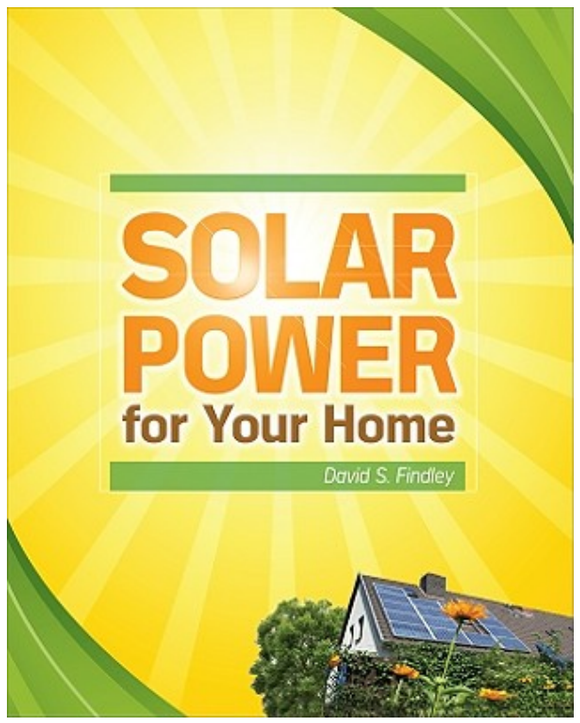
The sun provides more energy in one hour than all humanity uses, in all forms, in a single year. Sunlight can provide us with its own resolution to our energy problems. The only transformation required is for humanity to reduce, or end, consumption of stored solar (as fossil fuels) and, in its place, use freely available 'fresh' solar.

