

2.1.5 Energy Budget Conceptual Problems

The following questions and answers can be used as in-class or homework problems. The last page has just the questions.

1. You are a city planner for your local neighborhood. You notice that the air temperature in your city is slightly higher than a nearby farming suburb. What are some ways that you could increase the albedo so that your city does not absorb as much solar radiation?

Answers may vary. Possible answers include: Placing solar panels on top of buildings to absorb light and turn it into energy while also reflecting some light, painting tops of buildings white, painting tops of city buses white, use mirrored windows to reflect the sun. Trees and parks to reduce the amount of black asphalt.

2. There is a constant amount of solar radiation that reaches the Earth. If Jupiter, the largest planet, was the same distance from the Sun as the Earth, how much solar radiation would reach Jupiter's surface?
 - a. More than Earth
 - b. Less than Earth
 - c. The same as Earth

Explain why you chose your answer:

The amount of solar radiation that hits a surface is based on the area of the surface. Since Jupiter has a larger radius than Earth, it will intercept more solar radiation.

3. One effect of climate change is that higher air temperatures melt polar ice. How does this affect the energy balance of the Earth? Please be specific by stating what happens to a) albedo, b) the absorption and re-radiation of energy on the Earth, c) the Earth's temperature.
 - a) Melting ice caps will decrease albedo
 - b) Decreased albedo will increase the amount of energy that is both absorbed and re-radiated.
 - c) The earth's temperature will increase as a result of the increased solar absorption.
4. Las Vegas is built in a desert. Does the city (buildings, roads, parks) increase or decrease the Earth's albedo?

The building of a city added more concrete, asphalt, and buildings that have low albedo. Sand in deserts naturally has a very high albedo. Therefore, the Earth's albedo would have decreased.

5. Your friend learns how to make clouds. He thinks that if he produces clouds on a large enough scale that this will slightly decrease temperatures on Earth. Do you think you should invest in your friend's company or try to convince him to start a different business?

The effect of the clouds depends on their size and shape. Long, thin clouds do not add to the albedo and end up trapping radiation. Large, fluffy cumulous clouds increase the Earth's albedo by reflecting the solar radiation. Unless he can constantly manufacture large, fluffy clouds, I would not invest in his company. Another consideration is the cloud height – higher clouds will create warming.

Earth's Energy Balance Conceptual Problems for Students

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