Datalogging in Primary Science

Datalogging

A number of Dataloggers are suitable for use in Primary schools. For simplicity this article uses the *Philip Harris* CATCH AND KEEP LOGGER as an exemplar. ECOLOG, produced by *Data Harvest,* is a broadly similar design.

Datalogging requires four basic components:

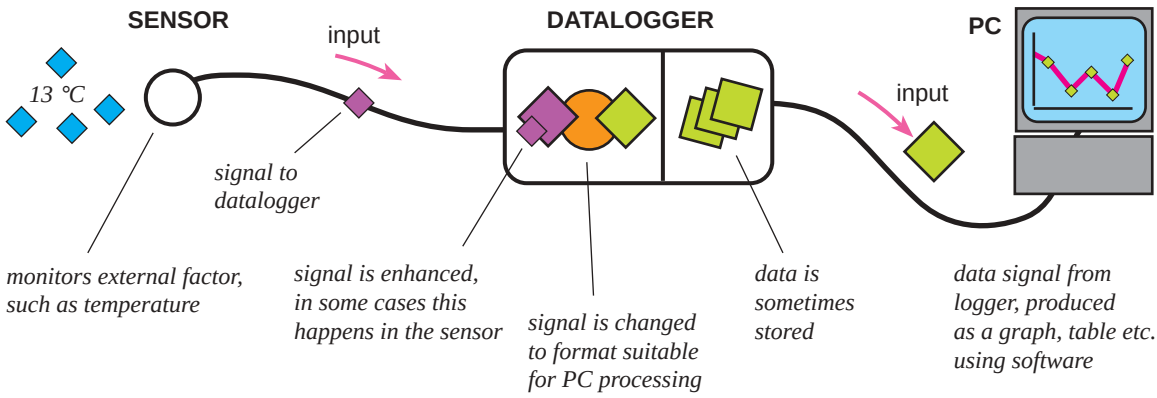
1 **sensors** to detect physical parameters such as light, sound and temperature. Basic sensors are usually built into the datalogger, these can be supplemented with plug-in sensors to make measurements a short distance away from the logger, in say, liquids.

2 **a processor** in the datalogger to transform the signal received from sensors into a format suitable for forwarding to an external device. Most dataloggers also have temporary data storage, or memory, to save sensor values over a period of time.

3 **external device**, such as a PC, Apple Mac, laptop or hand-held organiser (for simplicity this will be referred to as the PC)

4 **software,** loaded on the PC, that:

- controls the working of the logger for a particular investigation
- manipulates, analyses and displays resulting data.



Why datalogging?

Sensors offer significant advantages over more traditional data-capture methods.

A speed – either very fast capture of data, or extended recording without an 'observer' being present

B the ability to store the incoming data for later display and analysis

C accuracy.

The use of datalogging meets some of the ICT requirements within the National Curriculum.

Datalogging in the National Curriculum

QCA Scheme of Work for Science

There are no specific references to datalogging within KS1.

Within KS2 the following units could use datalogging:

Unit 1F Sound and hearing ■
2B Habitat ■
3F Light and shadows ■
4C Keeping warm ■
4D Solids, liquids and how they can be separated ■
4F Circuits and conductors ■
5D Changing state ■
5E Earth, Sun and Moon
5F Changing sounds ■ ■
6F How we see things
6G Changing circuits ■

■ *see* [**usingICT.pdf**] for a linked datalogging Activity

QCA Scheme of Work for IT

Unit 5E Controlling devices
5F Monitoring environmental conditions and change
6C Control and monitoring

QCA Scheme of Work for Design & Technology

Unit 4D Alarms
4E Lighting it up
6C Fairground
6D Controllable vehicles

NOTE: references to datalogging in D&T and ICT are usually part of the control process and referred to as monitoring.

Application of datalogging in Primary Science

In the primary curriculum the important concepts are:

1 logging data will lead to

2 establishing what value the data has and,

3 how might we best use this data to control/examine other situations?

Dataloggers vary. Typical Primary level dataloggers have temperature and light sensors built in, some also have sound. All have the ability to add at least one external sensor.

