Weather in a Tank: HSSP Spring 2011
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Course Description

Weather surrounds us. Whether blizzards in Boston or heat waves in Houston, weather plays a big role in our lives. In this class, we'll look at the components that drive the weather starting from the most basic concepts up to a full system. The ultimate goal is to answer the question: What ingredients make weather? Each class will have a fun lab or demonstration to drive home the day's point, building up to the rotating tank weather simulator (hence: weather in a tank). If you've ever wanted to understand what weathermen are talking about, add some depth to cloud-watching, or just want an earth science spin on the basic sciences, this class is for you!

Syllabus

Part I: The earth is warm at the equator and cold at the poles

1) Incoming radiation
   a) Where does all our energy come from?
   b) Lab: Solar cells on a sphere
   c) Daily and seasonal cycles
2) Outgoing radiation and the greenhouse effect
   a) Hot things give off energy; hotter things give off more energy
   b) Demo 1: Energy vs. surface area
   c) Different kinds of radiation
   d) Demo 2: Opacity to certain wavelengths

Part II: Fluids move things around

3) Basic fluid motions
   a) The kinds of properties fluids carry
   b) How properties change: Dispersion and diffusion
   c) Lab: Dyes in agitated and rotating fluids
   d) Movies and discussion: Volcano plumes, clouds, and pollution
4) Convection: How energy is moved upward
   a) The basic convection cycle
   b) Demo: Convection by a heating pad
   c) Lab: Convection by ice; thermal stratification
5) Convection 2: How energy is moved sideways
   a) Recap: The equator is warmer than the poles
   b) Lab: Slantwise convection with and without heating
   c) Discussion: What were the differences between upwards and sideways convection?

Part 3: Rotation makes a BIG difference!

6) Slow rotation
   a) Rotating fluids are weird! The Coriolis force.
   b) Demo: Convection + slow rotation = Hadley circulation, jet stream
   c) Movies and discussion: the jet stream and the weather
7) Fast rotation
   a) Demo: Convection + fast rotation = weather
   b) Pressure in a rotating fluid (geostrophic balance)
   c) Movies: Storms and hurricanes

Finale

8) Putting it all together
   a) Discussion: What are the three things necessary to make weather? What are the roles that they play?
   b) Things we didn't cover 1: Clouds and advanced radiation
   c) Things we didn't cover 2: The ocean circulation
   d) How to read actual weather maps