MiSP INSOLATION
Teacher Guide, L1 - L3

Introduction

This unit utilizes "classic" Earth science insolation labs wherein students subject contrasting materials to a source of radiant energy and measure temperatures. To develop the unit, the labs in Osmun/Vorwald/Wegner, *Explorations in Earth Science: The Physical Setting*, UPCO, 2001, were used as a resource. Teachers may use other versions of these labs instead.

Incoming solar radiation, or insolation, is Earth's source of energy for systems on the surface of the Earth. The labs measure the conversion of light energy to heat. The amount of insolation from the sun is basically constant. Variables that affect the amount of electromagnetic radiation that is converted to heat in matter include how much of the light is reflected or transmitted, the color of the object, and the angle of the insolation. The specific heat, relative mass, time of exposure, and an object's ability to retain heat (terrestrial radiation) will determine how much temperature will increase when exposed to a given intensity and duration of insolation.

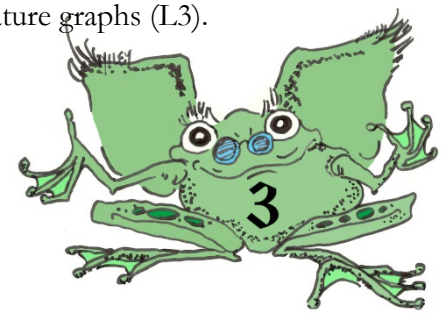
The following resource with simulations may be used:
http://www.windows2universe.org/earth/climate/sun_radiation_at_earth.html

Standards

ILST Core Curriculum — Major Understandings:
Standard 4 Physical Setting 2.1k, 4.1a, 4.1c, 4.1d, 4.2b, 4.5a
Physical Setting/Earth Science Core Curriculum — Major Understandings:
Standard 4 1.1f, 2.1a, 2.2a

Lesson Objectives: After completing this unit, students will be able to:

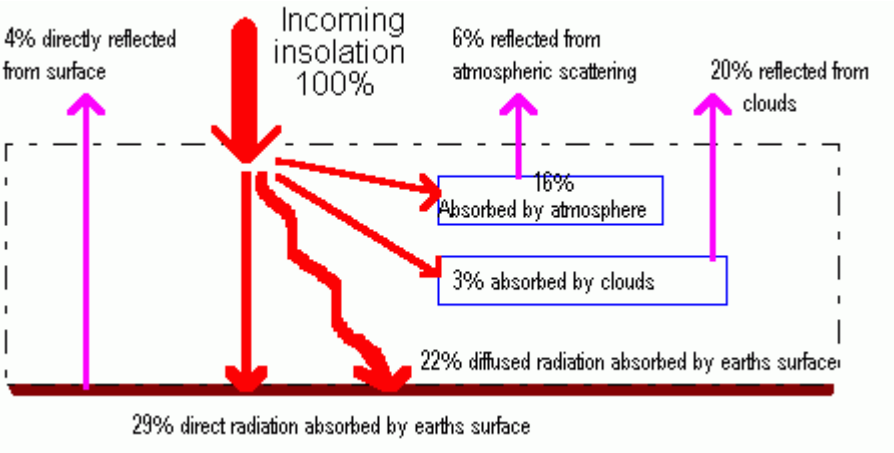
- Define *insolation*
- Perform experiments that measure the effect of selected variables on the amount of electromagnetic radiation/light/insolation that is converted to heat
- Graph and interpret data that show the amount of heating and cooling that occurs after materials are exposed to a light source
- Determine and use the unit rate of change for changes in temperature over time in materials exposed to light energy (L2)
- Determine and apply the formula for a line on time/temperature graphs (L3).



Day 1 — Insolation Introduction

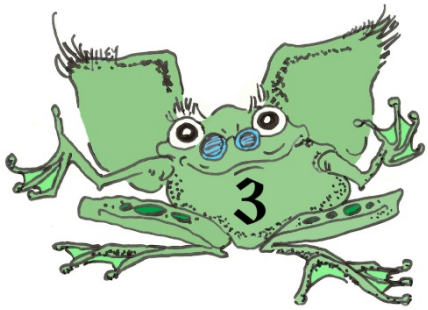
Day 1 introductory discussions will depend on prior teaching and learning and the type of course. Topics may include:

- Nature of light, related vocabulary (electromagnetic radiation), spectrum
- Definition of *insolation*
- Energy conversion, law of conservation of energy, light energy being transformed to heat
- Methods of heat transfer: radiation, convection, conduction
- What happens to insolation when it encounters Earth's surface:

