What is a weather station like and how can I use this data in the classroom?

Ken Bland, Head of Wider Schools' Workforce Development, University of Northampton and Christina Fairless, Environmental Sciences Technician, University of Northampton.

The aim of this article is focus on what a real weather station is like and to examine how schools can get and use real weather data for use in their classroom. As Bowles noted in the *Primary Geography Handbook* (Scoffham, S 2004, GA) 'The Geography curriculum does not require pupils to study weather and climate as a separate theme.'(p231) but notes that 'the weather is a key aspect of physical geography and will always feature in locality studies.' It the view of the authors that there should be more depth given to weather studies especially in key stage 2 where in some schools there are issues associated with a lack of progression and differentiation, especially with regard to weather recording and progression.

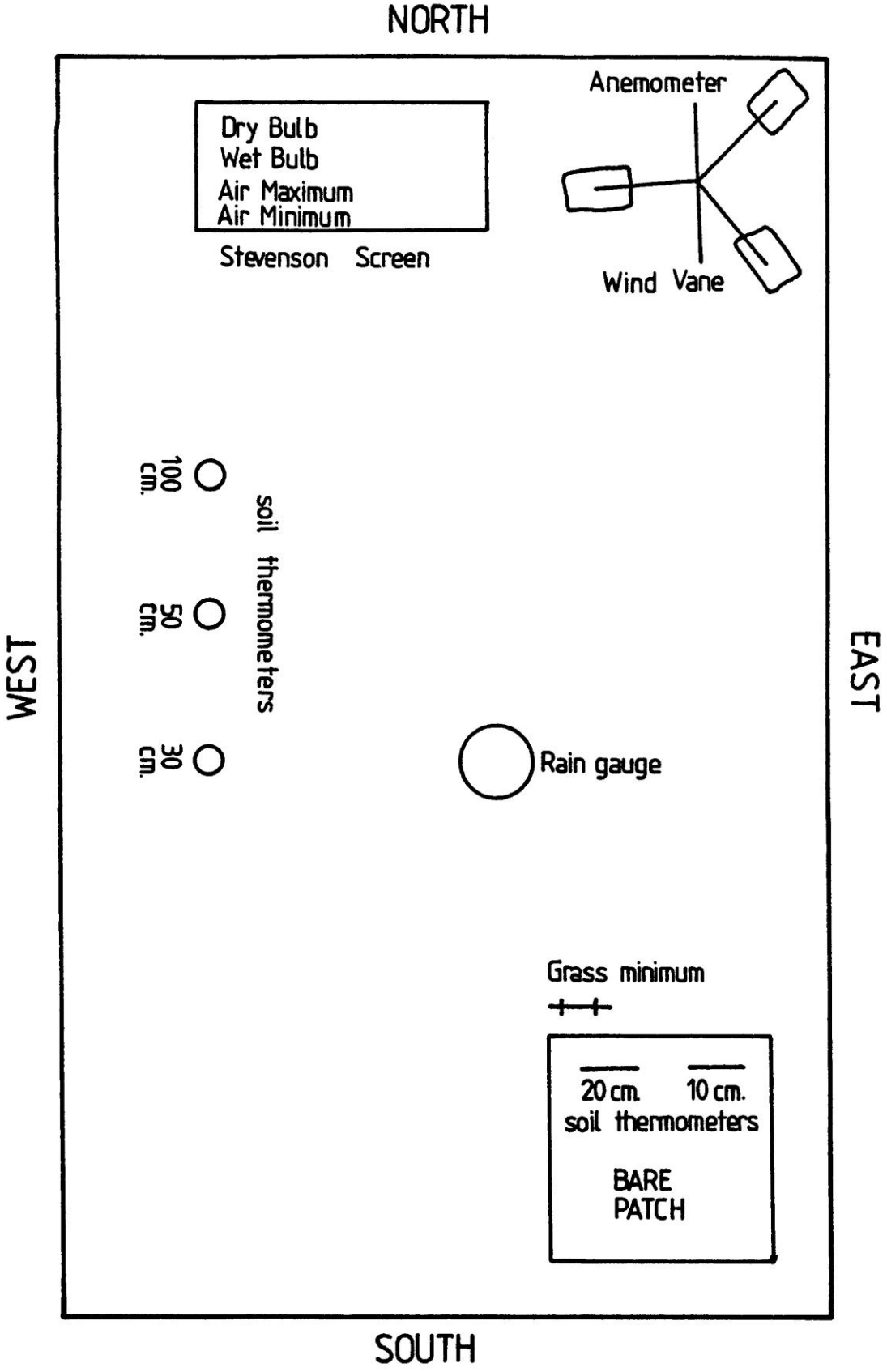
It is very difficult for schools to establish their own weather station in terms of security and cost so there has been a tradition of using established weather stations. There has been a weather station at the University of Northampton since 1975 and figure 1 shows the location of Moulton Park weather station.

