A brief description of Heat Energy by Chris Smith.

Heat is energy.

Heat present in a material substance manifests itself as the movement (or vibration of molecules) in that material.

Heat can move from one material to another but only in one direction. That is from a hot or warmer material to a cooler one.

Heat generally moves from a hotter or a warmer material to a cooler one by being in contact with it (touching it). A process known as Conduction.

Heat can also move from a hotter or warmer material to a cooler one through a process known as radiation and where the materials are not in contact.

Heat will ALWAYS move from a hotter one to a cooler one when a cooler one is present. It will continue to do so until the temperature of both materials is the same.

The word heat is a property meaning energy is present in a material. Cold is not a property. It merely describes the absence (or relative absence) of heat energy in a material.

Temperature is a word which describes the EFFECT of the presence of heat in a material. Temperature is measured in equally incremental units, typically degrees Fahrenheit (Imperial unit measurement system) or degrees Celsius (Metric unit measurement system also known as System International by the French who put the measurement system together).

Heat is also measured in units, typically Btu (British Thermal Units under the Imperial system) or Joules under the SI system.

The temperature of something only indicates the EFFECT of a given amount of heat energy in a given amount (weight or mass) of a material. To clarify this point an example. The same amount of energy (Joules) in say a kilogram weight (mass) of one material may result in that material indicating a certain temperature. The same amount of energy present in the same mass of another material might indicate a totally different temperature. Meaning the effect of that identical amount of energy in the identical mass of material but a different material may result in a different temperature indicated.

Frogs legs. For example, if say a certain amount of energy is added to an amount (by weight) of water with the result that the water's temperature is increased by 10 degrees, adding exactly the same amount of energy to exactly the same amount of frogs legs then the temperature of the frogs legs would increase by 11.5 degrees.

This is because the **Specific Heat** of water is *higher* than the **Specific Heat** of frogs legs and thus more energy is required to heat the water than to heat the frogs legs. Frogs get no say in the matter. It's simply a fact of physics.

Specific Heat. Every material possesses a property known as its '**Specific Heat**'. The Specific Heat property of different materials is always constant (does not change) and can vary enormously from one material to another. When the Specific Heat of a material is known (found in scientific tables) and the weight (mass) of that product is known and the temperature is known then it is possible to easily calculate the amount of energy it contains. Conversely therefore it is equally easy to calculate what the temperature of any material will be when the amount of energy it contains is known, its mass is known and finally its Specific Heat is known. All the formula involved use only simply mathematics and are entirely 'linear. Meaning that if say the temperature of a given material is increased by a single degree then it will be the result of a certain amount of energy being added to it. If the temperature is increased by another degree then it means that exactly the same amount of energy has again been added to it. To reiterate, this means the calculation is linear.

To reiterate again. Different materials may (and usually do though there are exceptions) posses different Specific heat properties. Water however is a different material to ice as far as its Specific heat is concerned. Steam again has yet another Specific heat property. So it is important to know what state a material is in when calculating matters concerning its energy content and its temperature.

Sensible temperature. So far heat energy has been considered only in ways it can be measured and 'felt'. That is 'sensed' to the touch, or measured using thermometers for example. This effect is therefore known as 'Sensible' temperature.

Latent heat. There is another part to heat energy however and this is a little (but not by very much!) more complicated.

All materials either contain (or don't contain) an amount of energy which keeps them in the physical state that they can be seen and felt in. This is known as 'Latent heat'. Water for example can only exist as a liquid because of the amount of Latent heat it contains. When its Sensible temperature and thus the amount of energy it contains is reduced to a certain point then it is forced to start emitting its Latent heat content. Once its Latent heat content has been removed it becomes ice.

Similarly, at the other end of the scale, when heat is added to water it eventually reaches a point at which the water can no longer accept any more heat energy being added to it. Any additional energy that is added will add to its Latent heat content and ultimately this will turn the water into steam. More heat added to the steam and then the temperature of the steam will continue to rise (increase in the Sensible temperature of the steam).

One of the most important and fundamental scientific phenomenon now presents itself. A basic tenet of physics and without which not only refrigeration, air conditioning and heating systems could not exist, nor could life!

Adding or removing a material's Latent heat content to the extent that it changes its state from one to another (E.g. from a solid to a liquid or from a liquid to a gas) is accompanied by NO CHANGE IN TEMPERATURE! In other words it is impossible to measure the change of state or the effect of the Latent heat content using temperature measurement instruments. The change of state is though easily observable. Ice for example is obviously a solid whereas what ice is made from, water, is obviously a liquid. Even though there is no change in temperature the amounts of Latent heat involved in changing the state of materials is large. It takes far less energy for example to raise the temperature of ice by a dicernably large amount than it does to actually melt it to turn it into water.

The next topic to be described will cover the time it takes for heat energy to move in materials and how this can and does vary from one material to another.

You might note at this point that no mathematical calculations, formula or equations have been mentioned. Indeed very few figures have been shown and none are required to be remembered. That is because it isn't necessary to fill one's brain with figures and formula which in any event are best kept in a book, or these days, a computer database! My job unavoidably means I am required to access thousands of figures and formulae every single day. Fortunately I am not required to store any of these in my head. I just remember where I left the book.