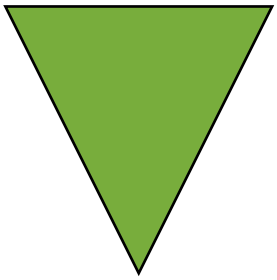
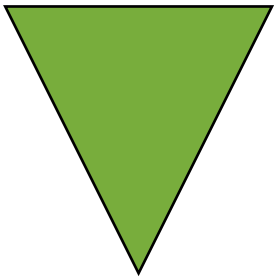
Imaging Associates International

ABN 188 562 560 10 ACN 005 457 787

Two Temperature and their Difference



Over Time.



by Andrew Reid

ThermoSense Mk1 came about along with its free supporting software in order to try and address in a simple Data Logging System sufficient capability so that it could compliment " Simulation " and "Modeling" educational methods in the Teacher Class Room .

Because of its ease of use , it is hope it will be used frequently, and thus through teacher and student familiarity with its operation, be seen to embrace applications involving Physics, Chemistry and Biology along with those needed in the implementation of the " Integrative STEM " educational philosophy.

Although experiments will naturally rely on explained " First Principles" their emphasis could well embrace through the use of the associated portable Netbook Computer applications outside the classroom. In this context we envisage that these experiments could be easily designed to make statements as to their relevance to Sustainability and day to day life situations.

To this end we felt that a "Theme" based approach will be most suitable. In the first instance we have concentrated on a theme implemented in the software ThermoSoft Mk1 which with teacher guidance can embraces the impact of two temperatures and their difference over time. Other software on the theme "Two Pressures and their Difference Over Time" is under consideration.

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Why Two temperatures first?

Two Temperatures and their Difference often fuels the chemistry of Life. They may not give a reason to live but in many instances they give us the means to live physically all the better.

Two temperatures when appreciated can be a window to the world we live in ------ all the better if we can easily make measurements for ourselves and investigate the impact upon life situations.

Most of us are familiar with temperature ---- the obvious one most important to us is our Biological Temperature, along with our Environmental Temperature, relating to our physical well being.

In our minds most of us subjectivity feel we are dealing with one temperature--------How Hot do I feel ? ----How Cold am I ? ---- this relates to Thermal Comfort and of course medically a High Temperature can be a major point of concern. Thermal Comfort also concerns other environmental considerations such as Relative Humidity.

In reality we are always dealing with Two Temperatures and thus a Temperature Difference in space and as a consequence a Heat Energy Transfer .

Students stimulated to gain the Two Temperature Insight may forget what some may see as dry Science and with teacher encouragement reflect upon the last 100 years or so and how with sustainability in mind how to make the next an improvement.

For this they may need :-

The Two Temperature Knowledge Impact ------ Teacher Delivered!

An Impact made possible by a scientific appreciation of Nature -------often involving experimental investigation.

In this context consider that all life on Earth relies to a large extent on Two Temperatures and their Difference. At it's most simple and most important level, the Temperature of our Sun and the lower Temperature of our Earth gives rise to an electromagnetic radiation transmission to the Earth which becomes the Energy Resource for Photosynthesis the basis for our being.

Students may be encouraged to consider whether some of the large scale man made "Two Temperature " applications of Engineering Technology are to their liking.

These include in the Big Picture!

*** Present Nuclear & Coal Fired Electrical Power Stations.**

*** Gas Turbine Electrical Power Stations.**

*** Home & Commercial Air Conditioners & Refrigerators.**

*** Airplanes, Motor Car & Marine Ocean Ship Engines.**

*** And many more.**

Student on the basis of this they may consider how small scale investigations of the "Two Temperature life Impact" associated with some form of rigorous or tailored to need Science Education may give them life supporting foundations for what ever career path may choose.

Some of the following experiments can easily be done by ThermoSense Mk1 and many other avenues which may be worth Teacher Exploration are at the end of this document.

*** The Two Coffee Experiment with explanations based upon Newton's Law of Cooling ----- Easy to do for all age groups and can be made more challenging for advance students of calculus.**

*** The Simple Greenhouse Experiment----- in this context a social impact implied in the context of temperature measurements done in and out side a parked car. Safety considerations for the living locked within even on a cool day.**

*** Simple use of the two temperature sensors ---- one wet one dry to measure relative Humidity . The physics of Thermal Comfort! etc .**

*** Compost Heap Temperature biology and for more advance ---measurement of Sap Flow by Heat Transfer.**

*** "Hopes Experiment" showing that water at a depth rarely goes below 4 degrees centigrade any where in the world.**

The list is endless so that some point of interest could be found for the most indifferent student.

*** Who has the Better Heat Energy Transfer Insulation for "Take Away Hamburgers" ? McDonald's or Hungry Jack's ?**

*** Chickens roasted in Supermarket ovens in Australia must have an internal temperature of 70 degrees centigrade. Why not check some Food Temperature Standards and identify some interesting experiments.**

*** If a Hot Potato is a human being: apply your forensic insight to estimate time of death.**

^ Measure the Temperature of a tent inside and outside with and without a Fly.