Figure 1

Photograph by Carol Wynne

Each met office station is laid out in a similar way. This can be seen in figure 2 below:

Figure 2



The main observation time for Met Office stations is 0900 UTC or Universal Time Co-ordinated which has replaced Greenwich Mean Time or GMT. Every station within the Met Office network will take reading at this time. Throughout the world, countries have their own weather departments and all the data is made available to through the World Meteorological Organisation.

Met Office stations use the same recording sheet (see figure 3) which is sent to the Met Office every month by stations such as Moulton Park. Some Met Office stations take readings regularly throughout the day, some on an hourly basis, and send more comprehensive data in a coded form in real-time.

A completed sheet for September 2006 is include as Figure 3 and this sheet will be used as a guide as to how data is collected.

Figure 3

4364 NORTHAMPTON, MOULTON PARK CLIMATOLOGICAL STATION SEPTEMBER 2006 0900UTC

	Cloud	DIR	SP	PW	DB	WB	MX	MN	GM	10cm	20cm	30cm	50cm	100cm	SoG	SNOW	RAIN	RoW	SUN
1	6	230		1	17.0	15.0	23.4	13.3	12.0			17.7	17.5	16.6	1		0.8		
2	8	160		52	14.4	13.9	22.0	10.6	10.5			17.8	17.6	16.7	1		2.7		
3	5	230		2	21.8	18.0	24.2	14.1	13.2			17.8	17.6	16.7	1		0.0		
4	7	230		2	16.2	14.1	23.0	12.5	8.0			18.0	17.8	16.7	1		0.0		

Each aspect of the record sheet will now be discussed by referring to the individual sections of Figure 3.

1) **Cloud.** A purely visual observation is taken which is coded from 0 (all blue sky) to 8 (all cloud) in 'oktas' or eighths of the sky covered with cloud. The code 9 indicates that the sky is obscured by fog or heavy blowing snow.

Suggested Activity:
Look at the following website:

http://www.bbc.co.uk/weather/weatherwise/factfiles/basics/clouds_formation.shtml
The BBC's Weatherwise site containing information such as cloud formation and types of clouds

http://www.metoffice.gov.uk/education/secondary/students/clouds.html
These web pages are designed to help teachers and pupils by extending their knowledge of weather and climate - in the UK and around the world.

http://scienceforfamilies.allinfo-about.com/features/clouds.html
Your guide and resource about clouds for kids, classrooms, and families.

http://www.cloudsrus.com/
The definitive weather website for kids - Follow the mascot Budgie through the site to discover all you ever wanted to know about the weather

2) **Wind Direction**, the wind direction is recorded each morning at the same time looking at the wind vane as it points to the direction from which the wind is blowing. The codes used are:

CODE FOR WIND DIRECTION (COLUMNS 4 and 5)

When the wind is calm, enter 00 for direction

Compass Point (from which the wind is blowing)	Coded Entry
North	36
North - north - east	02
North-east	05
East - north - east	07
East	09
East - south - east	11
South-east	14
South - south - east	16
South	18
South - south - west	20
South-west	23
West - south - west	25
West	27
West - north - west	29
North-west	32
North - north - west	34

ALL DIRECTIONS ARE FROM TRUE (not Magnetic) NORTH

Photograph by Carol Wynne

Suggested Activity:
Produce a wind rose for your area by drawing an octagon using the 8-points of a compass in the centre of a sheet of squared graph paper. Colour in a square corresponding to each wind direction over the course of a week, a month or a season. Which direction does the prevailing wind blow from? Does this direction change on a seasonal basis?

