

Measuring Carbon Dioxide in the Classroom

Students from any grade level can do this activity. The complexity of the experiments and ideas, which may arise from this activity, is dependent on the age of the students. In this document the activities of a 5th grade class will be described.

Aims

- To measure carbon dioxide concentrations in the classroom over a period of time (in this case, for a week)
- To measure carbon dioxide concentrations in the classroom over a period of time with the addition of experiments (in this case, for two weeks).

Preparation for the activity

Introduce the pupils to the subject of the carbon cycle by having them measure the carbon dioxide concentrations in different parts of the school with the hand-held CO₂ sensor (for example, in the schoolyard, in the parking lot, inside a small closed room with different number of persons inside, on the school roof and other places). After they have been acquainted with the use of the sensor, responsibilities can be assigned to different pupils:

- Photographers – 2 pupils who will take pictures of all the steps of the activity
- Set-up team – 2 pupils who will set-up the sensor in the classroom
- Monitors – 2 pupils who will record everything that happens inside the classroom:
 - when did the first person enter the classroom in the morning
 - how many people are there in the classroom
 - when were the doors and/or windows opened and how long
 - when did the class leave/enter the classroom
 - when did the last person leave the room
 - the weather conditions outside (sunny, cloudy, rainy, snowing, etc.)
- Recorders – 3 pupils who will download the data from the sensor into the computer and produce the graphs for the class
- Analysers – the whole class to analyse the results
- Reporters – 2 pupils who will summarise the whole activity and prepare a presentation if desired

The duration of this activity depends on the number of experiments the pupils would like to try and what questions they would like to have answered. One week should be allotted for baseline measurements. During this time no experiments will be performed. This is also the time to have the pupils get used to the novelty of having a sensor in the classroom. They will be curious at first, but after a couple of days this curiosity will have died down. The normal CO₂ fluctuations during normal class activities will be monitored.

Standard materials

- Handheld CO₂ sensor with data logger (example: TSI IAQ-Calc 7535)
- Stand and clamp
- Computer
- Extension cables
- Adhesive tape
- Digital Camera

Installing the CO₂ sensor

1. Place the CO₂ sensor at the back of the classroom in an elevated place in order not to distract the pupils during normal class hours.
2. Fasten the CO₂ sensor onto the stand with the clamp and, if necessary, secure this with adhesive tape. Be sure that there is free air circulation around the CO₂ sensor. (Fig. 1)



Fig. 1 Set-up. The CO₂ sensor is mounted on a stand and held with a clamp. It is placed in the back of the room on top of a shelf so the pupils will not be distracted. Free air circulation around the sensor should be ensured.

3. If a thermometer and a hygrometer are available, measurement of the room temperature and humidity can also be included.
4. If you use extension cables, make sure that these are placed so no one will trip on them.
5. The set-up team should check regularly if the CO₂ sensor is recording and storing data correctly.

Examples of experiments

1. Baseline studies

Record the daily fluctuations of CO₂ inside the classroom (Fig. 2). Correlate the concentrations with the length of time the students stayed inside the classroom or when the windows or doors were opened. Some fun activities can also be planned once a baseline has already been established. Examples are: Take note of the number of people inside the classroom and if the students were just listening to the teacher or writing a test. Try also asking the students to hyperventilate or jog in place and see how this affects the CO₂ levels inside the room.

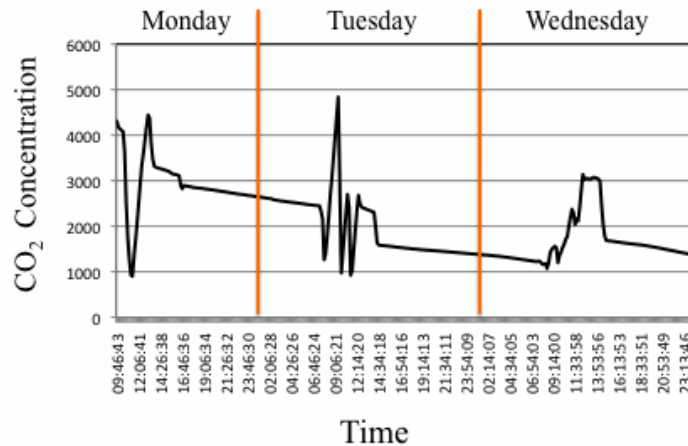


Fig.2 Baseline. Regular fluctuations of the CO₂ concentration in the classroom under “normal conditions”. As soon as a student enters the room in the morning, the CO₂ concentration starts to rise with the fluctuations due to changing of rooms for the different subjects. In the afternoon, when classes are over, the CO₂ starts to decline.

