albedo or reflectivity of the various surfaces in the world, including clouds, aerosols, ice or vegetation.

Absorption. Currently, about 70%, or 235 W / m2. Number of invisible infrared radiation absorbed by the atmosphere depends on the concentration of greenhouse gases.

What would happen if the Earth had no atmosphere?

Natural greenhouse? Between the Sun, which is sending about 1370 watts of power on average per square meter of surface, and the Earth (which is a sphere), which is getting about 342 watts, there is a thermal equilibrium. Engineers know that the temperature of any object, which is moving in space - such as artificial Earth satellite -, will be determined by the heat from the sun, the amount of reflected light and the amount of radiation heat. The Earth, like any other object floating in space, subjects to the same laws of thermodynamics. According to its thermal properties of the object, which is reflecting 30%, and radiating 100% and is located at the orbital position of the Earth, it would have to have a temperature of -19 C. If the Earth had no atmosphere, it would be much colder than now. The average temperature of the Earth, of course, is not such. The reason for this difference lies in the fact that the atmosphere absorbs and retains heat. Land is not turned into a desert ice ball because of the natural greenhouse effect. Satellites examine the infrared radiation of the Earth. When an object is heated, we can really feel it if we approach him. What we will experience is the heat, which is radiated into space. (When the heat is radiated, we can feel it, even if there is no air between the object and us.)

Ways of heat transfer. Radiation is a unique way, since it does not require direct contact between the objects, which are providing warmth. The sun warms the Earth by radiation through space. The planet is protected from overheating by giving a certain amount of absorbed heat in space. Earth radiates energy substantially at the temperature at which invisible infrared light is produced. The greenhouse effect occurs when some parts of this radiation are intercepted and absorbed by greenhouse gases in the atmosphere.

Convection. Sometimes fluid (liquid or gaseous) medium acts as a conveyor belt that promotes the flow of heat from one place to another. Prevailing winds carry heat areas, restoring the uneven distribution of temperature on the earth's surface. Storm winds perform the same function, albeit in a more abrupt and often destructive form. Ocean streams, such as the Gulf Stream, move enormous amounts of heat. It helps some regions, such as Europe, to support a much more temperate climate than it would be without warm streams.

Conductivity. It happens, when there is a direct contact between the substances or environments, for example, between the atmosphere and the oceans. Thermal conductivity is performed until thermal equilibrium is attained. It is set when the temperature of both neighboring substances becomes equal. This may occur even when one of the substances contains more heat than another. This may happen when the thermal equilibrium is reached between the air and the oceans. They may have the same temperature, but a certain mass of water contains more heat than comparable with it by volume air. Carbon dioxide does not absorb visible sunlight. Greenhouse effect occurs because of atmospheric gases (such as carbon dioxide) which absorb invisible infrared radiation, which emanates from the warm surface of the Earth. The amount of carbon dioxide each year increases in winter and decreases in summer. Autumn leaves and other parts of plants, which are dying, fall to the ground and begin to decompose, releasing carbon dioxide back into the atmosphere.

References

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