3) **Wind Speed.** Wind speed is recorded in knots. This unit of measurement is used to define horizontal wind speed. With increasing wind speed the anemometer cups rotate faster. Wind speed is not observed at the University of Northampton and there is no entry on figure 3.

Suggested Activity:
The Beaufort Scale can be used as a visual alternative to using an anemometer: what sort of objects or natural occurrences could be used to make up your own code? Using a map of the shipping areas http://www.metoffice.gov.uk/weather/marine/guide/shipping/key.html either plot the Beaufort Scale number and wind direction on the map after listening to the shipping forecast on BBC Radio 4 LW or use the details available on http://www.metoffice.gov.uk/weather/marine/guide/shipping_forecast.html

4) **The Run of the Wind** (RoW) The Run of the Wind is the amount of wind which has blown through the anemometer cups in the 24 hours between observations; with the answer being the difference in the cup counter reading recorded on each day.

Suggested Activity:
Look at a synoptic chart showing a well developed high pressure system, and then compare it with a deep low pressure system. What do you notice about their respective isobars? Which system is going to have gale force winds associated with it?

5) **Present Weather**.(PW) This is a record of what is happening now weather wise or what has changed over the last hour. Has any phenomena started or stopped, has the situation got worse or improved etc? A code is used and the details are in figure 4.

Carol please scan in table 2 here

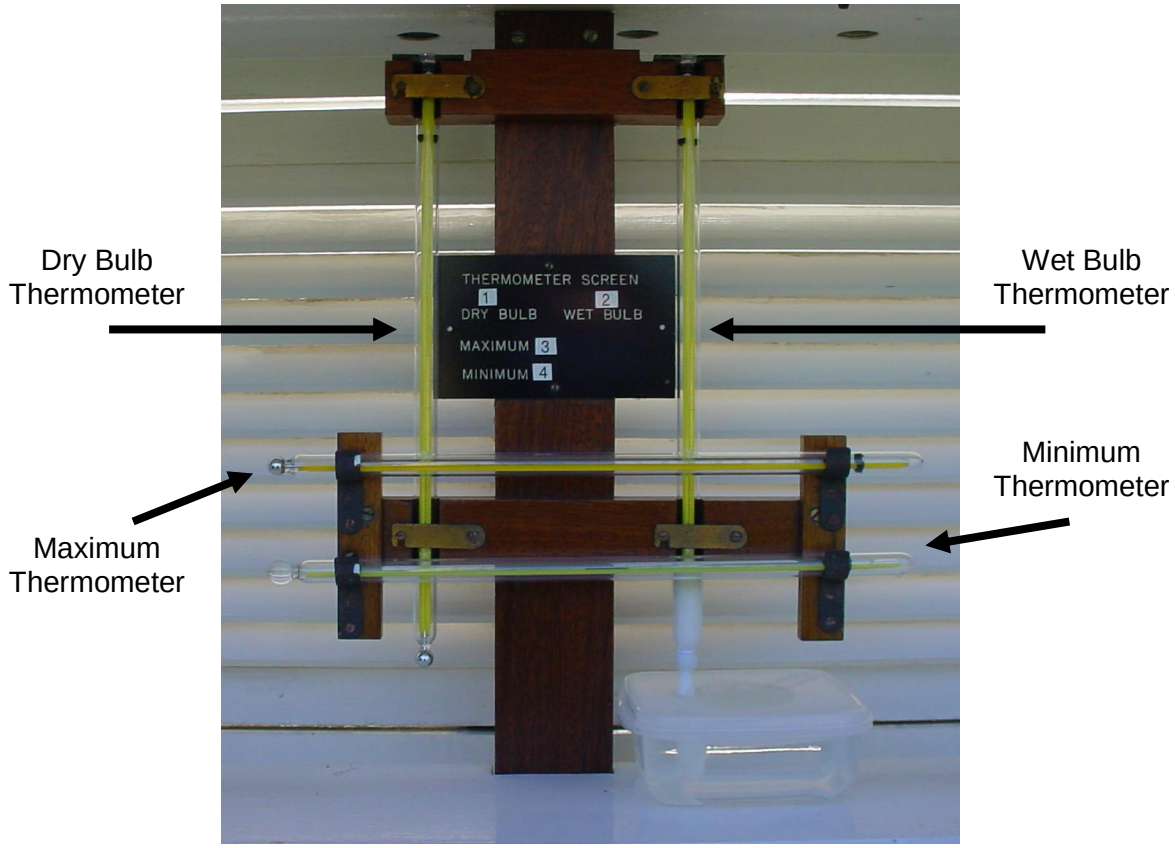
Suggested Activity:
Discuss a shorthand notation for describing the weather using symbols and letters; keep a weather diary for a day/week/month/term using the notation you have devised.

