Datalogging with Handheld Technology

KS3 Science
Unit 7L: The solar system and beyond
What causes the seasons on Earth?

This year7 unit offers a range of opportunities to exploit the learning potential offered by personal datalogging. Use of Heat sensors is at the heart of the datalogging in the aspect covered here. The focus of this module is taken from the QCA specification:

What causes the seasons on Earth?

Learning Objectives	*Possible teaching activities*	*Learning outcomes* Pupils	*Points to note*
▪ To use a model to show that the axis of spin of the Earth is at an angle to its orbit round the sun. ▪ To collect data about temperature and day length, using ICT. ▪ To interpret first-hand and secondary data about temperature and day length. ▪ To follow the sequence of actions and processes being developed.	▪ Ask pupils for an explanation about any work carried out at ks2 on seasonal variation, e.g. *changing hours of daylight throughout the year.* Help pupils model the idea of the tilt of the Earth. Ask pupils to suggest ways in which the seasons differ from each other e.g. *position of Sun in the sky, climate.* ▪ Help pupils to use a datalogger to test the validity of the 'tilted Earth' explanation of the seasons … Record and display the data as a graph for analysis and interpretation by pupils. ▪ Position the globe with Britain in a summer position relative to the light source 'Sun'. Place a light sensor on one point and slowly rotate the globe. Collect data illustrating the differing hours of day length in summer and winter positions, and how this is dependent on the orientation of part of the globe to the 'Sun'	▪ Describe that the axis of spin of the Earth is at an angle to the 'Sun' ▪ Identify on a diagram or model parts of the Earth which are experiencing different seasons, due to their relative position to the Sun ▪ Interpret graphical data produced by a datalogger and relate this to knowledge about variations in day length and climate in different seasons.	▪ Work relating to the Earth's orbit will have been done in key stage 2. However, pupils will not have related this to the seasons. This provides the opportunity to refine their use of the Sun, Earth and Moon model. ▪ An alternative arrangement is to use two or three trays of sand exposed to the same light source, but inclined at different angles and to record temperature changes.

Activity:

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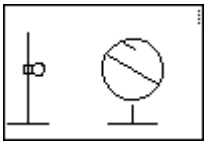
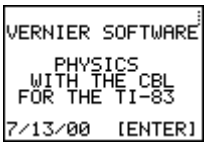
This activity will provide pupils with a possible reason for the seasonal variation witnessed on Earth. Pupils will record temperature rise during "summer" and "winter".

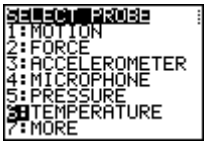
1. Set up the simulated sun – the light bulb (**not swicthed on**) and the tilted globe so that the sun is at the same level as the 23.5^{o} South latitude with the North pole pointing directly away from the sun. This will simulate the start of winter in the northern hemisphere.

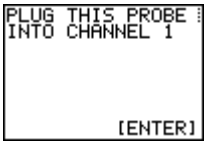


2. Tape the temperature probe along the line of longitude corresponding to your school. Ensure that the business end of the probe is in contact with the surface of the globe. (The older flexible probe is quite effective in this activity.)
3. Adjust the distance from the surface of the sun to the surface of the globe to 25cm. Make sure that the tip of the probe, the sun and the north pole lie in a vertical plane.
4. Attach the calculator to the CBL/CBL2, and the temperature probe to channel 1 of the CBL.

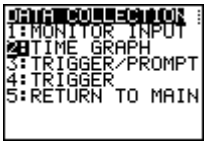


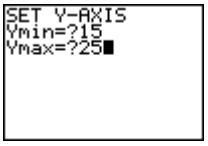
5. Run the Physics APP (or progam) and SET UP PROBES, using the STORED calibration.



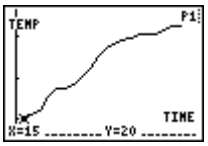


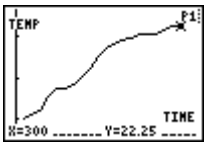
6. You are nearly ready to COLLECT DATA with a TIME GRAPH. 15 seconds between samples and a total of 20 samples provides a reasonable experiment.





7. A LIVE DISPLAY gives a real-time scattergraph of the temperature and shows the increase over the experiment time. Minimum and maximum temperatures are needed but these do not have to be precisely determined.
8. Once you are ready to proceed, switch on the sun! and start to record the data.

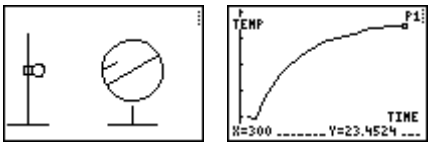




9. Once the data are collected, **switch off** the sun! and allow the globe to cool (assisting it with a cool air blower may help to get the temperature back to room level more quickly.)
10. The graph can be traced to find the initial and final temperatures, hence the temperature rise (2.25^{o}C in this case).

Temperature (^{o}C)	Winter	Summer
At end of period		
At start of period		
Rise		

11. Once the globe has cooled. Set up the summer position with the north pole pointing directly towards the sun. Make sure that the sun, the tip of the probe and the north pole lie in a vertical plane.
12. Start the APP/prgm over again and once you are in a position to collect the data switch on the sun and record the temperature change (see steps 5 to 9 above).



13. The change shown this time is 3.45 ^{o}C (you may get a more dramatic difference between your summer and winter temperature rises).

Possible Extension Work

- The temperature change for different latitudes could be explored.
- Winter in the north is summer in the south – explain.
- A light probe might be used with a slowly rotating globe to collect data about the length of day on different parts of the globe in summer.
- Pupils could find out about the importance of the accurate measurement of time in relation to determination of longitude (Harrison)

Links

- This unit relates to Unit 9J "Gravity and Space"
- Reflection of light is covered in Unit 8K "Light"
- The ks2 Units: 5E "Earth, Sun and Moon" and 6E "How we see things" provide the building blocks for this unit.
- Unit 21 "From Aristotle to the atom" of the history SoW provides a historical context for discoveries about the universe.

Health and Safety

In this unit pupils:

- **Study the Sun**
- **Use mains powered light bulbs**

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Datalogging kit

- TI-73, TI-82, TI-83 or TI-83 Plus graphing calculator
- CBL or CBL2
- temperature probe
- TI-GRAPH LINK™ and cable
- Physics APP (TI-83 Plus) or program group (TI-73, TI-82 or TI-83)
- optional: ViewScreen™, vs-calculator and OHP

Apparatus required

- 'tilted globe'
- stand
- switched heat/light source e.g. 100W bulb (60W silvered spot lamp)
- 30cm measure
- adhesive tape

Useful web sites

www.ti.com/calc/docs/graph.htm
www.vernier.com
www.oxford-educational.co.uk
www.qca.org.uk
www.jb.man.ac.uk