

TEACHING CLIMATOLOGY AND METEOROLOGY

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Abstract: Climatology and meteorology are often regarded as very difficult to teach by teachers and very hard to learn by students. This paper presents simple practical exercises which will enable teachers to make the topic of greater interest and easier for students to understand some of the basic ideas.

INTRODUCTION

A survey undertaken by Sherwood in 1989 revealed that less than 40% of the teachers who took part taught any aspect of climate or meteorology as part of their Leaving Certificate geography programme. While basic aspects of climate and meteorology are part of the Junior Certificate course, there does not appear to be very great enthusiasm displayed by many teacher (or their students) about the work. Teachers informally reveal that they find the material to be difficult to understand and that they do not have a very strong background of knowledge in this area, possibly reflecting the strong tradition that geography is taken as an Arts subject in Irish universities. They also suggest that their students find the work hard to understand and many suggest that it is boring. A further problem raised by teachers is that equipment particularly for the study of meteorology is expensive and, since it must be left outside, vulnerable to theft and vandalism.

It must be acknowledged that in-depth understanding of many aspects of weather does involve a high degree of scientific competence, but a basic understanding does not require this. Expensive instruments may make the measurement of various aspects of the climate easier, but much can be accomplished with the aid of simple instruments used in straightforward ways.

The short exercises described below allow students to measure aspects of the weather/ climate and develop understanding of some fundamental aspects of meteorology.

MEASURING THE WEATHER BASIC EXERCISE

Aim

- To develop an understanding of basic aspects of the weather

Outcomes

At the end of this exercise students will have learned about:

- measurement of temperature, wind speed and wind direction
- identification of some types of cloud
- assessment of the amount of cloud cover
- the differences between conditions predicted in the national weather forecast and those experienced in reality.

Equipment required

- cheap garden thermometers
- ranging poles [or garden canes]
- compasses
- bubbles
- copies of Beaufort scale
- diagrams/pictures of cloud types
- weather forecast from daily paper barometer, if possible

Method

- Each student should be supplied with a copy of the worksheet [Fig.1].
- Groups of 4-6 students should be given a ranging pole, bubbles, compass and thermometer.
- Guidance in the use of the equipment should be given and students allowed to make measurements outside the school building.
- The worksheet should then be completed on the return inside.

HOW TO MEASURE WEATHER

Wind direction

1. Identify north using the compass. *[I have often found that students are unaware of how easy it is to reverse direction by 180°.]*
2. Blow bubbles and note the direction in which they drift away. *[It is generally necessary to remind students that the wind direction is based on where the wind is coming from rather than where it is going to.]*

Wind speed

1. Students should use the Beaufort scale guidance to identify the wind speed.

2. If possible an anemometer should be used to measure wind speed more accurately. If a commercial one is not available then one can be constructed (see Appendix A).

Temperature

1. Students should hold their thermometers at about 1.5m from the ground for several minutes. *[Holding the thermometer alongside the ranging pole (or garden cane) makes it easier to ensure that it is held steadily and to see that it is being held by the casing not around the glass.]*
2. Temperature can then be noted.

Cloud amount

1. Students should assess the amount of cloud cover by visual inspection. *[While technically cloud amounts are assessed in oktas - it is generally sufficient with less experienced students to limit the assessment to quarter, half, three quarter or full cover.]*

Cloud type

1. Using the pictures provided students decide on the cloud type current. *[This can lead to considerable dispute in some cases - you should be prepared to arbitrate or allow a vote!]*

Precipitation

1. Students should note whether it is raining/drizzling/fine, etc. *[For obvious reasons, it has usually been fine when I have done this exercise!]*

FURTHER DEVELOPMENT

LOCAL WEATHER VARIATIONS

The basic exercise can be developed to explore local variations in climate by taking similar measurements to those in the basic exercise at a number of stations located in different parts of the school grounds.

Outcomes

At the end of this exercise students will have:

- learned about the effects of shelter and aspect on wind speed, wind direction and temperature
- practised basic map location skills

Fig. 1: Basic Weather Exercise Worksheet**Measuring the Local Weather****Date/time:** _____**Name:** _____ **Class:** _____

1. Complete the 'Outside' column in the table using the readings you took outside. *[If no barometer is available, leave atmospheric pressure off the worksheet.]*
2. Use the forecast from the newspaper to complete (as far as you can) the 'Forecast' column. Use the map nearest to the time when you made your measurements.

	Outside	Forecast
Temperature [°C]		
Wind direction		
Wind speed		
Cloud amount		
Cloud type		
Precipitation		
Atmospheric pressure		

3. Which two aspects of the weather show most difference between your measurements and the forecast?
4. Suggest two reasons why the local weather is not exactly the same as the forecast predicted
[The answers might include :
 - *the forecast measurements are made some distance from the school*
 - *the forecast was made the previous day and the weather may not have developed as predicted*
 - *student measurements may be inaccurate, particularly windspeed using Beaufort scale*
 - *time of day is not very clearly specified in newspaper forecasts, e.g morning might be 6.00 or 11.30 a.m.]*

Equipment required

- cheap garden thermometers
- ranging poles [or garden canes]
- compasses
- bubbles
- copies of Beaufort scale

Method

- Students should complete the measurements as in the basic exercise at the first station. *[It would probably be best if all gathered together and agreed the readings - this would enable a check to be made to ensure that all are taking them correctly.]*
- Groups should then move around to each of the other stations, following the map provided, taking the same readings each time and completing the other information in the table on the worksheet [Fig.2]. *[I have found it helpful to set the groups off at different stations, preventing a large group massing at any one station.]*
- The remainder of the worksheet should be completed after the fieldwork.

