

4.3 Case study 3 (CS3 Sweden)

Concept focus	The effects of microgravity
Activities implemented	Activities A-B, Activity D
Inquiry skills	Forming coherent arguments
Scientific reasoning and literacy	Scientific reasoning (argumentation)
Assessment methods	Classroom dialogue Student devised materials
Student group	Grade: lower second level; implemented with four grade 7 classes and one grade 8 class Age: 13-15 years Group composition: mixed ability, mixed gender Prior experience with inquiry: Yes, some prior experience of inquiry

For this implementation, the activity focused on carrying out everyday tasks in a microgravity environment. Students first suggested everyday activities, and how they may need to be adapted in a microgravity environment. They then watched a video on life on the ISS, and were allowed to change their ideas as a result. To assess students' skills in *forming coherent arguments* and *scientific reasoning*, the teachers evaluated how students argued for changing their initial ideas, after watching the video.

(i) How was the learning sequence adapted?

The inquiry activity was implemented as the original activity, with some adjustments. The students did not plan an investigation. Students worked in groups of 3-4. The activity was implemented as suggested in the unit:

1. Students were presented with some background information about the International Space Station (ISS) and gravity. Then they were asked to think about some of their daily routines and what it would be like to carry out these routines in a microgravity environment.
2. The students watched a video about everyday life on the ISS and were asked whether there was anything that they would change in their initial thoughts about carrying out daily routines in a microgravity environment.
3. Group discussions, where students presented their ideas from the video and gave reasons for changing their prior thoughts about daily routines in a microgravity environment.

(ii) Which skills were to be assessed?

The unit was implemented in order to assess students' skills in *scientific reasoning* and *forming coherent arguments*. To do so, the teachers:

1. listened to the students during the group discussions, and
2. collected students' written ideas (Figure 1).

(iii) Criteria for judging assessment data

The teachers made attempts to assess how students argued for changing their initial ideas, after watching the video. The main success criterion was whether the students could form coherent arguments and clearly explain the reasons for revising their hypotheses.

(iv) Evidence collected

Teachers' opinions

On the one hand, the learners really enjoyed the activity and they were certainly fascinated by thinking about and discussing the microgravity environment. On the other hand, the teachers unanimously thought that it was difficult assessing students' inquiry skills with this task. However,

the teachers also noted that the activity could have been used in order to assess students' conceptual understanding, if the activity had been an integrated part of a teaching sequence about gravity, but not in this case when it was a stand-alone activity and most of the students lacked sufficient prior knowledge in this area.

Sample student artefacts:

Students' written ideas were collected, see Figure 1 for an example.

Att dricka vatten
 Jag dricker vatten dagligen för att jag ska må bra. Jag tror att det kommer bli svårt att dricka vatten i rymden om man dricker med glas. Eftersom man lutar glaset när man dricker för att vattnet ska nå munnen kommer det nog vara svårt för att det dr. tyngdlöst.
 Om jag skulle dricka vatten i rymden, eller någon form av vätska, hade jag haft det packat (som ett juicepaket) med sugrör. Men då måste ju vätskan sväva på sig själv ut genom sugröret. Det hinner så långt innan jag hinner dricka upp det. Hur kommer jag ta vattnet i glaset från början? När allt är tyngdlöst blir det mycket svårare!
 Det jag trodde skedde på ett visst sätt. De hade någon reaktion till ett plastpaket, men vattnet rann inte ut av sig självt. När han tryckte på flaskan kom det ut en bubbla som han kunde fånga i munnen och då drack han. Det som överraskade mig mest var hur runda bubblorna var. Det känns så onaturligt att dricka vatten som svävar runt. Aktiviteten gör att gravitation i rymden jag trodde att det skulle bli svårt men det var det inte. Det var bara att fånga vattnet i munnen. Något annat som överraskade mig var hur fränt rymdskeppet verkade vara. Det var inte vad jag hade förväntat mig.

To drink water
I drink water daily in order to feel well. I think it will be difficult to drink water in space if you drink it in a glass. Because you tilt the glass when you drink so that the water may reach your mouth it will probably float away since there is no gravity. If I should drink water in space, or some kind of fluid, I would have it in a container (like a juice container) with a straw. But then the fluid has to float in a way through the straw. It will probably float away before I have time to drink it. How will I get the water into the glass to start with? When there is no gravity everything is much more difficult.
In a way, what I expected was true. They had something like a straw in a plastic container, but the water did not float away by itself. When he pressed the bottle there was a bubble that he could catch in his mouth and drink. What surprised me the most was how round the bubbles were. It feels so unnatural to drink water that is floating around. The activity can be performed in space. I thought it would be difficult but it was not. It was only to catch the water in your mouth. Something else that surprised me was how confined the spaceship seemed to be. It was not what I had expected.

Figure 1: Example of student performance: Ideas about drinking water in a microgravity environment and argument for changing ideas after watching the video.

(v) Use of assessment data

Students were given group feedback during the activity. 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 the activities

The teachers were not themselves clear about the assessment criteria, which affected the activity and student performance. These teachers would therefore advise other teachers to work out the assessment criteria more clearly before starting the activity, and share the criteria with the students.

The teachers also found it difficult to assess student written performance, since many students had problems expressing their thoughts in writing. Still, it was believed to be even more difficult to find time for oral assessment.