David S. Findley



Arizona State University
SES 194

Energy in Everyday Life

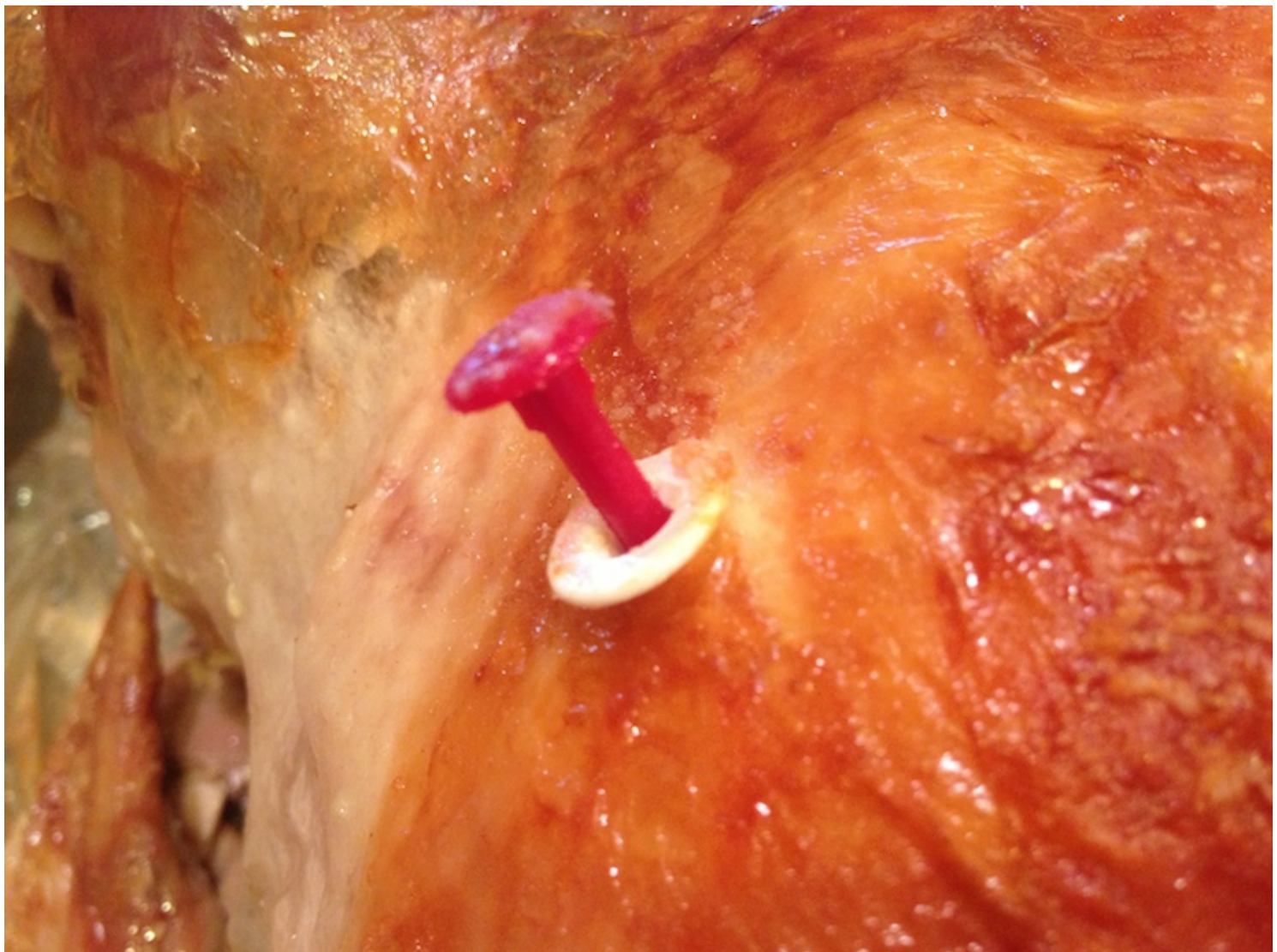
TemperatureTech: Popups and Galileo's

Frank Timmes

ftimmes@asu.edu

Pop-up Thermometers

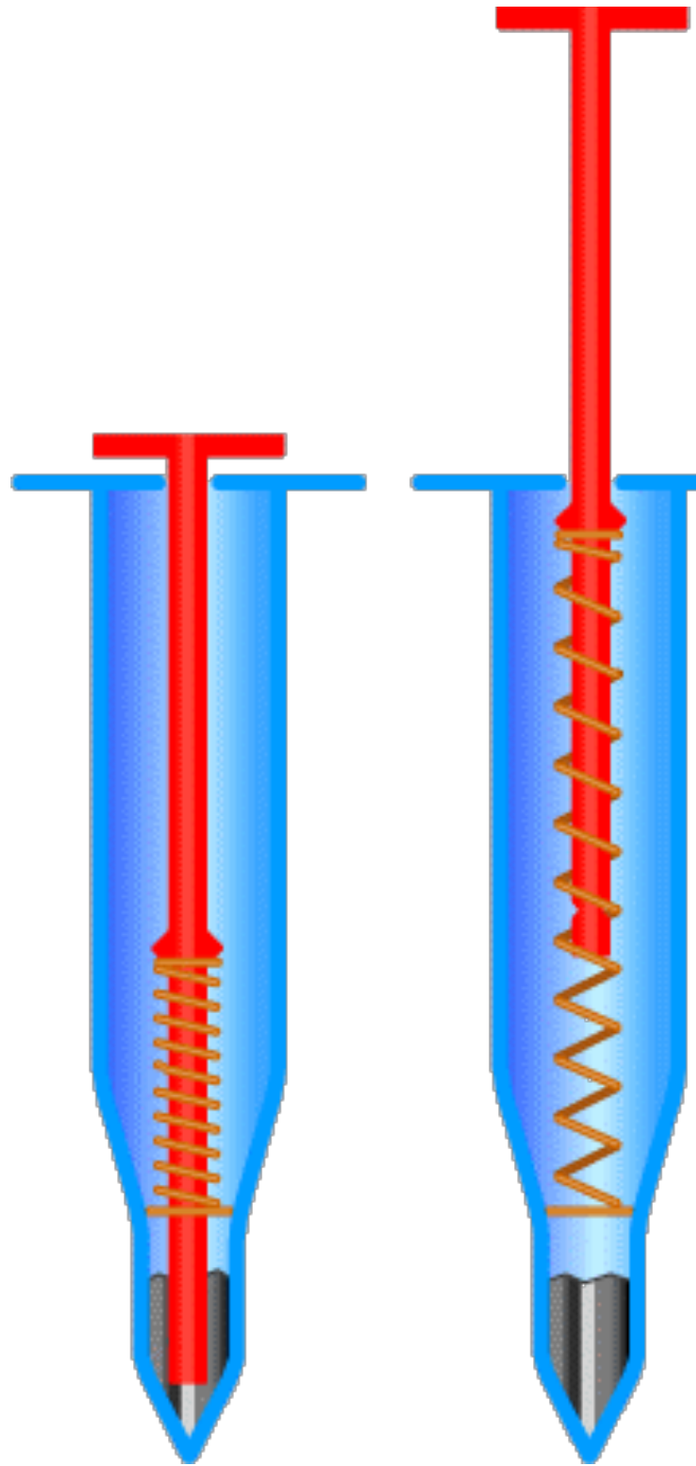
You are cooking that Thanksgiving turkey, and you want to make sure that the inside of the turkey is not overcooked. You can use a thermometer known as the pop-up timer.



This instrument is stuck into the turkey, and when the turkey is done, a red indicator pops up.

The red indicator is spring loaded and held in place by a blob of solid metal or wax.

When this metal or wax reaches 85 °C, the temperature of a fully cooked turkey, it melts, and the spring is released causing the red indicator to pop up.



This technology is similar to that used in sprinklers found on the ceilings of many buildings, which actually served as the inspiration for the pop-up turkey timers.

When a certain temperature is reached, a metal or wax component melts, releasing a spring which opens a water valve.

By mixing different metals, an alloy can be created with a desirable melting point. Pop-up timers can be purchased for a wide variety of foods.

Perhaps the most unusual thermometer ever invented is one of based on a device invented by Galileo.

The instrument does not look like a thermometer, as it is composed of several glass spheres containing different colored liquids that are suspended in a cylindrical column of a clear liquid.

Attached to each of the colored spheres is a little dangling metal tag with an engraved temperature.

The temperature is determined by reading the tag on the lowest floating sphere.

As the temperature rises, the spheres will fall one by one. When the temperature drops, the spheres will rise one by one.

The liquid within each glass sphere is composed of either colored water or alcohol.

Usually the volume of each sphere is the same, but each has a slightly different mass by making each tag a slightly different mass.

The clear liquid surrounding the spheres is an inert oil, such as mineral oil.

As the oil warms, it expands, becomes less dense, exerts a smaller buoyant force, so the heaviest sphere sinks.

If the temperature continues to rise, the oil expands more, causing more spheres to fall.

As the oil cools, it gets denser, exerting a greater buoyant force, causing the spheres to rise.

The spheres do not expand or contract nearly as much as the oil since they are composed of glass, which hardly expands at all when heated.

Even though they look nothing like a “normal” thermometer, the Galileo thermometer still functions according to the same basic principle as most other thermometers: substances expand when heated and contract when cooled.