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This concept trailer from OpenStax motivates conduction, convection, and radiation through cooking.

Students will be able to...

So far we have discussed heat as it relates to the first law of thermodynamics where we learned that heat is a way for systems to exchange energy, similar to work. We then discussed specific heat and heat of transformation under the section "Heat", but really we were just talking about energy transfers where heat was the most common way to transfer that energy, as opposed to work. What have not yet discussed is the specific mechanisms by which energy is transferred via heat. There are three main mechanisims for heat transfer, conduction, convection, and radiation.

Conduction: Thermal energy, which quantifies the motion of microscopic particles, can be transferred by faster moving particles colliding with slower moving particles and transferring some of their momentum - and thus kinetic energy. Conduction is the primary heat transfer mechanism for solids, where atoms in the crystalline lattice that are wiggling a great deal due to their high thermal energy, start to make the atoms next to them wiggle more. This wiggle-transfer, from one atom to the next, is the primary conceptual understanding of conduction.

Conduction is quantified as a rate of energy per time. It is dependent on a number of factors including temperature differences, size parameters, and a material property called the thermal conductivity.

Convection: Thermal energy, which is a measure of motional energy of microscopic particles, can also be transferred when a higher energy particle physically moves from a higher energy to a lower energy location. In doing so they will have decreased the thermal energy in the hotter location and increased the thermal energy in the colder location. This physical transfer of mass from one location to another is called convection and is the most prevalent form of energy transfer in a gas.

Quantifying convection requires the use of the calculus, which is beyond the scope of this discussion, so conceptual understanding is key. It"s important to be able to identify when convection is present and describe the mechanism in terms of particles moving from one location to another.

Radiation: All objects with a temperature greater than 0 K, so all objects... even deep space is around 4 K, radiate electromagnetic energy.

A full blown understanding of this phenomena requires deeper physics (quantum mechanics) than is the scope of our discussion here. But even if we can"t understand all the underlying mechanisms, we can still quantify

the results. As with conduction, radiation is cast in terms of a rate of energy transfer.

Notice that if the object and its environment have the same temperature, the net thermal radiation is zero - just as much energy leaves as enters the object.

Now, take a look at the pre-lecture reading and videos below.

OpenStax Section 14.4 | Heat Transfer Methods