*** Make the famous Australian Coolgardie Safe and measure it's cooling performance.**

See more typical possibilities list at end of this document.

To implement these experiments successfully the hardware had to be simple and robust and compatible with all modern Windows PC's with USB ports. The only piece of electronics is small , about the size of of an adult thumb. To this, two accurate and well matched one wire temperatures sensors are plugged in to a standard telephone socket. The cables to which the temperature sensors are connected are not special, they are again ordinary telephone cable and may may be obtained from Reject shops throughout Australia.

The simple ThermoSense Mk1 hardware could be loaned to Students for Home Inquiry Learning in Science. The ThermoSoft Mk1 software is free and downloadable from our data logging website along with application notes and other free supporting material.

The dual measured temperature measurements are displayed in graphical form in as they occur in Real Time The Graphs are single page with provision to put the Student name, Experiment name and a short description of what temperature was being measured.

In addition, the measured temperature data may be saved in CSV format for which more advanced students familiar Excel type spreadsheets may input the data for experimentally required calculations.

At this stage what can go wrong!

Well from my past classroom experience , if it can go wrong, it will go wrong, and in this context a great deal of thought has been given to what I call the Window's Maze!

Software problems must not undermine the Teaching effort. Even though students are usually quite familiar with PC type computers. The running of Application Software should not add to the Teaching load. Ideally students themselves in the classroom or laboratory should become a resource.

With this in mind we are going to Support ThermoSoft Mk1 with some Free software called "TeamView".

TeamView enables two computer users to use each others machine in secure communication as if it were their own. This communication does not affect a School network but users must exchange passwords to establish mutual connection. These passwords are changed automatically after each session and do not have to be remembered as they are available at the point of exchange of each computers unique identification .

In the context of supporting ThermoSoft Mk1 a user must download the free for Teachers, Students, Education and non commercial users version and follow the simplest of instructions.

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Some of the communication ways of using TeamViewer are shown below .

With this in mind we have set aside a computer running ThermoSoft Mk1 with two temperature Sensors measuring inside and outside our Laboratory window.

Thus any Teacher in Australia or the world for that matter, may after they have installed the free TeamViewer and we provide the password of the day, evaluate this product from their own computer.

Like wise we could with Teacher permission trouble shoot an installation.

For some time, and under Teacher guidance we are pleased to allow a couple of responsible students to use the system and give their reaction regarding its ease of use as they see fit to the teacher. Remember the product is simple and the collected data for analysis the main concern. Suggestions for improvements within its original objectives would be appreciated.

In conclusion perhaps some interest may be shown in Dimensional Analysis, again to support Simulation and Modeling and where applicable ,be used to confirm the original formulas relevant to the experiment through the use of the experimental data collected.

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Some sites of interest:-

Dimensional Analysis

http://www.tech.plym.ac.uk/maths/resources/PDFLaTeX/dimensions.pdf

TeamViewer

http://www.teamviewer.com/en/index.aspx

The STEM Team - Queensland University of Technology

http://stem.ed.qut.edu.au/

HyperPhysics
http://hyperphysics.phy-astr.gsu.edu/Hbase/hframe.html

Many more easy applications of Temperature Measurement are.

1. **Evaporative cooling:** Dip the Temperature Sensor into rubbing alcohol, acetone, or other solvent. Start ThermoSoft , and then wave the Temperature Sensor quickly through the air. What will happen to the temperature as each liquid evaporates?

2. **Thermal energy in solids:** Compare the temperature of a Coin before and after being struck with a hammer. Or apply a heat source to one end of a metal rod and monitor the temperature at various distances along the length of the metal.

3. **Friction and thermal energy:** Test the temperature of various surfaces before and after being scrubbed with sandpaper. Does the grain of sandpaper used make a difference in how the temperature changes?

4. **Physiology study:** Use the Temperature Sensor to map the temperature across various body parts: for example, neck - shoulder - elbow - wrist - hand.

5. **Sense-ability:** A useful demonstration of how we sense relative hotness / coolness asks the volunteer to hold one hand inside a beaker containing very warm water while holding the other hand in a beaker of ice water. After 30-60 seconds, move both hands into a beaker containing room-temperature water. What do you predict you will feel? Use the Temperature Sensor to monitor how long it takes the temperature of each hand to change throughout the experiment. Use caution - do not burn or freeze your skin!

6. **Exothermic and endothermic reactions:** Predict how the temperature will change when you drop Alka-Seltzer into water. Can you predict how one tablet will differ from two or three? Or try testing other common chemical reactions: for example, vinegar and baking soda.

7. **Thermal energy in the environment:** What is the temperature of puddles after a rainstorm? How about the soil at different depths? How does a brick wall in the sun differ from a wooden door? How much cooler is the air in the shade versus the sun?

8. **Does color matter?** Compare the temperature of a dark-colored surface and a light-colored surface after exposure to sunlight.

9. In a black insulated container filled with a know mass of water covered in glass on a clear day at a noted time record the temperature rise and make an estimate of the solar radiation received.

---------- **End** ----------