Is there any meteorological truth in weather sayings? E.g. Red sky at night, shepherd's delight. For more sayings click on http://www.metoffice.gov.uk/education/primary/students/sayings.html

6) **Visibility:**
If a weather station has a 360° panorama visibility is recorded. Easily identifiable objects at known distances are used to judge the clearest view for the furthest distance e.g. a church spire at 270° and 10Km from the site.

Suggested Activity:
What objects are visible from your school playground? Using a map and a compass, calculate the distance "as the crow flies" and angle of the object from the school.

7) **<u>Dry Bulb (DB)Thermometer</u>** (mercury in glass), this indicates the temperature at the time of observation.



Photograph by Carol Wynne

Suggested Activity:
Why is the Stevenson Screen painted white? Discuss why is it important to read the dry bulb thermometer as soon as the Stevenson Screen is opened. Which direction does the screen open towards? Why is this direction important?

8) **<u>Wet Bulb Thermometer (WB)</u>** (mercury in glass). Basically this a dry bulb Thermometer but the bulb is covered by a wick which is constantly moist. The continuous evaporation of water from the wick cools the thermometer; hence, on a foggy day the difference between the two readings will be nil or negligible because of the high relative humidity whereas on a sunny day there will be a larger variance indicating a lower relative humidity.

Suggested Activity:

18 October 06		18 October 04	
Dry Bulb	= 12.1°C	Dry Bulb	= 10.0°C
Wet Bulb	= 12.1°C	Wet Bulb	= 8.4°C

Which was the best day for hanging the washing out to dry?

9) **Maximum Thermometer (MX)** (mercury in glass). The maximum thermometer records the highest temperature reached throughout the 24 hour period. This is not attained necessarily during the afternoon.

Suggested Activity:
Using the September 2006 data, calculate the average maximum temperature from 17th to 21st.

10) **Minimum Thermometer (MN)** (alcohol filled). Within the alcohol column is a blue glass index and the lowest temperature is recorded by the position of the right hand end of it, and not where the alcohol column is indicating the current temperature.

Suggested Activity:
Graph the air minimum temperature for each day in September 2006. Circle the lowest temperature recorded.