2. How do plants affect the CO₂ concentrations inside the classroom?

Request the pupils to each bring a potted plant to school. Place the plants on the windowsill and measure the changes in the CO₂ concentrations. They can do this for one week and then compare the CO₂ levels with the baseline measurements. (Fig. 3) (see also Fig.4 c)

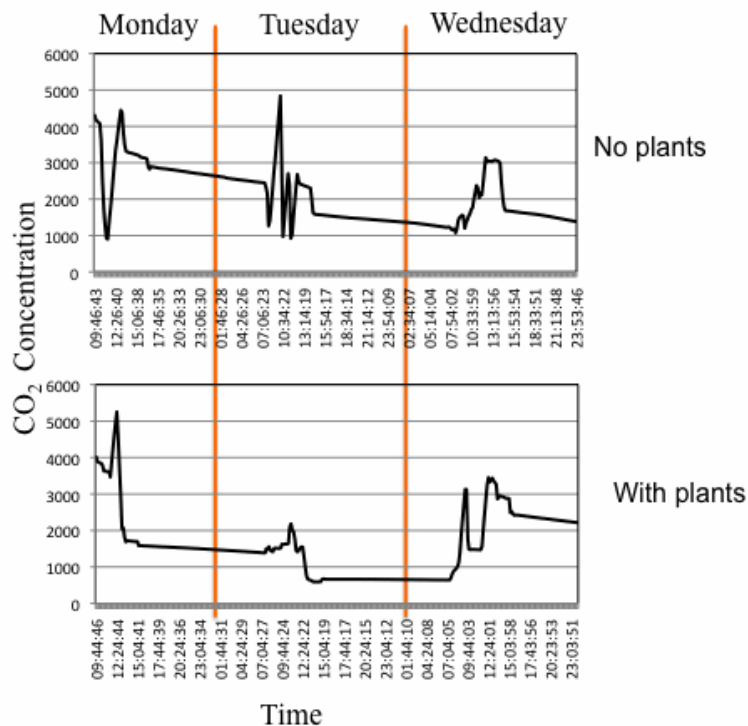


Fig. 3 Effect of plants. With plants in the room the CO₂ concentrations are lower especially during the night.

3. How do we simulate burning fossil fuels in the classroom?

Let the pupils light candles during class for 15 minutes (Fig. 4b). This should be done with supervision since children are fond of playing with fire. They can combine this with the first experiment. They can light candles with plants and without plants in the classroom. (Fig. 4 and 5)

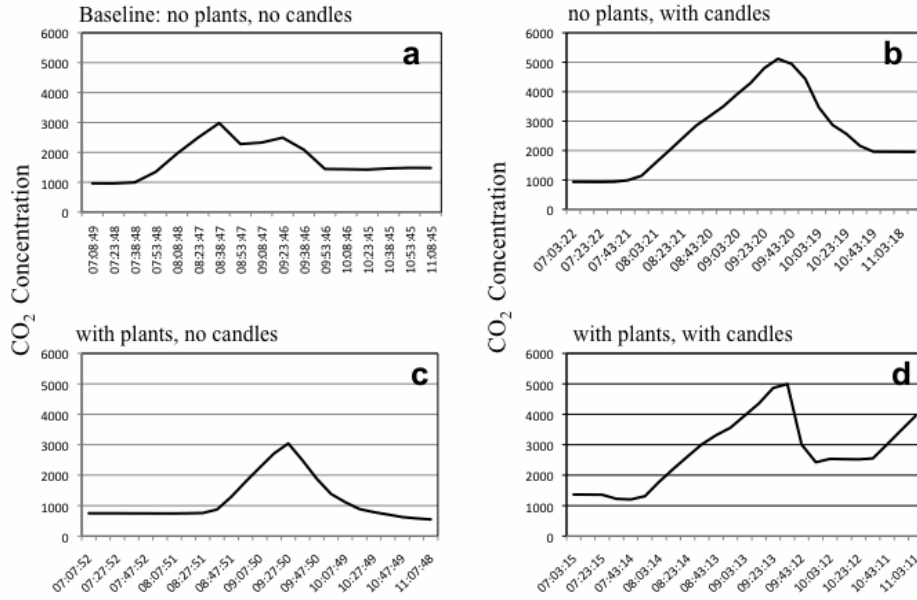


Fig. 4 Results of experiments. The CO₂ concentration profile inside the classroom on the same day of the week to ensure the same schedules: (a) Baseline- no plants and no candles (up to 3000 ppm CO₂), (b) no plants with candles- increase of CO₂ up to 5000 ppm, (c) with plants, no candles- CO₂ increases up to 3000 ppm but decreases to less than 1000 ppm after class hours, which is lower than that at baseline, (d) with plants, with candles- also an increase up to 5000 ppm but decreases faster after the candles are blown out

