Energy & Heat Capacity



Temperature & Internal Energy

Temperature increases as we raise the energy, increasing the random motion of the molecules.



Temperature & Average Energy

Temperature of an object depends on the *average* amount of energy per molecule.

Sparks from sparkler are burning iron dust. They don't burn skin since they are tiny so they have very little *total* internal energy, despite their high temperature (5000 °F).



Sparklers



Temperature Analogy

Red-hot iron dust has very little total energy, just as dust falling on your head from a great height would wouldn't hurt as it has little energy.



On the other hand, a gallon of molten iron would has a huge amount of energy, like a bowling ball falling on your head.



Heat Capacity

Some people need a lot of money to make them happy. Some don't.

An object with a high heat capacity needs a lot of energy to raise its temperature.

An object with a low heat capacity doesn't need much energy to raise its temperature.





Heat Capacity

Water has a high heat capacity; it takes a lot of energy to raise its temperature.

Sand has a low heat capacity; it takes little energy to raise the temperature of sand.

www.flickr.com/photos/caseycanada/

On a sunny day the sand heats quickly while the water stays much cooler.

Boiling Water in Paper Cup

- A paper cup filled with **sand** heats up quickly because it has a low heat capacity.
- A paper cup filled with water does not burn because it has a high heat capacity so it can absorb large amounts of energy.



Specific Heat Capacity

Specific heat capacity is the heat capacity per kilogram of a material.

Material	Specific Heat Capacity	
Gold, Mercury	0.1	
Copper	0.4	
Steel	0.5	
Sand, Stone, Glass, Bone	0.8	
Plastics	1.3-1.7	
Wood	2.0-2.9	
Animal Flesh	3.5	
Water	4.2	k

kJ/(kg K)

(Not) Burning Money



(Not) Burning Money

Soak a dollar in *Everclear* and light it on fire; when the alcohol is gone the bill is undamaged.

Heat produced by the burning alcohol heats the water but due its high specific heat capacity the water can absorb all of the energy.



Methane Foam in Hand



Methane Foam in Hand

I was not burned because I made sure to **soak my hand in water** before scooping up the methane foam lighting it on fire.



Fire Walking

Walking on hot coals can be done safely if your feet are very wet.

Water has a high heat capacity and the ashes have a low heat capacity.

Nevertheless, you can be badly burned if careless!



Summary

- Temperature of an object depends on the average amount of energy per molecule.
- Materials with a high specific heat capacity, such as water, need a lot of energy to raise their temperature.
- Materials with a low specific heat capacity, like sand, glass, and metals, don't require much energy to raise their temperature.