

MEASURING TEMPERATURE

The Thermometer

new VOICES

MIRVETTE CHAMOUN looks at the historical development of a measurement scale with the view of helping children understand the role that mathematics plays in society.

Temperature — distinguishing between “the degree of hotness or coldness [of] a body or environment” (askoxford.com, 2005) — is a phenomenon that has been extensively investigated over a significant period of time. As a result of this investigation, a device known as the thermometer was developed with a sole purpose of measuring the degree of hotness or coldness in a body or environment using a particular scale (World Book, 2000). The apparatus constructed has the ability to show the temperature measure, as incorporated within its structure is a liquid that rises and falls in a tube as the temperature around it cools or warms (U Learn Today, 2001). This rise and fall is due to the fact that “when the temperature rises, the liquid in the glass tube warms up and molecules move apart causing expansion in the liquid, which in turn takes up more space in the tube” (U Learn Today, 2001, p. 6).

The history of the thermometer

The thermometer took on many different shapes and forms over many years of exploration to get to where it is today. The accuracy and precision of the modern day thermometer came about after many years of trial and tribulation, experienced by an array of inventors and scientists. These scientists and inventors aimed in developing a device that took on the forces of the world around them to measure temperature. In 1593 a

man by the name of Galileo Galilei started the journey in discovering the best tool to measure temperature. In his attempts at creating such a device the *thermoscope* was born, which had the ability to recognise a change in temperature (Bellis, 2005). The thermoscope however lacked the ability to provide a numerical value in accordance to the temperature being experienced, as it merely recorded whether it was higher, lower or the same as the previous temperature (Bellis, 2005). This flaw encouraged the scientist, Santorio Santorio, to develop the first thermometer with a scale in 1612 (U Learn Today, 2001). The Grand Duke of Tuscany, Ferdinand II was the next person in line to modify the components of the thermometer, introducing the idea of a sealed liquid-in-glass thermometer (also known as the spirit thermometer). The thermometer had within its chambers an alcohol filling and was accompanied by “50 degree marks on its stem with no fixed point used to zero the scale” (Brannon, 2004). This caused the thermometer to be inaccurate as it did not comprise a standardised scale and so the push for a more accurate device to measure temperature was on its way.

In 1714 Daniel Gabriel Fahrenheit developed the first mercury thermometer, which he identified as a more precise method for measuring temperature due to the fact that “the expansion of mercury is more predictable combined with improved glass working techniques” (Brannon, 2004). As well as this, Daniel Gabriel Fahrenheit introduced the Fahrenheit Scale, which established a freezing point of 32°F and a boiling point of 212°F (World Book, 2000). These findings were a revelation in accurate temperature measurement impacting society as a whole. The Fahrenheit scale is still used today in many countries as their mode of temperature communication.

Anders Celsius was the next genius inventor whose work impacted greatly on modern day temperature measurement. The Celsius scale or centigrade scale identified by Anders in 1742 divided the freezing and boiling points of water into 100 degrees, establishing the boiling point of water to be 0 degrees and the freezing point of water to be 100 degrees (Bellis, 2005). Jean Pierre Cristin in 1743 “inverted the Celsius scale to produce the centigrade scale which recognises freezing point to be 0 degrees and boiling point to be

100 degrees” (Bellis, 2005). In 1948 an international agreement saw Cristin’s adapted scale become known as Celsius (Brannon, 2004). This Celsius scale is now standard in a majority of countries and is used in many households, hospitals, medical centres and clinics around the world to measure temperature.

In 1848 Lord William Thomas Kelvin introduced absolute zero to the world of temperature (U Learn Today, 2001). This idea provoked the last known scale to be introduced to the measurement of temperature. The Kelvin scale represents the ultimate extremes of hot and cold whereby “zero degrees is the theoretically lowest temperature possible where molecular motion ceases” (Brannon, 2004). Lord William Thomas Kelvin recognised and used the degree Celsius in his scale (i.e., 1 degree Celsius is equivalent to 1 Kelvin degree) however extending it to an absolute zero of -273.15°C (U Learn Today, 2001). Scientists around the world today use this form of temperature measurement, as it is the most accurate.

The Kelvin, Fahrenheit and Celsius Scales are the leading scales used for measuring temperature today. Each scale plays a different role in society with the same objective, being that an accurate measurement of temperature may be recorded. However the history of temperature measurement does not stop with the creation of these scales. It has been extended to the thermometers that accompany these scales

and how they have changed to cater for an ever growing, technologically-advanced society. In 1866 Sir Thomas Clifford Allbut introduced the first short clinical thermometer. The thermometer was an innovative and welcome change from the 30 cm long instrument that required 20 minutes to register a patient's temperature (U Learn Today, 2001). Today both liquid-in-glass and electronic thermometers are in existence, which take a few seconds to record the temperature of an environment or body. These electronic thermometers are quick and efficient and function with the help of some inbuilt sensors (Bellis, 2005). The scales that are located on these devices were identified many years ago and will undoubtedly continue to evolve.

A model for students to make

A means by which children are able to construct knowledge on the nature of temperature and its measurement is the sole purpose of the product created. The thermometer shown in Figure 2 has been divided into three distinct sections, each displaying one of the three temperature scales used in society today: Fahrenheit, Celsius and Kelvin. This allows students to compare systems of temperature measurement used in society and allows students to recognise the similarities and differences of each scale. Pictures representing the different temperatures have been created and

attached to the thermometer so that students are able to note temperatures in different situations. The product created is one that is easy to assemble and a great source for learning. In Bobis, Mulligan & Lowrie (2004) it is stated that such a "discovery-like process is important for mathematical understanding to occur as it ensured that the knowledge was meaningful" (p. 12). This is a major reason why I would place the construction of such a tool into a unit of work on temperature, as students will be actively involved in their exploration of the thermometer in a fun and interactive way. Additionally, the creation of a thermometer is a great starting point for further learning experiences in the area of temperature.

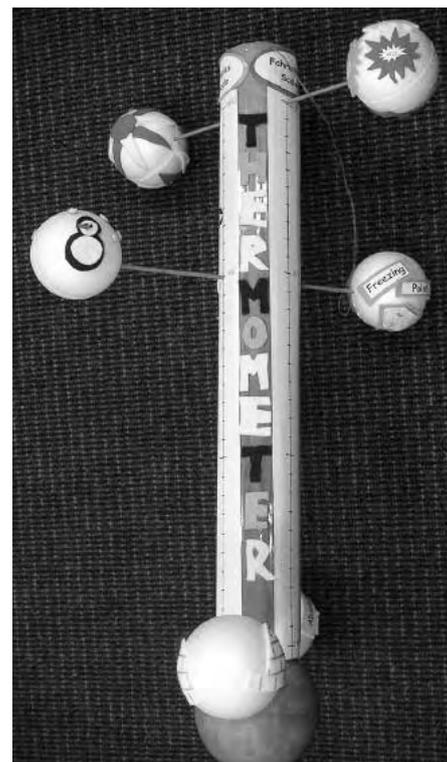


Figure 2

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