At Primary level a sound sensor is essential, as is an extra temperature probe for use in liquids (ideally, two external temperature probes, to enable 'fair test' conditions of comparison).

Some dataloggers may also have a *control function,* enabling the datalogger to output signals as well as receive data. These dataloggers meet the National Curriculum ICT and Design and Technology specifications.

Typical primary loggers

CATCH and KEEP datalogger
Philip Harris

EcoLog datalogger
Data Harvest

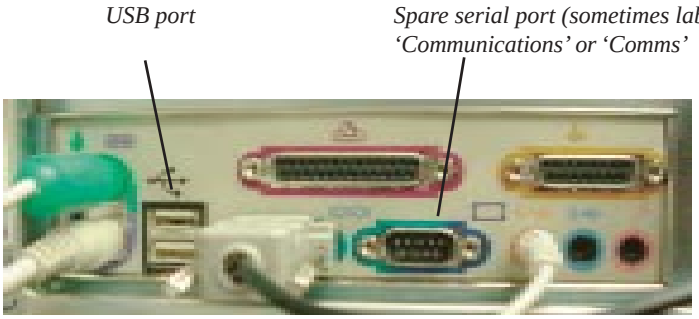
When used remotely, i.e. away from the PC, the datalogger will collect data from the internal and any attached external sensors. Data is then downloaded at some convenient time to the PC by connecting with a cable and suitable software.

The size of the datalogger memory will determine the amount of data that can be stored before downloading.

Depending on the model of datalogger, data is usually downloaded via a cable connected to a serial port (RS232) or USB port located on the back panel of the PC. Some dataloggers connect to a USB PC using a port adapter.

Although technology is constantly evolving the vast majority of in Primary education dataloggers use serial ports. Other interfaces include wireless technology (bluetooth, airport), infrared, or 'smart' card.

A typical port for interfacing with your computer will look like this.



In the case of networked machines, and PCs using USB peripherals (Apple Mac systems, most scanners and digital cameras), talk to your school ICT co-ordinator or datalogger supplier about a suitable interface connection.

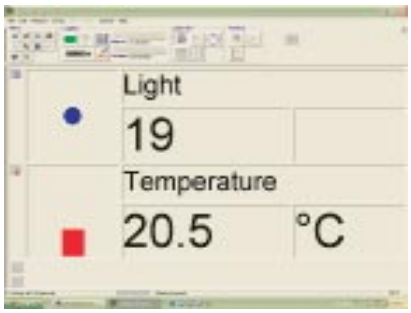
The investigation

For an investigation you will typically need

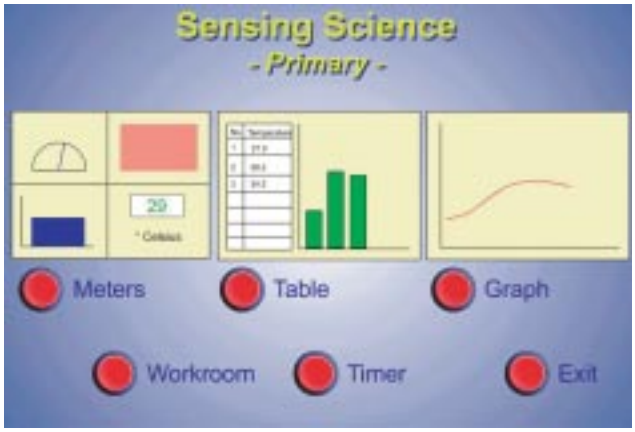
- PC with loaded software with a spare port for downloading data available
- Interface lead between PC and datalogger (usually RS232)
- Datalogger
- Sensors appropriate for investigation.

When launching your datalogger software your PC will either, show the meter reading of the sensor you have attached, or offer a screen asking you what you wish to do. Software will then tend to follow a logical pattern for on-screen set-up.

