Informal to Formal

Adapting the Tools and Techniques of Little Shop of Physics to the K-12 and College Classroom

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Hands-on activities

4 steps:

- In cooperation with CMMAP scientists, we decide on important topics for students to learn.
  - *Example: It is important for students to understand the mechanics of energy transport (and energy balance) via radiation.*
- We consider K-12 science standards and develop an activity to teach about this topic.
  - *Example: Students use infrared thermometers to measure radiation from earth and sky.*
- We develop the activities in consultation with teachers in the summer course.
  - *Example: Teachers felt that students needed more background on what, exactly, the thermometers were measuring. We came up with a new activity that*
- In cooperation with CMMAP scientists, we decide on important topics for students to learn.
  - *Example: It is important for students to understand the mechanics of energy transport (and energy balance) via radiation.*

Content guides

Materials for Teacher Workshops

The latest and greatest versions of all of our activities.

Making a cloud in a bottle!

The documents below instructions and information for performing hands-on atmospheric investigations in your classroom. Please download and use them, but do give credit to CMMAP and the Little Shop of Physics.

Please e-mail us with your comments and suggestions.

Ten Things You Should Know About the Atmosphere

In the summer of 2011 we polled CMMAP scientists as to what they thought were the 10 most important things that everyone should know about the atmosphere. We took their answers and condensed them into a list of 10 items, with explanations and activites you can use to teach these concepts to your students. Each of our activities is titled with an intriguing question, followed by some introduction and theory, a parts list, and helpful suggestions for implementing these activities in your classroom! Also, it is important to note that the "10 Things" list is in no particular order!

1. The sky is falling. (Or a least the clouds.)

A cloud consists of droplets of water suspended in air. As you might expect, adding the droplets of water increases the density. A cloud at the same temperature as surrounding air will be more dense than the surrounding air. So why don't clouds fall? In fact, in some sense, they do! The big, puffy cumulus clouds that you see form atop columns of rising air. The air is moving upward. So the bottom of the cloud is—relative to the air—moving downward. The clouds are falling! Whenever you see cumulus clouds in the sky, that tells you that the air is moving vertically. Clouds mean rising air (and thus falling clouds!) and clear sky means falling air.

Activity	Description
Does air weigh anything?	*Indeed it does! But most simple experiments that purport to show this don't work. This one does.*
Why do raindrops sometimes land gently, and sometimes land with a splat?	*An inexpensive investigation you can do with just water, food coloring, and mineral oil!*

Goal:

We are starting to produce guides that outline essential principles that includes video clips, written information, and investigations that illustrate the key concepts.

Features:

- All content is connected to standards, but driven by what working scientists find is important.
- Materials are produced by a team that includes scientists and educators.
- We focus on making topics accessible, understandable, and memorable.

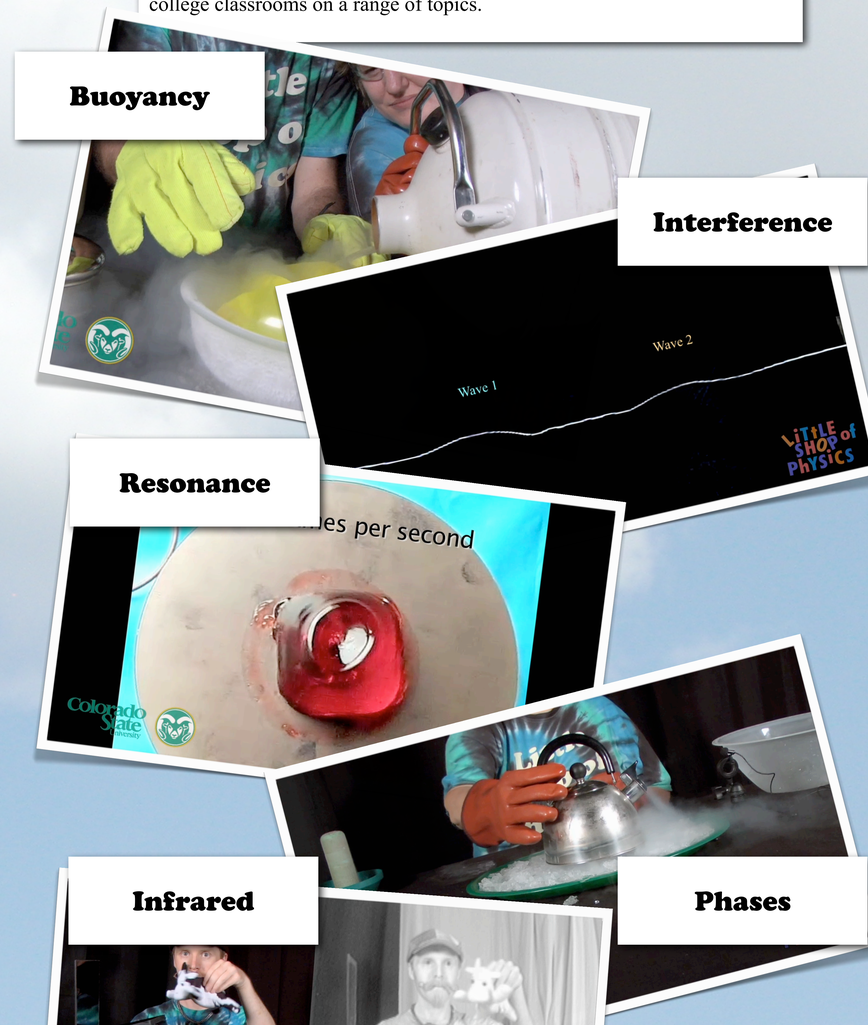
Our first topic is "Ten Things You Should Know About the Atmosphere."

