

Name: _____

Class: _____

Due Date: _____

B.2 Greenhouse Effect

Understandings

- The conservation of energy.
- Emissivity as the ratio of the power radiated per unit area by a surface compared to that of an ideal black surface at the same temperature as given by
$$\text{emissivity} = \frac{\text{power radiated per unit area}}{\sigma T^4}.$$
- Albedo as a measure of the average energy reflected off a macroscopic system as given by
$$\text{albedo} = \frac{\text{total scattered power}}{\text{total incident power}}.$$
- The Earth's albedo varies daily and is dependent on cloud formations and latitude.
- The solar constant S .
- The incoming radiative power is dependent on the projected surface of a planet along the direction of the path of the rays, resulting in a mean value of the incoming intensity being $\frac{S}{4}$.
- Methane CH_4 , water vapor H_2O , carbon dioxide CO_2 , and nitrous oxide N_2O are the main greenhouse gases and each of these has origins that are both natural and created by human activity.
- The absorption of infrared radiation by the main greenhouse gases in terms of the molecular energy levels.
- The augmentation of the greenhouse effect due to human activities is known as the enhanced greenhouse effect.

Equations

$$\text{emissivity} = \frac{\text{power radiated per unit area}}{\sigma T^4}$$

$$\text{albedo} = \frac{\text{total scattered power}}{\text{total incident power}}$$

The solutions can be found on the YouTube channel Go Physics Go:

<https://www.youtube.com/@gophysicsgo/playlists>

Part 1: Use your favorite sources to answer the following questions

1. C: State the law of conservation of energy.
2. C: State the definition, equation, and units for *emissivity*. What is the *emissivity* of a really dark colored object? What is the *emissivity* of a really light colored object?
3. C: State the definition, equation, and units for *albedo*. What is the *albedo* of a really dark colored object? What is the *albedo* of a really light colored object?

4. C: What is the mathematical relationship between the *albedo* and *emissivity* of an object?
5. E: A naked person has a surface area of 1.80 m^2 , an emissivity of 0.980, and a skin temperature of 37.0°C . This naked person is in a room with room temperature of 20.0°C . How much energy does this person lose per minute?
6. E: By which factor does the power emitted by an object decrease when its temperature decreases from 800.0 K to 500.0 K?
7. E: On a hot summer day a forest receives an intensity of approximately $1,210 \frac{\text{W}}{\text{m}^2}$. If the forest has an albedo of approximately 0.122 then determine how much energy is absorbed and reflected every second by each square meter.

8. E: The planet Saturn has an average surface temperature of -178°C and a radius of approximately 5.82×10^7 m. Suppose Saturn has an emissivity of approximately 0.650. Determine the rate of thermal energy emitted.

9. C: What is the meaning of the Sun-Earth *solar constant*?

10.E: The luminosity of the Sun is approximately 3.828×10^{26} W. The average distance from the Sun to Earth is 1.5×10^{11} m. Use the equation $I = \frac{P}{A} = \frac{P}{4\pi d^2}$ to determine the Sun-Earth *solar constant*.

11.C: Describe the equation $\bar{I} = \frac{P}{A} = \frac{S}{4}$.

12.E: The average albedo of Earth is approximately 0.300 and the average emissivity of the Earth is approximately 0.600. Use the solar constant to determine the average temperature of the Earth.

13.E: The average albedo of Earth is approximately 0.300. Use the solar constant to determine the average intensity reaching the Earth during the day or night.

14.C: Define the *greenhouse effect* and the *enhanced greenhouse effect*. What are the four major *greenhouse gases*? State their name and chemical formula.

Part 2: Browse these websites for more information on climate change

The world's most viewed site on global warming and climate change

www.wattsupwiththat.com

Climate Depot: Redefining Global Warming Reporting

<https://www.climatedepot.com/>

Part 3: Explain what went wrong from these climate predictions

<https://cei.org/blog/wrong-again-50-years-of-failed-eco-pocalyptic-predictions/>

<https://extinctionclock.org/>

<https://mishtalk.com/economics/lets-review-50-years-of-dire-climate-forecasts-and-what-actually-happened/>

1. 1967 Salt Lake Tribune: Dire Famine Forecast by 1975, Already Too Late
2. 1969 NYT: *“Unless we are extremely lucky, everyone will disappear in a cloud of blue steam in 20 years. The situation will get worse unless we change our behavior.”*
3. 1970 Boston Globe: Scientist Predicts New Ice Age by 21st Century said James P. Lodge, a scientist at the National Center for Atmospheric Research.
4. 1971 Washington Post: Disastrous New Ice Age Coming says S.I. Rasool at NASA.
5. 1972 Brown University Letter to President Nixon: Warning on Global Cooling
6. 1974 The Guardian: Space Satellites Show Ice Age Coming Fast
7. 1974 Time Magazine: Another Ice Age *“Telling signs everywhere. Since the 1940s mean global temperatures have dropped 2.7 degrees F.”*
8. 1974 *“Ozone Depletion a Great Peril to Life”* University of Michigan Scientist
9. 1976 NYT The Cooling: University of Wisconsin climatologist Stephen Schneider laments about the *“deaf ear his warnings received.”*
10. 1988 Agence France Press: Maldives will be Completely Under Water in 30 Years.
11. 1989 Associated Press: UN Official Says Rising Seas to ‘Obliterate Nations’ by 2000.
12. 1989 Salon: *New York City’s West Side Highway underwater by 2019* said Jim Hansen the scientist who lectured Congress in 1988 about the greenhouse effect.

- 13.2000 The Independent: *“Snowfalls are a thing of the past. Our children will not know what snow is,”* says senior climate researcher.
- 14.2004 The Guardian: The Pentagon Tells Bush Climate Change Will Destroy Us. *“Britain will be Siberian in less than 20 years,”* the Pentagon told Bush.
- 15.2008 Associate Press: NASA Scientist says *“We’re Toast. In 5-10 years the Arctic will be Ice Free”*
- 16.2008 Al Gore: Al Gore warns of ice-free Arctic by 2013.
- 17.2009 The Independent: Prince Charles says Just 96 Months to Save the World. *“The price of capitalism is too high.”*
- 18.2009 The Independent: Gordon Brown says *“We have fewer than 50 days to save our planet from catastrophe.”*
19. 2013 The Guardian: The Arctic will be Ice Free in Two Years. *“The release of a 50 gigaton of methane pulse”* will destabilize the planet.
- 20.2013 The Guardian: US Navy Predicts Ice Free Arctic by 2016. *“The US Navy’s department of Oceanography uses complex modeling to makes its forecast more accurate than others.*
- 21.2014 John Kerry: *“We have 500 days to Avoid Climate Chaos”* discussed Sec of State John Kerry and French Foreign Minister Laurent Fabious at a joint meeting.