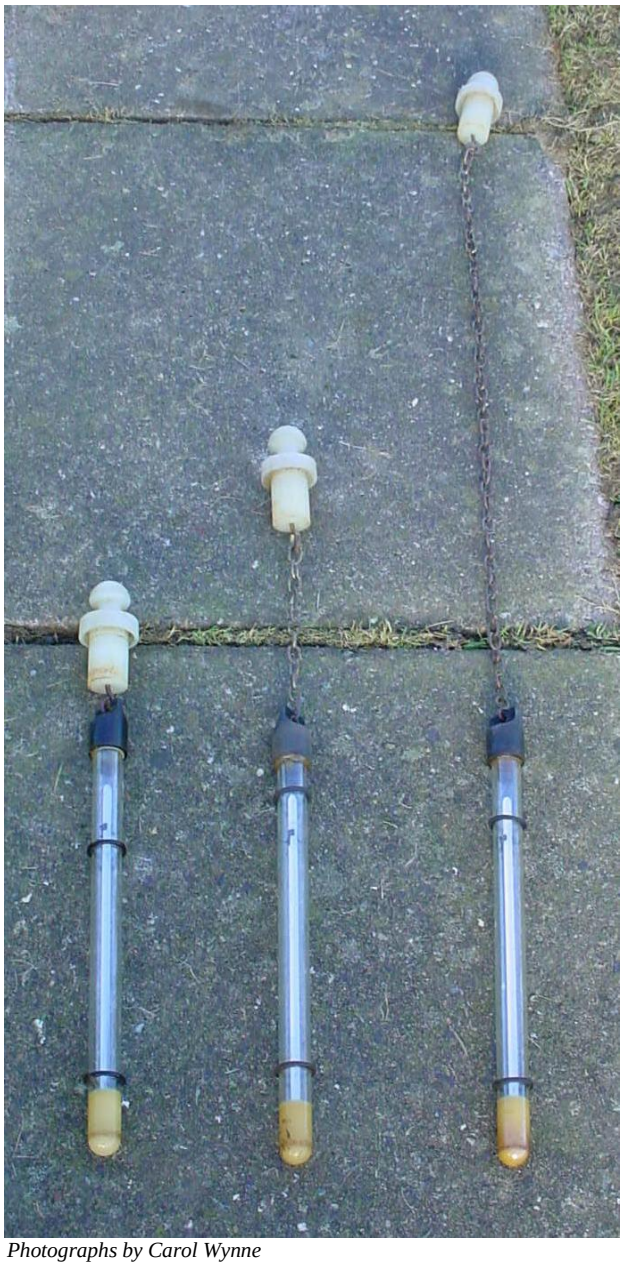
11) **Grass Minimum Thermometer (GM).** This is positioned on the ground with the bulb just above the grass tips.

Photograph by Carol Wynne

Ground frosts are not only experienced in the winter months, but also occasionally in the summer. For example, on the 20th August 1976 at Moulton Park a maximum temperature of 25.8°C was recorded with an overnight grass minimum temperature of -1.6°C.

Suggested Activity:
Plot the grass minimum thermometer temperatures on the same graph as the air minima using a different coloured pencil. Indicate the lowest grass temperature with a box. Do the dates for the two lowest temperatures coincide? Do you think this will be the case each month?

12) Soil Thermometers are used to record the sub soil temperatures. Chains are used to hold the bulbs at set distances below the ground surface at depths of 10, 20 30 50 and 100 centimetres.



Photographs by Carol Wynne

Suggested Activity:

A knowledge of the temperature at different depths is important for gardeners and farmers. Discuss which season is likely to be the best for planting crops. Which other climatic variables are involved in producing a good harvest?

13) **<u>State of the ground (SoG)</u>** The grass has been removed to reveal the soil beneath. A coded entry is used.

Photograph by Carol Wynne

CODE FOR 'STATE OF GROUND' (Column 53)	Coded Entry	CODE FOR 'STATE OF GROUND' (Column 54)
Surface of ground dry (without cracks and no appreciable amount of dust or loose sand)	0	Ground predominantly covered by ice.
Surface of ground moist	1	Compact or wet snow (with or without ice) covering less than one-half of the ground.
Surface of ground wet (standing water in small or large pools on surface)	2	Compact or wet snow (with or without ice) covering at least one-half of the ground, but ground not completely covered.
Ground flooded	3	Even layer of compact or wet snow covering ground completely.
Surface of ground frozen	4	Uneven layer of compact or wet snow covering ground completely.
Glaze on ground	5	Loose dry snow covering less than one-half of the ground.
Loose dry dust or sand not covering ground completely.	6	Loose dry snow covering at least one-half of the ground (but not completely).
Thin cover of loose dry dust or sand covering ground completely.	7	Even layer of loose dry snow covering ground completely.
Moderate or thick cover of loose dry dust or sand covering ground completely	8	Uneven layer of loose dry snow covering ground completely.
Extremely dry with cracks	9	Snow covering ground completely; deep drifts.

