Exploring Properties—
Heat Transfer

How do we keep computers from overheating?

NanoDays™
The Biggest Event for the Smallest Science!

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Try this!

1. Feel both blocks. Which one *feels* warmer to your touch?
2. Make a prediction: Which block will cause an ice cube to melt faster?
3. Place a cube of ice on each block. Do they melt at the same rate? Which one melted faster?

What's going on?

One of the blocks is made of aluminum and the other is made of high-density foam. They are both at room temperature, but even though the aluminum block *feels* colder, it actually makes the ice melt faster!

When you touch the aluminum block, the heat of your hand quickly transfers away into the block. This leaves your hand feeling cold. But when you touch the foam block, only a little heat slowly flows into the block. So your hand still feels warm. Remember both blocks are at room temperature, much warmer than an ice cube! Heat transfers quickly from the aluminum block to an ice cube, melting it very quickly. But heat only slowly transfers to the ice cube on the foam block, making it melt more slowly.

The difference happens because of **thermal conductivity**. Thermal conductivity measures how quickly heat flows through a material. The aluminum has a higher thermal conductivity and the foam has a lower thermal conductivity.

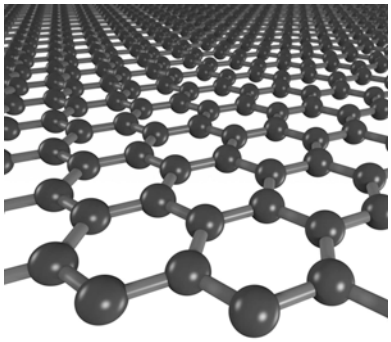
Now, try this!

1. Press the edge of the graphite piece into an ice cube.
2. What happens to the ice? Do you feel anything surprising in the fingers holding the graphite?

What's going on?

You are slicing the ice with the heat from your hand! The little piece of graphite is a very good conductor of thermal energy. The heat flows from your hand quickly and easily through the graphite and to the ice. The graphite piece in the demo is a very pure and highly ordered form of graphite—unlike the graphite in a regular pencil, which has various clays in it.

How is this nano?



Graphene

The way a material behaves on the macroscale is affected by its structure on the nanoscale. Graphene is a single layer of carbon atoms arranged in a honeycomb pattern. It is the thinnest material that exists.

While most nanoscale films have poor thermal conductivity, graphene has excellent thermal conductivity. In 2008, researchers at the University of California, Riverside showed that graphene's thermal conductivity is about 20 times greater than aluminum, 10 times greater than copper, and 3 to 5 times greater than diamond (the previous record holder). Graphene has the potential to play a major role in keeping future electronic devices from overheating!