 Using data loggers

Stage 6 Chemistry

**Note *–*** Teachers and students are reminded that, where the planned observations have a potential impact on the welfare of animals, the provisions of the Animal Research Act must be satisfied. Before commencing any activities for Stages 4-6, please refer to the publication, ‘**Animals in Schools; animal welfare guidelines for teachers’**. Please consult the animal welfare liaison officer in your school. Before establishing a pond or aquarium and stocking it with vertebrate animals (such as fish and amphibia), refer to the above publication.

If you refer to the skills modules (8.1 and 9.1) in any of the Stage 6 science syllabuses, 12.2(a) states that, in relation to outcomes P12 and H12, [students must] “gather first-hand information by using appropriate data collection techniques, employing appropriate technologies, including data loggers and sensors”.

In this list of experiences drawn from the stage 6 Chemistry syllabus, suggestions are given where the use of sensors and a data logger are seen as appropriate.

Sensors that are available for monitoring and measurement in chemistry include:

* an angular position sensor coupled to a gas syringe to measure changes in gas volume
* a conductivity probe (sensor) for measuring conductance (this data can then be used to determine the total mass of dissolved solid)
* a carbon dioxide gas sensor for displaying the concentration of carbon dioxide gas
* coupling device to connect a data logger to an electronic balance
* dissolved oxygen sensor
* light sensor and a lamp to be used as a qualitative or model colorimeter (light absorbance is logged and colour filters or coloured light emitting diodes (LEDs) can also be used
* oxygen gas sensor
* pH electrode (sensor)
* pressure sensor
* specific ion sensors (such a s Cl-, PO43-, etc)
* temperature sensors of various ranges and construction
* voltage and current sensors

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8.2 The Chemical Earth

* show the decomposition of a carbonate by heat, using appropriate tests to identify carbon dioxide and the oxide as the products of the reactions (p. 26)
  + **Opportunity –** log the change in volume of the contained gas and the carbon dioxide concentration.

8.3 Metals

* …determine the metal activity series, … and analyse the reactions of metals with water, oxygen, dilute acid (p. 29)
  + **Suggested activity –** logging the volume of gas evolved and temperature changes and relating that data to relative chemical activity.

8.4 Water

* the effect of anti-freeze and salt on the boiling point of water (p. 34)
  + **Suggested activity –** logging temperature change over time to observe eutectic points.
* Test the solubilities in water of a range of substances that include ionic, soluble molecular, insoluble molecular, covalent networks and large molecules (p. 35)
  + **Suggested activity –** logging changes in conductance.
* use micro-techniques to compare the solubility of appropriate salts in solution through precipitation reactions (p. 36)
  + **Suggested activities** – i) using a model colorimeter; ii) logging conductance and temperature change.
* measure the change in temperature when substances dissolve in water and calculate the molar heat of solution (p. 37)
  + **Suggested activity –** logging temperature change when substances such as ammonium chloride and sodium hydroxide dissolve in water

8.5 Energy

* use the process of fractional distillation to separate the components of a mixture such as ethanol and water (p. 40)
  + **Suggested activity –** log temperature changes in different parts of the apparatus.
* measure the change in mass when a mixture such as wood is burned in an open container (p. 41)
  + **Suggested activity –** logging mass change (before and after burning).
* Observe and describe examples of endothermic and exothermic chemical reactions (p. 41)
  + **Suggested activity –** logging temperature change
* observe the impact on reaction rates of:

1. changing temperature
2. changing concentration
3. adding catalysts (p. 42)
   * **Suggested activity –** logging volumes and/or pressure of gas produced.

9.2 Production of Materials

* compare the reactivities of appropriate alkenes with the corresponding alkanes in bromine water (p. 47)
  + **Suggested activity –** using a model colorimeter.
* carry out the fermentation of glucose (p. 49)
  + **Suggested activity –** logging temperature, gas volume or pressure and carbon dioxide produced.
* determine and compare heats of combustion of at least three liquid alkanols per gram and per mole (p. 49)
  + **Suggested activity –** logging change in temperature using a calibrated calorimeter
* identify the conditions under which a galvanic cell is produced (p. 50)
  + **Suggested activity –** logging conductance of the electrolyte and voltage produced.
* measure the difference in potential of different combinations of metals in an electrolyte solution (p. 50)
  + **Suggested activity –** logging voltage produced.

9.3 The Acidic Environment

* decarbonise soft drink and gather data to measure the mass changes involved and calculate the volume of gas released at 25°C and 100 kPa (p. 54)
  + **Suggested activity –** logging volume or pressure of gas produced.
* use pH meters/probes and indicators to distinguish between acidic, basic and neutral chemicals (p. 54)
  + Suggested activity – logging pH.
* measure the pH of identical concentrations of strong and weak acids (p. 54)
  + Suggested activity – logging pH.
* identify examples of naturally occurring acids and bases, their chemical composition (p 54)
  + Suggested activity – logging pH.
* identify the pH of a range of salt solutions (p. 55)
  + Suggested activity – logging pH.
* determine the concentration of a domestic acidic substance using computer-based technologies (p. 55)
  + **Suggested activity –** logging pH of substances such as vinegar or orange juice.

9.4 Chemical Monitoring and Management

* use qualitative and quantitative tests to analyse and compare the quality of water samples (p. 61)
  + **Suggested activity –** logging pH, conductance (dissolved solids), dissolved oxygen.
* gather, process and present information on the range and chemistry of the tests used to:

1. identify heavy metal pollution of water
2. monitor possible eutrophication of waterways (p. 61)
   * **Suggested activities –** i) logging conductance to determine concentration of dissolved solids; ii) logging dissolved oxygen, pH, temperature.
   * **Extension –** test for solids in water samples from the local environment by logging conductance

9.5 Option – Industrial Chemistry

* gather information and qualitatively analyse an equilibrium reaction’ (p. 62)
  + **Suggested activity –** using a model colorimeter, and logging conductance and temperature change.
* observe the reactions of sulfuric acid acting as:

1. an oxidising agent
2. a dehydrating agent (p. 63)
   * **Suggested activity –** using a model colorimeter.

9.6 Option – Shipwrecks, Corrosion and Conservation

* compare the rate of corrosion of iron and an identified form of steel (p. 66)
  + **Suggested activity –** logging temperature change and surface reflectance.
* analyse and explain the conditions under which rusting occurs (p. 66)
  + **Suggested activity –** logging humidity, temperature and gas volume per time units (day, hour etc.).
* compare and describe the rate of corrosion of materials in different:

1. oxygen concentrations
2. temperatures
3. salt concentrations (p. 68)
   * **Suggested activity –** logging rate of gas production, conductance, temperature changes

* perform a first-hand investigation to compare and describe the rate of corrosion of metals in different acidic and neutral solutions (p. 68)
  + **Suggested activity –** logging change in conductance, pH and temperature.

9.7 Option – The Biochemistry of Movement

* observe the effect of changes in pH and temperature on the reaction of a named enzyme reaction (p. 72)
  + **Suggested activity –** logging pH and temperature.

9.8 Option – The Chemistry of Art

* observe the colour changes of a named transition element as it changes in oxidation state (p. 80)
  + **Suggested activity –** using a model colorimeter, and logging conductance and temperature change.
* demonstrate and gather first-hand information about the oxidising strength of KMnO4 *(p. 80)*
  + **Suggested activity –** using a model colorimeter, and logging conductance and temperature change.