Suggested Activity:
Will there be any differences in how clay and sandy soils respond to heavy rain and strong sunshine? How will this reaction show itself? Does soil type influence crop growth?

14) **Precipitation** Rainfall is collected via a funnel and stored in a bottle until the observation time. A measuring cylinder, calibrated to the rain gauge, is used to determine the amount of water which has fallen. When it snows, the depth of snow is recorded and the snow is melted to calculate the 'water equivalent'. Snow can be categorised as either "wet" or "dry"; the difference being that snowballs can be made with wet snow but cannot be made when the snow is dry and powdery.

Photograph by Carol Wynne

Suggested Activity**:**
Rainfall can be very patchy in nature, especially when showery conditions prevail. Is there a school on the opposite side of your town willing to share and compare their rainfall data with you? Look at a physical geography map of the UK. Discuss the rain shadow effect and prevailing wind direction, and then decide which areas are more likely to be the wettest and the driest overall.

15) **Sunshine Recorder (SUN)** The sunshine recorder seen below is a Campbell-Stokes variety. It faces due south and it is tilted at the angle of our latitude. Three different styles of card are used covering the summer, winter and Equinox periods. A fresh card is inserted into the holder behind the solid glass sphere each day, with the sphere acting like a magnifying glass to pinpoint the sunshine into a white dot which burns a trace into the card which is then converted into an amount of time.

Suggested Activity:
What is latitude a measure of? Look in an atlas to find out the latitudes of various cities e.g. London, Sydney, New York and Cape Town. Which city is further North – London or New York? Which city is further South – Cape Town or Sydney?

Photograph by Carol Wynne

Many schools use the internet to find real weather data and potential data includes

http://www.metoffice.com/education/index.html
The primary section has the latest UK observations from synoptic stations and a rolling archive of UK data, historic weather data and is available free of charge for school projects.

http://www.met.rdg.ac.uk/~brugge/col.html
Use this address to access the Climatological Observers Link (COL) site. There is no requirement to run a weather station to be a member. The majority of sites submitting data are UK based but an increasing number of sites from European countries also send contributions to the Bulletin. Each month an issue is published comprising, *inter alia*, data from about 350 stations, a synopsis of the previous months' weather and an article. An annual summary is also produced. The subscription rate for 2007 is £27.00 for hard copies of the Bulletin or £10 for the pdf version.

http://www.met.rdg.ac.uk/~brugge/colsites.html
This site gives a list of participating COL stations.

http://www.royalmetsoc.org
The Royal Meteorological Society provides a seasonal summary sheet 'Weather Front' which is distributed free to members and Libraries. Schools are entitled to belong to the Society as School Corporate Members. For the 2007 calendar year the membership fee is £17.

http://www.metlink.org
The Royal Meteorological Society also run MetLink International - an internet based project where schools submit weather data all year round. However, for a period of 2 to 3 weeks, during the "active phase", professional help is on hand during this time to analyse and interpret the data. You will need to consult the website to find out when the next stage begins.

Weather data may also be collected by other organisations and individuals in the local area of your school for example

- Natural History Society
- Sailing/Flying Schools
- Parks Department of Local Council
- Interested amateurs
- Local Schools

Suggested Activity:
Do an internet search for local weather stations. For Northamptonshire the following station were mentioned:

http://www.bbc.co.uk/northamptonshire/weather/forecast/index.shtml
http://www.northamptonshirewildlife.co.uk/wildlife/nweather.htm
http://www.stanwickweather.org.uk/
http://www.brixworth.demon.co.uk/

Ken Bland, Head of Wider Schools' Workforce Development, University of Northampton Ken.Bland@northampton.ac.uk and Christina Fairless, School of Applied Sciences, Division of Environmental Science.

Acknowledgements

The authors would like to thank Carol Wynne, the School of Education Curriculum Support Technician, at the University of Northampton for her help in taking the photographs for this article.