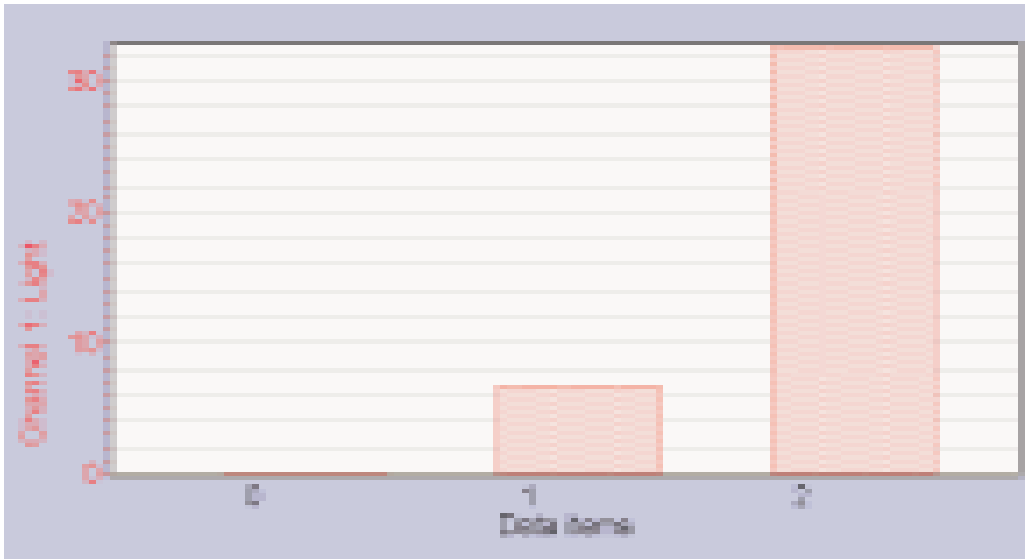
This captured screen shot (Philip Harris software) shows a typical front screen with a light and temperature sensor plugged into the datalogger



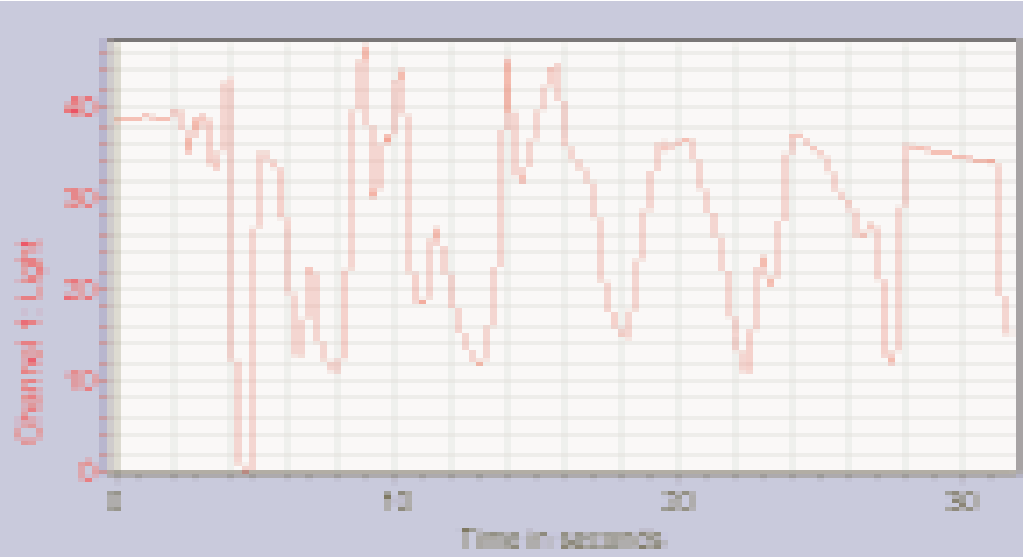
Opening screen shot from Data Harvest's SENSING SCIENCE *Primary*



Software varies between suppliers both in clarity and ease of use. All have the ability to make recordings that are discrete rather than continuous. With the Philip Harris software an application called SNAPSHOT enables a reading to be taken from the datalogger's sensor at a time of your choosing, using START and STOP buttons. After saving data, and PC processing, the resulting on-screen output might look like this:



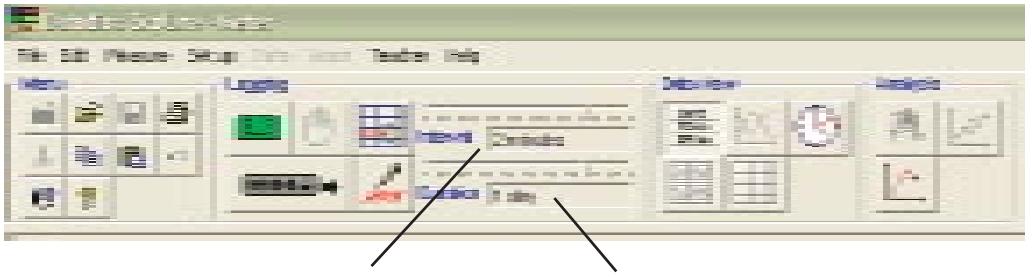
In a different investigation where data is being recorded continuously the plots might have the following format when displayed on screen.



Remote logging

Most primary dataloggers allow continuous recordings of data away from the computer. Some dataloggers can be programmed to record intermittently – as SNAPSHOT described above.

This is a screen shot showing that the investigation will be measuring the temperature every two minutes [A] for a period of a day [B].



interval [A] two minutes *duration [B] one day*

Most primary loggers will store only one data file, which MUST be downloaded before you record again. More sophisticated dataloggers have a facility to record many files before the need to download.

Using ICT Datalogging terms

Sensors are devices that are either built in the datalogger or connected to it. Sensors measure physical parameters such as temperature, light, sound. Sensors plugged into a data logger are called **external sensors** they are sometimes referred to as **probes.** An external sensor could be used for taking readings in small spaces or in situations which might otherwise damage the datalogger, such as sensing the temperature of a liquid.

Nearly all sensors actually measure small changes in voltage or resistance (and do this using an **analogue** format). These changes are amplified either in the sensor or inside the datalogger. Sometimes dataloggers are recording more than one stream of information. Each set of data is referred to as a channel.

PCs use data in **digital** form for display or storage.

Converting the analogue signal from sensors into digital form suitable for a PC processing takes place inside the datalogger. This step is referred to as data reformatting or **conversion**.

The National Curriculum KS2 makes reference to computers using digital data. Pupils may be familiar with the word digital (digital TV, digital radio etc.), but unfamiliar with the term analogue. An explanation of these terms may use comparisons, such as analogue and digital watches. More able pupils may move on to the concept of discrete and continuous data.

Interfacing – making a connection between components – joining a datalogger to a PC is interfacing. Most children will be familiar with interfacing a games console to a TV and games controller.

When a datalogger receives a signal from a sensor, it amplifies the signal, converts it to digital form, and then either:

1 transmits the data directly to the PC, acting as a **relay**, or

2 stores the data, a process called **remote logging**. At some later time the data is passed to the PC (a process called **downloading**).

Instructions controlling these operations are sent to the datalogger using the PC before the start of any investigation.

For remote logging the size of datalogger's memory will determine the amount that can be retained. Memory is usually in the form of a microchip although some dataloggers use 'smart' cards.

A general word of warning about data protection
Data is stored in the datalogger until you transfer or download to your PC. Be aware that if you record again **before** downloading you will overwrite this stored data!

Dataloggers need **power**. In the classroom dataloggers get power supply from a mains transformer plugged in through a socket or **port**, i.e. the datalogger is therefore also **interfacing** with the national grid! Away from the classroom dataloggers run on batteries.

In Primary science, a datalogger is used in two ways. It can record a stream of information such as changes in temperature over time, or using a control function, take readings at set intervals.

Control activities As a development of this a datalogger, with appropriate software, can be used as a controllers mimics industrial processes. Dataloggers used this way will be encountered in National Curriculum Secondary Stage Science and control (D&T) and ICT. All these decision trees are software controlled.

Software licence Software to support the interface with the datalogger is supplied with a user licence. You need to decide if the software is to be installed on only one machine, on a network, or on a mixture of PCs, laptops and hand-held devices. This will determine if you need to buy a single, multi-user or site licence.

There are advantages in the greater flexibility of networks, but network licences are more expensive.