# Ideas for using sensors and data loggers in science lessons

## Introduction

This document provides some suggestions for ways you can include sensors or data loggers into demonstrations or practical investigations you may already be conducting in class.

Table 1 – incorporating sensors and data loggers into Stage 4 and 5 sciences

|  |  |  |
| --- | --- | --- |
| Practical | Common method | How data loggers could be incorporated |
| Modelling the greenhouse effect | Measuring temperature change in an open and closed environment. For example, using cling film to model the greenhouse effect. | Sample of air with different amounts of CO2. Stopper with temperature probe. Place in front of a heat lamp and measure the temperature change over time.  [Greenhouse effect model](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/stem/stem-2023-greenhouse-effect-model.docx) |
| Observing photosynthesis | Geranium leaves – removing the pigment and then testing for starch using iodine. | Use carbon dioxide gas sensor to show that CO2 is used in photosynthesis. Use an oxygen gas sensor to show that oxygen is produced during photosynthesis. This can be expanded to test factors that affect photosynthesis.  [Investigating photosynthesis](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/stem/stem-2023-investigating-photosynthesis.docx) |
| Observing changes of state | Heating a beaker of ice until boiling while taking measurements every minute with a thermometer. | Use a temperature sensor with data logging software or hardware to graph temperature change over time. There will be clear distinctions of the changes of state in the graph. The sample data logger output below shows the change in temperature over time.  Figure 1 – graph of changing temperature over time  Graph showing changing temperature over time |
| Demonstrating that gases have mass and different densities | Weighing a balloon before and after blowing it up. | Mix a small amount of vinegar and bicarbonate of soda in a 500 ml beaker. Place a carbon dioxide gas sensor in another beaker and then pour the gas into the beaker. The CO2 levels will shoot up! |
| Evidence of a chemical reaction taking place (producing CO2) | Flame being extinguished. Or bubble through lime water. | Mix a small amount of vinegar and bicarbonate soda in a 500 ml beaker. Place a carbon dioxide gas sensor in another beaker and then pour the gas into the beaker. It can be ‘poured’ because CO2 is heavier than most of the gases in the air. The CO2 levels will shoot up! |
| Effectiveness of different insulating materials (energy transfer) | Manually measuring temperature change in cans wrapped in different materials. | Collect the data for all treatments concurrently with multiple temperature probes. |

Table 2 – incorporating sensors and data loggers into Biology

|  |  |  |
| --- | --- | --- |
| Practical | Common method | How data loggers could be incorporated |
| Enzyme activity with catalase | Measuring bubble height | Use an oxygen gas sensor to measure the change in oxygen concentration over time.  Or  Use a pressure sensor to measure the increase in pressure. |
| Enzyme activity with amylase and starch | Observe qualitatively the change in colour when the starch and iodine solution is broken down. | Use a colourimeter to measure the amount of light transmitted through the substrate solution. |
| Investigating factors which affect transpiration | Potometer with a calibrated pipette. | Create a potometer with a gas pressure sensor attached. The change in pressure will be relative to the transpiration occurring in the plant. |

Table 3 – incorporating sensors and data loggers into Chemistry

|  |  |  |
| --- | --- | --- |
| Practical | Common method | How data loggers could be incorporated |
| Boyles Law | Balloon in a bell jar. | Use a pressure sensor with a syringe to demonstrate the pressure change with change in volume. |
| Titration | Burette with chemical indicator. | pH sensor and drop counter to measure progression of titration and plot the titration curve. |
| Buffers | Use an appropriate indicator to observe the changes in pH. | Use a pH sensor to monitor the change in pH of a buffer solution when small amounts of acid or base are added to it. |

Table 4 – incorporating sensors and data loggers into Physics

|  |  |  |
| --- | --- | --- |
| Practical | Common method | How data loggers could be incorporated |
| Speed and acceleration | Using a stopwatch and rule or trundle wheel. | Use a smart cart or accelerometer to measure the displacement, speed, time and acceleration. |
| Projectile motion | Stomp rocket experiment. | Measure the time of flight with a time-of-flight pad. Use a projectile launcher and light gates to detect launch speed. |
| Ohm’s Law | Analog meters. | Use current and voltage sensors to graph changes in current and output. |

Table 5 – incorporating sensors and data loggers into Earth and Environmental Science

|  |  |  |
| --- | --- | --- |
| Practical | Common method | How data loggers could be incorporated |
| Greenhouse effect model | Measuring temperature change in an open and closed environment. For example, using cling film to model the greenhouse effect. | Sample of air with different amounts of CO2. Stopper with temperature probe. Place in front of a heat lamp and measure the temperature change over time.  [Greenhouse effect model](https://education.nsw.gov.au/content/dam/main-education/en/home/schooling/curriculum/stem/stem-2023-greenhouse-effect-model.docx) |

Table 6 – incorporating sensors and data loggers into Investigating Science

|  |  |  |
| --- | --- | --- |
| Practical | Common method | How data loggers could be incorporated |
| Mod 1 – Carry out a practical activity to qualitatively and quantitatively describe an object falling due to gravity | Using a stopwatch to time how long it takes an object to fall different distances. OR Slow-motion camera or photo burst/multi shot to deduce the time from the distance travelled at intervals. | Set up a light gate and drop an object from different heights.  Figure 2 – measuring a falling object  Card  A ring stand with a clamp holding a ruler and three arrows pointing to different heights  Light gate  Ruler |
| Mod 6 – Effect of speed on distance travelled | Timing how long a car takes to cover a certain distance. | Use light gates to measure the speed of an object over a certain distance. |
| Mod 6 – Effect of pressure on volume of gas | Balloon in a bell jar. | Use a syringe with a pressure sensor. |

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