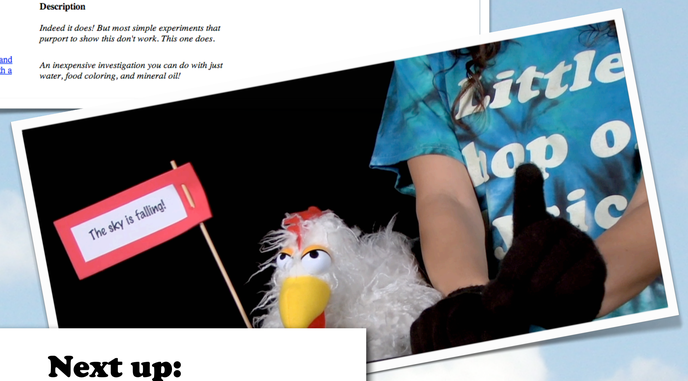
Creative use of video

Rationale:

As part of our Everyday Science television program, we spend a good deal of time exploring the use of video as a tool to make complex physical concepts understandable and memorable.

We are producing a series of video clips that people can use in K-12 and college classrooms on a range of topics.





What does an infrared thermometer measure?

A laboratory experiment from the Little Shop of Physics at Colorado State University

CMMAP — Reach for the sky.

LITTLE SHOP of PHYSICS

Overview

These days, infrared—or "non-contact" thermometers are popular items in hardware stores, auto parts stores, and stores that carry high-end cooking equipment. You point a thermometer at an object, and it reads the temperature. You can see how this could be useful in cooking, in working on your car.

But... What does such a thermometer actually measure? If you are cooking a roast, there's a good chance that the reading will correspond to the surface temperature. But the truth is not always so simple, as we'll see!

Theory

All matter is made of atoms, and the atoms are in constant motion; this is the molecular view of thermal energy. And one of the basic tenets of physics is this: When you accelerate a charged particle, it emits electromagnetic waves. Does this mean that all objects will emit electromagnetic waves?

Indeed it does. This *thermal radiation* is emitted by all solids and all liquids; gases are another story that we'll turn to later. Hotter objects emit more, objects at different temperatures emit different wavelengths, and some objects (metals, for instance) are pretty poor emitters. But the ground, clouds (which are made of solid or liquid water), your body, the walls of the room

When you aim a thermometer at the sky, ... temperature. What, exactly, are you mea...

Necessary materials:

- Infrared thermometer. There are two important properties to look for:
  - ***Wide temperature range.*** The low end is most important, -50°C is good. The radiation emitted from the sky can be minimal, so a low end of the temperature range is important.
  - ***Small area for measurement.*** The thermometers collect radiation from a certain angle. We use a thermometer with a 12:1 distance-to-spot ratio; this means that, at a distance of 1 foot, the spot from which radiation is collected is 1 inch in diameter. This corresponds to an angle of about 5°.
- Mug warmer
- Can of juice or other non-carbonated beverage. Whatever you pick, it should have areas with paint, bare metal, and clear coatings. We will be looking at the difference in emission from different places on the can.

What topics should we investigate next?

Next up:

10 Things You Should Know About Climate Change

What are the 10 things?

What topics should we illustrate next?