Fig. 2: Local Variations in Climate Worksheet *[Site map would be on reverse of this sheet]*

Local Variations in Climate **Date/time:** _____
Name: _____ **Class:** _____

1. Take the readings for site A along with all of the class and enter them in the correct places in the first row of the table.

	Close to buildings yes/no	Direction to buildings	Temperature [°C]	Wind Speed	Wind Direction
Site A					
Site B					
Site C					
Site D					
etc.					

2. Move around the circuit in the order given and complete the readings at each of the stations in turn.

WHEN YOU COME INSIDE ANSWER THESE QUESTIONS

- 3. Which station shows the greatest variation in**
 - (a) temperature from Site A?
 - (b) wind speed from Site A?
 - (c) wind direction from Site A?
- 4. Describe the site conditions at each station named in Q3:**
 - (a)
 - (b)
 - (c)
- 5. How do you think your answers to Q3 and to Q4 are related to each other?**
[It is likely to be necessary to guide discussion before this question can be answered - to ensure that the appropriate linkages are actually made, e.g. lower wind speed if the building is up-wind of the station, lower temperature when in the shade of a building, higher temperature when sheltered from a strong wind, etc.]

Rainfall can also be monitored at the various sites, using rain gauges sited at each one and read over a period. As described by Harrison and Bairner (1997) [Appendix B] satisfactory, cheap and easily replaceable rain gauges can be made from 2 litre plastic drink bottles. Questions again would be related to the site where there was the greatest difference from the amounts measured at the first 'standard' station.

b) Micro climate

The basic exercise can also be modified to include aspects of micro climate, for example taking ground and air temperature on a variety of surfaces, e.g. tarmac, long grass, short grass. This can be done as part of the same circuit as the local variations. Students must measure the temperature twice at each station, once with the thermometer held at 1.5 m above the ground and once with it touching the ground surface at the base of the ranging pole. Alternatively, thermometers may be mounted on stands at each site at appropriate heights and read by each group in turn (Appendix C).

Questions similar to those for local variations can be asked based on these results, relating to the greatest differences and the smallest differences.

CONCLUSIONS

While this exercise does not deal with all aspects of meteorology, it does provide students with practical experience which can only serve to make the work both more understandable and more interesting. It will, at least, prevent students from having the same experience as some in a school visited by the author some years ago, where they were shown expensive weather instruments, which were totally unused and still in their original packing because they were too valuable to allow students to use (or even handle) them!

REFERENCES

- Firth, T. (1988) '4.1: Weather studies' in *Geographical Work in Primary and Middle Schools* (ed. D. Mills), Geographical Association, Sheffield.
- Harrison, J. & Bairner, J. (1997) 'Studies in microclimatology', *Teaching Geography* 22 (4): 173-179.
- Sherwood, D. (1989) 'Geography at second level: content and aims', in *Geography in Education in the Republic of Ireland, G.S.I. Special Publication No. 4* (ed. R.W. Alexander & D. A. Gillmor), Geographical Society of Ireland, Dublin.

APPENDIX A:

MAKING AN IMPROVISED CUP ANEMOMETER

[Firth]

This can be achieved by fastening together two slats of wood 45 cm by 2.5 cm so that they are at right angles. Drill a hole through the centre to take a biro pen top and glue firmly. Punch horizontal slits in 4 small light jelly moulds (cardboard egg boxes can be a temporary measure using the small 'cups') and pass slats through with the moulds facing the same way. Paint one 'vane' red. Place the pen top, with slats attached, on a stout vertical wire filed to a point. Try out in the wind and count the number of times the red vane passes in a minute. Compare with estimate using the Beaufort Scale. A conversion graph can be made; i.e. the wind vane's rotation speed with the Beaufort Scale.

APPENDIX B:

THE 'POP-BOTTLE' RAIN GAUGE

[Harrison and Bairner]

An acceptable rain gauge can be made using a 2-litre pop bottle. Wrap a band of masking tape around the bottle approximately 10cm below the open neck. Carefully cut around the upper edge of the tape. Once separated, the top part of the bottle should be inverted to make the funnel part of the gauge. The gauge rests on the ground surface and should be secured using small pegs. The rainfall collected should be measured in ml using a standard 100 ml measuring cylinder and converted in mm of rainfall by dividing by the cross-sectional area of the funnel mouth, usually a factor of between 8.1 and 8.2. If sited 2h (twice the height of the nearby objects) from nearby objects of height which offer shelter, the gauge will perform as well as standard metal gauges.

APPENDIX C:

THERMOMETERS FOR MICRO CLIMATE

[adapted from Firth]

Stands should be borrowed from the science department. Three clamps are required for each stand. The clamps should be attached to the stand at heights of (for example) 20 cm, 40cm and 60 cm. Cardboard tubes should be fixed using these and a thermometer inserted in each one - thus avoiding the possible problems of trying to clamp glass thermometers. A fourth thermometer should be placed in a cardboard tube on the base of the stand. Readings can then be taken at four standard heights at each location.