

4.2 Case study 2 (CS2 Germany)

Concept focus	Introducing density
Inquiry skills	Developing hypotheses Planning investigations
Scientific reasoning and literacy	Not assessed
Assessment methods	Classroom dialogue Peer-assessment Student devised materials (report)
Student group	Grade: 7 th grade, lower second level science class Age: 12 years Group composition: mixed gender and ability (6 girls, 8 boys) Prior experience with inquiry: Almost no prior experience

This implementation was trialled as part of nine lessons focused on introducing the concept of density. The main focus of the inquiry activity was on *planning investigations*, in which students had to formulate a research idea, plan an investigation, conduct the experiment and document and present their results. The teacher provided formative assessment throughout the lessons, and evaluated student artefacts at the end. Peer-assessment was also used for formative feedback purposes.

(i) How was the learning sequence adapted?

When implementing the **Oranges** SAILS unit, the teacher made the following adaption: She used different fruits and not only oranges. The idea was that the students would generate a multitude of different research ideas. In addition, the students were expected to investigate one research question and to write a protocol for their investigations (report). The teacher spent nine 45-minute lessons on this unit, because she wanted to introduce the new concept of density in this class.

(ii) Which skills were to be assessed?

The main inquiry skill assessed in this implementation was *planning investigations*. Especially, the students had to:

- Formulate research ideas and research questions,
- Plan an investigation,
- Conduct an investigation,
- Document and present their results.

(iii) Criteria for judging assessment data

The teacher was aware of the assessment rubrics of the SAILS project and kept the performance levels from the rubrics in her mind. However, she found that the large differences in performance between the students were a problem. Some students were not able to formulate a hypothesis that could be investigated, thus represented a performance level below “emerging” on the original rubric, while some of the students were capable of refining a good hypothesis.

The teacher provided feedback during the whole session. Peer-assessment was used during the phase where the students collected different research ideas.

(iv) Evidence collected

Teacher’s opinion

This unit gives the opportunity to explore many research ideas. The teacher guidance required by the students is low and some of them come up with unexpected ideas and experimental set-up. This unit is open to different approaches. However, the teacher expected that the students in this age

group would be more skilful, but some of them needed a lot of feedback concerning the formulation of research questions and on how to improve a protocol. Therefore, the assessment was an important part of this unit. The concept of density can be introduced in this unit. The context of fruit and behaviour in water is suitable.

Sample student artefacts

The students wrote protocols that were read by the teacher and written feedback was given. Some students wrote excellent records of their investigations. The students in Figure 1 describe how they conducted the experiment. They also indicated clearly what part belongs to a specific hypothesis (hypothesis 1, hypothesis 2).

Implementation

I have 700 mL of water in the two beakers and then I have weighed the lemon and lime. The lime was 78.1 g and the lemon was 81.9 g. } hypothesis 1

I put the lime into the water and see how much water it displaces: 60 mL. For the lemon it was 100 mL. So the lime has a volume of 60 mL and the lemon 100 mL. } hypothesis 2

Figure 1: Example of part of a student protocol.

Some groups came up with unexpected experimental set-ups. For example, one group tried to find out the amount of air inside the fruits. For this reason, they suggested squeezing the fruit under the water level and collected the air in a measuring cylinder with a fine scale.

(v) Use of assessment data

Students got feedback from the teacher and peers. The teacher gave verbal feedback and made written comments on the protocol. In addition, a single hypothesis of one group was discussed in more detail (variables, control of variables) in the class and formulated as a correct research hypothesis. All students investigated this hypothesis in an experiment and wrote a short protocol.

(vi) Advice for teachers implementing this unit

This unit can be used with young students with great success. However, the teacher has to be aware of the multitude of different ideas and experimental set-ups. The teacher must be able to provide the necessary equipment. Therefore, this unit might be especially fruitful in small classes.

In this unit, weak and stronger students are able to conduct an investigation. However, the teacher assessment and peer-assessment is especially necessary for weaker students to “find” a hypothesis that can be investigated successfully.