

Improving our Classroom Environment CO2 v5 July 2025

Internet of Things: CfE Science 2nd Level

Lesson Activities



THE UNIVERSITY
of EDINBURGH

Improving our Classroom Environment



**Data-Driven
Innovation**



**CITY
REGION
DEAL**
Edinburgh
& South East
Scotland



Activity 1 Investigating Environmental Factors

Learning intention

- We are learning how environmental factors, such as CO₂ can affect children's learning.

Success criteria

- We can find evidence that shows how environmental factors affect learning
- We can share and present our findings
- We can work well in groups

1.1 The class (working in groups) carries out Internet research to find out how environmental factors such as CO₂ can affect learning.

Links may be suggested to support this activity for example in relation CO₂ We are still looking for some level 2 learner resources for this activity. In the meantime...

<https://letstalkscience.ca/educational-resources/stem-in-context/there-too-much-carbon-dioxide-in-your-classroom>

<http://learnometer.net/variables.html>

<https://energyair.com/classroom-temperature-affect-learning/>

<https://heppell.net/byop/>

<https://thinkprogress.org/exclusive-elevated-co2-levels-directly-affect-human-cognition-new-harvard-study-shows-2748e7378941/>

1.2 Learners share and present their findings.

Activity 2 Introduction to sensors and environmental data

Learning intention

- We are learning how sensors can record environmental data.

Success criteria

- I can describe types of environmental data recorded by a sensor.
- I can say why data about the environment is helpful.
- I can analyse environmental data about a classroom.

2.1 Recap on Activity 1 – looking at how environmental conditions like CO₂ can affect learning.

2.2 Learners are introduced to the use of sensors to monitor indoor environments such as school classrooms, offices and homes.

2.3 Learners consider the purpose of monitoring environmental conditions such as CO₂ levels in workplaces and homes. Possible considerations include health and wellbeing, safety, productivity, comfort and being eco-friendly.

2.4 Learners are presented with the data from the classroom at Cladach Primary School which measures the CO₂ throughout the school day.

2.5 In groups, learners discuss and analyse the data from Cladach Primary. They should be encouraged to identify trends and changes during the day, eg CO₂ levels rising steadily throughout the morning, and with a similar pattern in the afternoon. They should discuss the data and develop hypotheses to explain why such changes occurred. For example:

- CO₂ levels increase from 9 am due to pupils and teachers breathing and speaking. This falls over lunchtime when pupils are outside but increases steadily again during the afternoon until 2 pm.
- CO₂ levels fall significantly between 2 pm and 3 pm. This suggests that the teacher has opened the windows to let fresh air into the classroom. Alternatively it may be that the class is elsewhere, for example, doing PE in the school gym.
- CO₂ levels increase from 9 am due to pupils and teachers breathing and speaking. This falls over lunchtime when pupils are outside but increases steadily again during the afternoon, following a similar pattern.

Activity 3 Investigating Our Learning Environment

Learning intention

- We are learning how to plan and carry out an investigation into our classroom environment using the PPDAC model.

Success criteria

- I can identify the problem to be investigated.
- I can plan an investigation.
- I can describe how our sensor will provide us with data.
- I can work well in groups

3.1 The main purpose of the investigation is for learners to determine how environmental conditions in their classroom affect their learning.

Learners will undertake an investigation to determine the impact of environmental factors on their learning.

The class should use the PPDAC model:

- Identify the problem
- Plan how to carry out research
- Identify/gather data required to help solve the problem
- Analyse the data
- Draw conclusions



3.2 The process may be presented to the class in this way.

Problem: We want to know if CO₂ could be affecting our learning.

Plan: We will plan how we will gather the data on CO₂.

Data: We will gather data about CO₂ in our classroom.

Analysis: We will analyse the data to understand if CO₂ could be affecting our learning.

Conclusion: We will draw conclusions from our investigation.

3.3 Learners discuss the problem of CO₂ in the classroom, prompted by the teacher.

3.4 How might we check and see if it could be affecting our learning? Learners know that Cladach Primary used a sensor to gather this data (Activity 2) so they should use their sensor to generate similar data about their own classroom.

Learners find out about the indoor environment sensors which are in their classroom to support their research.

They learn how the sensor operates; how it captures data and sends it to the University's cloud-based computers. They learn how they will access data about their classroom through their dashboard.

3.5 Learners discuss where the sensor should be located within the classroom. Consideration is given to where in the room data gathering will be optimised. Teachers should be aware that the sensor measures the CO₂ and other entities in the immediate vicinity. For example, placing the sensor on the teacher's desk or on pupil desks will likely measure increased levels of CO₂. This should not be confused with the ambient levels of CO₂.

At the outset, learners need to establish what the normal pattern of CO₂ is for their classroom and how it varies throughout the day and week.

3.6 The data from the sensor is collected over a period of time determined in the group discussion.

Activity 4 Analysing the Data

Learning intention

- We are learning how to analyse sensor data about our classroom.

Success criteria

- I can identify changes to classroom CO₂ data.
- I can suggest possible reasons for changes data during the school day.

4.1 For 3+ weeks, learners analyse the data from the sensor dashboard and discuss changes to CO₂ levels.

4.2 Learners explore how environmental metrics change during the course of the school day and week.

- At what times of day are CO₂ levels highest/lowest?
- What might be the cause of these changes?

4.3 At the end of the data collection period, the class could be split into groups, each group present their findings to the class.

- In groups, discuss what we've learned from our analysis of data.
- Agree possible explanations for changes to sensor data during the day and week.
- Describe how changes to our classroom environment might affect learning.

Activity 5 Improving Our Learning Environment

Every classroom in every school will have heightened CO₂ levels at some point during the day and week. Based on the learners' findings from the analysis in Activity 4, learners look for ways of improving their classroom environment through reducing the amount of CO₂ overall, or look at mitigating measures at the pinch points identified in the data.