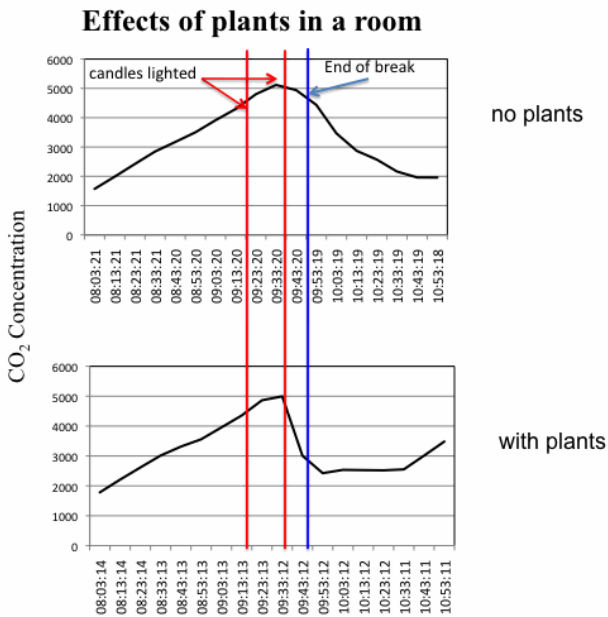


Fig. 5 Effect of plants. When candles are lit the CO₂ concentration rises up to 5000 ppm with or without plants. After the candles are blown out, the CO₂ level decreases quickly if plants are present in the room. The blue line shows the duration of the break, when the students went out of the room.

4. How do increased CO₂ concentrations affect the ocean?

Set up an aquarium at the back of the classroom. Fill the aquarium with distilled water (or seawater). Aerate the aquarium with a pump to ensure that the water is aerated with the surrounding air. Place the probe of a pH-Meter in the water for continuous measurements (Fig. 6). Correlate the pH values of the water with the CO₂ concentrations in the air (Fig. 7).

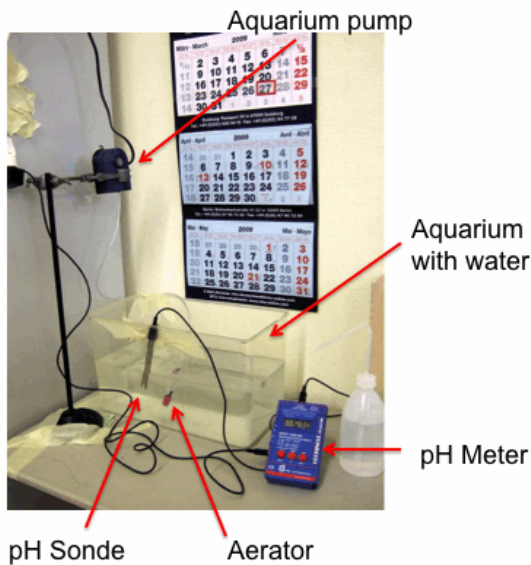


Fig. 6. Set-up

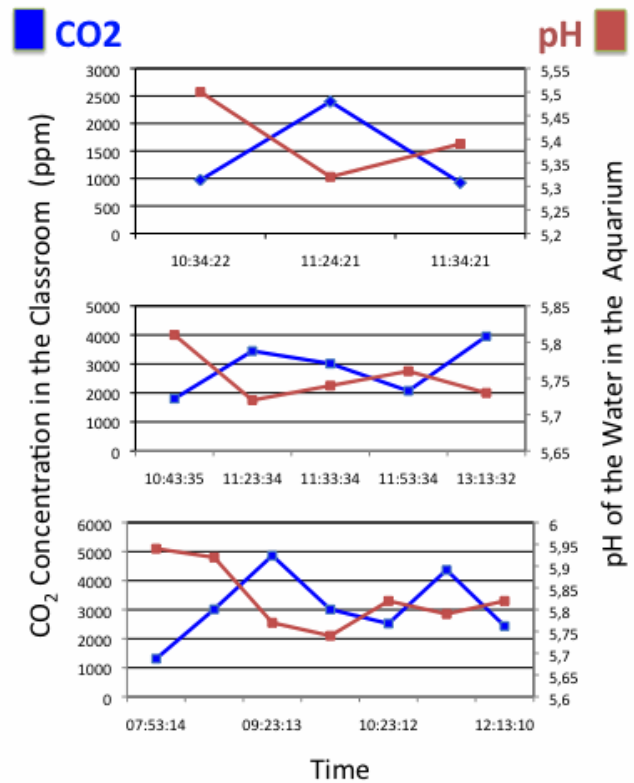


Fig. 7 Effect of CO₂ on the pH of water.
When the CO₂ concentration in the air rises, the pH of the water goes down (becomes acidic)

Presentation of results

1. Plot the data in Excel graphs to demonstrate the regular fluctuations and the changes of the CO₂ concentrations in the classroom.
2. Correlate these with the activities performed using the protocols of the reporters.
3. Make separate 12-hour graphs with the times and dates indicated. Cut these to a uniform size. Ask the pupils to arrange these chronologically like in a puzzle and have them stick(or paste) them on the board. Have them mark on the graph with arrows the points where the different experiments were done.
4. Ask the pupil "reporters" to prepare a power point presentation of the activity.

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