

4.6 Case study 6 (CS6 Sweden)

Concept focus	Effect of light and carbon dioxide on rate of growth of algae
Inquiry skills	Planning investigations
Scientific reasoning and literacy	Not assessed
Assessment methods	Classroom dialogue Teacher observation Student devised materials (experimental plans)
Student group	Grade: 8 th and 9 th grades (implemented in two classes) Age: 14-16 years Group composition: co-ed, groups of 2-3 (mixed gender and ability) Prior experience with inquiry: Yes, some prior experience

This case study describes implementation of the unit as a planning exercise only, in which students were asked to investigate how the rate of growth in a common waterweed was affected by the amount of light and carbon dioxide. The focus of assessment was on *planning investigations*, which was assessed through two key assessment methods – teacher observation during the activity and evaluation of students’ written experimental plans. The teacher provided formative feedback through a whole-class discussion.

(i) How was the learning sequence adapted?

The activity was performed in two classes: one grade 8 and one grade 9 class (14-16 years). The schools were pre-school to grade 9 schools. The students worked in groups of 2-3 students. The students had some prior experience of inquiry.

The students were assigned a task, where they were to investigate how the rate of growth in a common waterweed (*Elodea canadensis*) was affected by the amount of light and carbon dioxide. They were provided with materials and equipment (such as waterweed, beakers, water and carbon dioxide). Then they were asked to carefully plan an investigation, in order to solve the task. It should be noted that the students did not carry out the investigation, they only planned the investigation.

The inquiry activity was implemented with quite some modifications, since it was done with lower-secondary students and a lot of the equipment in the original activity was not available (including the algae). The original activity is more advanced than is usually taught in lower-secondary school in Sweden. Furthermore, the materials and equipment are not commonly available in such schools. Therefore, the teacher had to make some quite extensive modifications of the original design. This means, for instance, that: (1) waterweed was used instead of algae; (2) the investigation targeted rate of growth in relation to amount of light and carbon dioxide instead of plant nutrition; and (3) the primary focus of teacher’s assessment was students’ skills in planning an investigation.

(ii) Which skills were to be assessed?

The activity was used in order to assess students’ skills in *planning investigations*. The teacher: (1) made observations and listened to the students when they performed the activity and (2) collected students’ written designs (Figure 1).

(iii) Criteria for judging assessment data

The teacher made observations about how practical and comprehensible the designs were and to what extent the individual students participated in the planning.

(iv) Evidence collected

Teacher's opinion

The students found the activity interesting, but difficult (grade 8). The students in grade 9 did not find the activity very difficult. Students were given feedback through whole-class class discussion after the activity.

Sample student artefacts

*Take three beakers.
Fill up all three beakers with water (they should be just half-full) .
Add the waterweed to all three beakers.
Cover one beaker so that it will not allow in any light , cover 2 and then let them receive light.
Then, measure the plant in the beaker and see how long it is.
Once you have done that , wait a day to see how long it has become.
Then, measure all again and get a conclusion and see how long they are.*

Then do the same thing when you are going to measure the carbon dioxide and take a straw and blow down carbon dioxide. If nothing happens this means more is needed

*Take the three beakers
Measure all plants
Fill each beaker with water (fill halfway).
Add the waterweed to each beaker
Cover one beaker completely so that it will not allow in any light.
Cover the second beaker partially, so that it will allow in some light
And do not cover the third beaker at all
Since the waterweed can grow up to 5 cm per day, you can check out the next day to see which plant has grown most.
Then, measure all again and then you can see what that has grown the most*

Wait for the result

*Take the three beakers
Measure all plants
Pour in water to halfway in each beaker
Place the plants in the beakers
In one, do not blow into the straw
In the second one, blow into this straw once a day
For the third one, blow into the suction tube three times a day
Then measure all the plants again after a few days*

*Take a beaker, fill it with water and add the waterweed. Set the beaker so that the plant is in sunlight and then put a straw into the water and blow. What happens?
Take a second beaker, fill it with water and add the waterweed. Set the plant now in a dark room, so that the plant can not get access to sunlight. Then take your straw and blow. What happens?
Take a third cup and fill it with quite a bit of water and add the waterweed. Let it get access to sunlight and then take your straw and blow. What happens?*

You might have to wait around in the day to see the change!

Figure 1: Examples of student performance: three designs for investigating the rate of growth in waterweed.

(v) Use of assessment data

Assessment data was not used for summative purposes. As a stand-alone activity, the teachers did not use assessment data for their own planning or evaluations.

(vi) Advice for teachers implementing this unit

The teachers' advice would be to think closely about how to support the students during the activity, for instance how much information and/or equipment should be presented to the students. If too much support is given to the students, they may not be given the opportunity to show what they are really capable of.