

YouTube Physics

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Heat and temperature cannot be seen by the naked eye.¹ But they can be visualized now using an affordable infrared (IR) camera. For those who do not have access to an IR camera, recorded videos of energy transformation or heat transfer may still be useful classroom demonstrations. These five YouTube videos present a set of IR imaging experiments that teach the concepts of heat capacity, conduction, radiation, convection, and latent heat. Each of these videos raises an interesting question that can bring inquiry to a deeper level. For more information about these experiments (and others), visit energy.concord.org/ir.

1. Why do metals feel colder? – This video shows a comparison of thermal conductivities of metals and foams. A thin metal sheet was placed on top of a foam core board and then the entire foam core board was covered by a piece of paper. A thumb was laid above the metal piece and the other above the foam core area. Before starting the video, ask students to predict what will happen. When students see thermal energy spread out in the metal piece, pause the video and remind them that this means the metal piece actually became warmer. Ask them how it is possible that, while the metal piece has become warmer, our hands still feel cold. At the end of the video after the thumbs were lifted, stop the video and ask students to explain the temperature difference between the two touched areas. Challenge students to come up with a theory to explain all these observations.

2. Why do leaves feel colder? – One way to tell if an indoor plant is plastic or a real one is to touch its leaves. Although a plastic and a real leaf are both at room temperature, a real leaf feels colder. The key is the increased heat capacity due to water in real leaves. This video used a dry sponge and a wet sponge to simulate this. Both were wrapped with plastic film to stop water loss from the wet sponge through evaporation and ensure that they have the same emissivity. The video shows that the wet sponge absorbed more thermal energy from the fin-

ger that touched it than the dry one. The ability of absorbing and storing more thermal energy came from water, which provides higher heat capacity. Before starting the video, ask students to predict what will happen. When the video shows the temperature distribution patterns on the sponges after the fingers moved away, ask students what they can conclude from the patterns.

3. Amazing self levitation illusion – This video shows the radiation heat transfer between an ice water jar and a piece of paper. Before starting the video, ask students to recall their experience of facing a campfire. Then switch the subject to facing very cold objects and ask them to predict and explain what they would feel. A further question to discuss is how this process of heat transfer differs from conduction and convection.

4. Why does convection stop in salt water? – Two ice cubes were put into a cup of freshwater and a cup of salt water, respectively. This IR video shows that the melting of the ice cube in salt water was slower than in freshwater. Students can observe apparent convection patterns in freshwater characterized by sinking “cold columns,” which did not occur in salt water. Challenge them to explain why thermal convection stopped in the cup of salt water.

5. What warms up a piece of paper when it is above a cup of tap water? – This video shows that a piece of paper hung above the surface of tap water appeared to warm up as if heat were transferred from cool water to it (which could not happen according to the second law of thermodynamics). Ask students to think about how this is possible. Give them hints of evaporation, condensation, latent heat, and conservation of energy.

1. Charles Xie and Edmund Hazzard, “Infrared imaging for inquiry-based learning,” *Phys. Teach.* **49**, 368–372 (Sept. 2011).

If you have a favorite YouTube video that you use in your physics classroom, please send the link and a brief description to driendeau@dist113.org.