• Instructors: E. Boss and MJ Perry

• Last week’s homework.

U-monometer, Units, Mass flux, $\pi$, force on side.

• Class web site:

  http://misclab.umeoce.maine.edu/boss/classes/SMS_204_2006/Syllabus.htm
Heat and temperature

Temperature—proportional to microscopic kinetic energy of matter.

If two objects (systems) have the same temperature they will stay the same upon contact.
• Heat and temperature

Heat- microscopic kinetic+potential energy of matter. When we change the state of a material we need to provide heat.

To warm a mass of material by $\Delta T$ we need to supply it with heat (energy):

$$\text{Heat} = C_p \times \text{Mass} \times \Delta T$$

$C_p$ - specific heat capacity
For water 1calorie (~4.2joules) heats 1gr of water one degree at STP.
Heat and temperature

Why do we sweat? Why do dogs have a wet nose?
Measuring temperature

Find materials whose physical properties you measure (X, e.g. volume) varies linearly with temperature (T):

\[ X = aT + b \]
• **Heat flux:**

Three main pathways:

1. Conduction
2. Convection
3. Radiation

+ horizontal advection when measuring at a point.
Radiative heat flux:

Bodies radiates energy according to their temperature.
Convective heat flux:
The fluid density is temperature dependent.
At a point, horizontal advective heat flux may be important.
• Heat conduction:

Flux = -K(dQ/dz)

K - heat diffusion coefficient

Examples:
Ice, Fur, Blubber
• Heat flux, recap:
• The heat balance of the Earth:

The greenhouse effect:

Greenhouse Gases

Solar Energy Absorbed at Surface

Converted into Heat Causing the Emission of Longwave Radiation

Surface Gains More Heat and Longwave Radiation is Emitted Again

Some Longwave is Lost to Space

Some Longwave is Lost to Space

Reflected by Earth's Surface to Space
How does T affect biology?

• How do organisms lose/gain heat?
• Cold/warm blooded organisms
• Enzymatic reactions
• Swimming performance
• Heat and size (area/volume ratio)
• Water vs air (heat capacity) \( \leftarrow \) implications?
• Hypothermia

• Solutions?