One way that has had proven success in schools throughout the world, is the introduction of plants into the classroom (See Activity 6). Other simpler interventions for pinch points, including opening windows and doors should also be considered.

Learning intention

- We can draw conclusions from our learning environment investigation.
- We are looking to improve our learning environment
- We will create a presentation about our investigation and share it with the class.

Success criteria

- I can describe the problem to be investigated.
- I can describe how we planned the investigation.
- I can describe the role of data in our investigation.
- I can describe how we analysed the data.
- I can describe the main conclusions of our investigation.
- I can suggest ways of improving our classroom environment.

5.1 Learners reflect on what they have learned about the impact of CO₂ on their learning.

5.2 In groups or as a whole class, learners discuss what they would need to do to improve their learning environment.

- Opening windows and/or doors to reduce CO₂.
- Introducing plants to the classroom. (Note: there is a separate extension activity which focuses on the impact of plants on classroom environment).

5.3 Learners create a presentation about their investigation and share it with the class. Each group may present the entirety of the investigation or, alternatively, each group presents only one of the PPDAC stages. The Data Education in Schools team will link you with other classes doing the same investigation so that you can collaborate online and perhaps present findings to each other.

Activity 6 and further extension work

The sensors that you have deployed in school are available for use long term. Should time permit with the class, it would be useful to implement the interventions and see what effect these have on the CO₂ levels.

Learning intention

- We can implement suitable interventions to improve air quality in the classroom.
- We see the changes in CO₂ data from the sensors
- We can suggest further interventions to improve air quality

Success criteria

- I can summarise the interventions I have put in place and the effects that would expect to see
- I can draw conclusions from the analysis of the sensor data once the interventions are in place
- I can suggest further ways of improving our classroom environment.

6.1 Over the following weeks, learners analyse sensor data regularly to see if their interventions have been successful in achieving optimal levels.

6.2 Learners summarise their findings and draw conclusions.

Introducing Plants into the Classroom

Schools that have introduced plants into their classroom have noticed a difference in the air quality, depending on the number and type of plants.

The introduction of plants is likely to be the most active way for children to improve their learning environment. There is evidence that even a small number of plants reduces the level of CO₂ in a learning space/classroom. Stephen Heppell's website (BYOP – bring your own plant) is a good source of information and ideas about improving air quality.

Extract from: <https://heppell.net/byop/>

Getting the CO₂ down and the learning up!

Higher than normal CO₂ levels will directly impact badly on human cognition. As more and more research comes in, we realise that the level for damage to occur is lower than was first thought. Many, many children's school performances are

currently damaged. As we seek to make learning better, a simple target for improvement and for significant marginal gain is getting the CO₂ levels down.

There is much interest in plants and air quality - countless studies confirm that the right plants can have an active role in reducing CO₂ and increasing oxygen particularly in any closed space (although plants also respire and are counter effective as oxygen producers at night in the dark).

We have been encouraging schools to harness the power of plants through Bring Your Own Plant projects, which really do make things better during the school day. Better oxygen brings behaviour, engagement, wellbeing and other gains.

Ideally, the plant needs to be in a white pot - normally the school provides these for uniformity and to make sure they fit the plant pot holders. Photosynthesis uses light absorption, white pots reflect light a little more to help balance this. The data gains for white pots vs dark pots might seem very small but the impact in terms of meta cognition is significant: children think about 'Why white?' A white background behind the plants helps too.

Measuring the CO₂ at 3 points during the day, before and after the plants were added will give surprising results. It provides a good data visualisation and graphing task too. Target CO₂ is to keep below 1,000 parts per million (ppm) throughout the day, and you will all notice when levels are worse (above) than that.

Plants and humidity

The Covid pandemic has brought a number of problems to schools and working spaces. CO₂ spikes can be a useful indicator that you are not ventilating the space well enough to minimise aerosol plumes in confined spaces. But lately the role of humidity has become increasingly clear in research: put simply, moist air (above 40% humidity) helps the body to battle infections and of course with windows necessarily open to ventilate, with dry winter air, and / or with air conditioning too, air can become very dry. Water troughs or even wet towels on radiators can boost humidity, but actually Plant Walls or just lots of plants (1 per learner) with moist soil really do help get the humidity up. Even more reasons for BYOP!

Activities

- Learners can research which plants are best for reducing CO₂ (spider plants are particularly effective). The NASA Mars Mission has already done some research and produced a top-list of plants.
- Each learner can bring their own plant to school with their name written on the pot and they are tasked with looking after it and monitoring moisture levels.
- Plants could be introduced gradually, so that learners can monitor and analyse the incremental changes to CO₂ levels.
- Plant walls are available to purchase – learners may discuss ways of raising funds to enable purchase of plants or a plant wall.
- Learners may decide to grow their own plants.
- Contact can be made with other schools doing similar research to find out the results of their investigations and compare with their own. The Data Education in Schools team at the University of Edinburgh will supply details of participating schools.

- Some schools may look at venturing into hydroponics or BBC Microbit controlled watering systems. The Data Education in Schools team can point you in the right direction.

Other Extension Activities

Various activities may be undertaken to extend the lesson or create additional lessons to increase breadth/depth and promote interdisciplinary learning.

Learners discuss why data about environmental conditions in other indoor settings such as offices, factories and in homes might be important.

Learners develop deeper knowledge of data by reviewing all the data produced during their research; analysing, comparing, and summarising the data.

Learners use online visualisation websites like <https://app.flourish.studio> to produce graphical representations of the data.

Contact is made with other schools doing similar research to find out the results of their investigations and compare with their own.

Write a blog or newspaper article about their research for a local newspaper or school magazine.