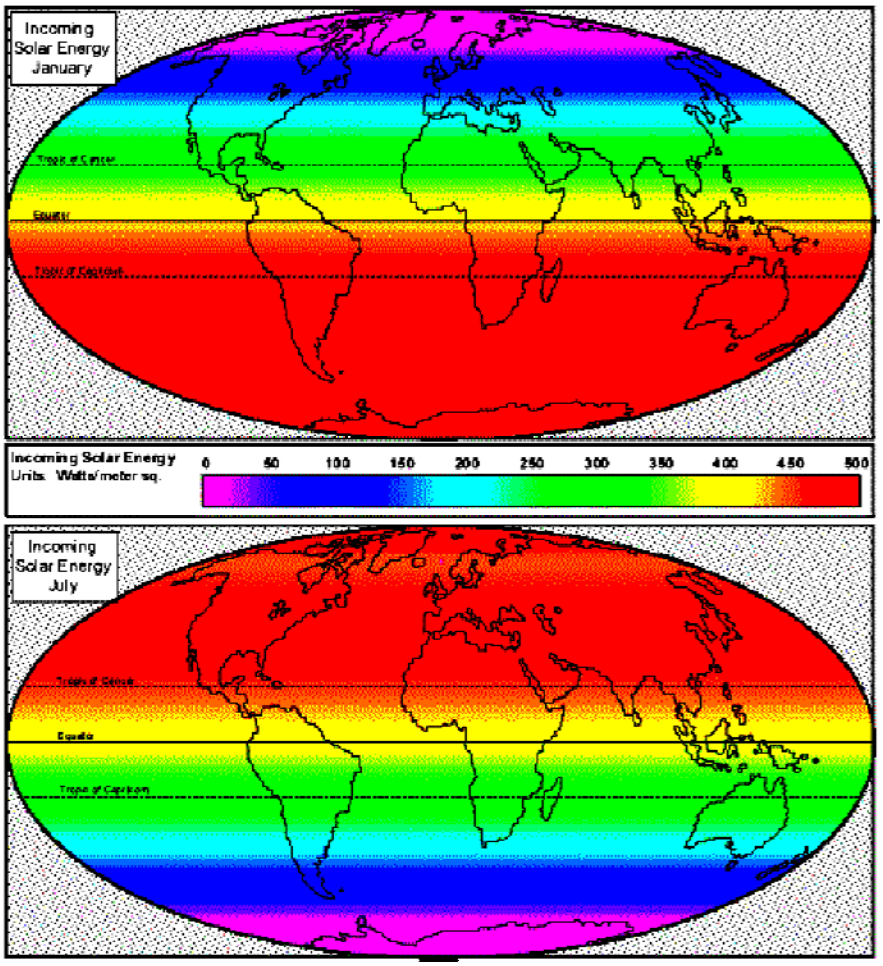


From www.auf.asn.au/meteorology/section1b.html

- Different latitudes of the Earth receive different amounts of insolation (these images should be observed in color; see the link).



Visualization of incoming solar energy for January and July



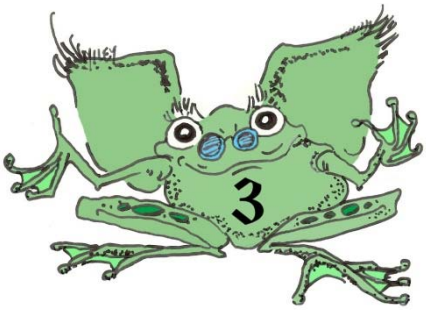
From http://www.core.org.cn/sofia/gallery/geography/assignments/assignment02.html

It is recommended that students do these labs as inquiry experiences. The experiments and data will allow students to discover that the angle of insolation affects the amount of temperature change and that water and soil absorb and radiate heat differently. This inquiry learning can then be applied (depending on the course) to a variety of Earth science topics, such as seasons, land and sea breezes, the impact of bodies of water on climate, and temperature/climate differences at different latitudes.

Teachers may want to set up the day 2 lab on day 1.

Question of the Day:

If you are standing in front of a fireplace and your skin feels too hot, you can move farther away or you can remain at the same distance but place yourself at an angle. Either movement will help cool you off. Why?



Day 2 — Absorption and Radiation by Land and Water

See Osmun/Vorwald/Wegner, *Explorations in Earth Science: The Physical Setting*, UPCO, 2001, p. 265.
Similar lab experiences may be used instead; options include:
http://web001.greece.k12.ny.us/files/1081/Lab-HeatAbsorp%20%20Sept.pdf
http://www.dlt.ncssm.edu/resources/images/Absorp-n-Rad.pdf

Lab notes:
Students should wear goggles.
Computer temperature probes may be used.
Equal masses of soil and water should be used.
A 150 W or greater bulb should be used
Caution students about the heat of the lamps.
Students should calibrate thermometers. (Select two that have equal readings.)

Question of the Day:

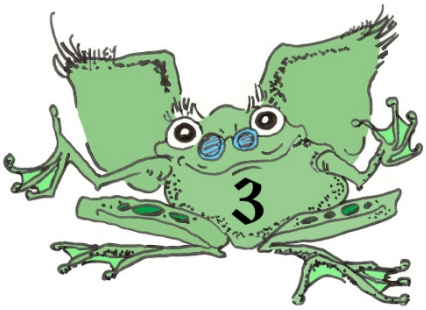
While at the beach on a bright, sunny day, what feels warmer on your feet: the sand or the ocean water? Why? Late on a cool summer night, what feels warmer on your feet: the sand or the ocean water? Why?

Days 3 and 4 — Angle of Insolation

See Osmun/Vorwald/Wegner, *Explorations in Earth Science: The Physical Setting*, UPCO, 2001, p. 261.
Similar lab experiences may be used instead; options include:
http://danling.com/earthling/es/8energy/labs/AngleInsolationLab.pdf
http://www.vrml.k12.la.us/rpautz/documents/8th%20Grade/Insolation%20and%20the%20Seasons.pdf

Lab notes:
Students should wear goggles.
Stick-on thermometers are used and attached to different angle blocks. The surface of the block directed toward the light source should have a rectangle (bigger than the block and thermometer) of black paper to increase the conversion of radiant to heat energy.

Computer temperature probes may be used but are not recommended.
A 150 W or greater bulb should be used.
Caution students about the heat of the lamps.



Students often have problems understanding the concept that the angle of insolation affects temperature. Additional discussion and/or demonstrations may be needed.

Day 5 — Assessment

Administer the appropriate level assessment.