

## 4.4 Case study 4 (CS4 Germany)

<b>Concept focus</b>	Oil pollution – removal of oil from water
<b>Inquiry skills</b>	Planning investigations
<b>Scientific reasoning and literacy</b>	Not assessed
<b>Assessment methods</b>	Classroom dialogue Teacher observation Peer-assessment
<b>Student group</b>	<b>Grade:</b> 7 <sup>th</sup> grade (lower second level); student-selected science course “science experiments” <b>Age:</b> 12 years <b>Group composition:</b> mixed ability and gender; (5 boys, 5 girls) <b>Prior experience with inquiry:</b> Some prior experience with inquiry (e.g. Floating orange SAILS unit)

This implementation focuses on oil pollution and the challenge in removing oil from water. Therefore, the emphasis in the experimental phase was on removal of oil from water surfaces. When *planning investigations*, a “market place” method of group discussion and peer-assessment was utilised, where the groups showcased their ideas to their peers. Other assessment methods were teacher observation and classroom dialogue – the teacher watched, listened and gave advice for additional experiments.

### (i) How was the learning sequence adapted?

The **Black tide – oil in the water** SAILS unit was implemented in a special science course called “Science Experiments.” The special course is taught in parallel to regular courses in physics, chemistry and biology. The teacher adapted the unit slightly – she focused on the problem of oil pollution and potential methods for clean-up. She did not use the work sheet from the unit, and the emphasis in the experimental phase was on the removal of oil from the water surface. Students worked in small groups of two persons each.

The main phases in this unit were:

- Discussion between the groups after the generation of ideas for investigation
- Carrying out the planned experiments.

The discussion in the first phase was done with the “market place” method, where the groups showcase their ideas and plans for experiments, and students can go from group to group to look at the plans. The teacher’s expectations with regard to carrying out the planned experiments was that students would carry out an error analysis if their first experiments failed. Students were expected to improve or to change their experimental approach.

It was difficult to prepare the simulated oil using a plant oil and cocoa powder. After a multitude of mixing experiments the best simulated oil was a mixture of oil for bicycle chains and a few drops of black acrylic paint.

### (ii) Which skills were to be assessed?

The skills assessed in this case study were *planning investigations* and carrying out the planned experiments. The teacher used mainly two different formative assessment strategies:

- Peer-assessment, whereby students commented on the ideas of other students.
- Teacher observation and classroom dialogue: the teacher watched, listened and gave advice for additional experiments.

### **(iii) Criteria for judging assessment data**

There was no use of rubrics. Also no criteria were fixed in a written format before implementation of the unit. However, the teacher had a clear idea about the expectations in this unit.

### **(iv) Evidence collected**

#### **Teacher's opinion**

The teacher reported that the students enjoyed this unit. She noted that the lack of prior knowledge for this unit might be one source of this fun. The omission of summative assessment and the absence of presentation in talks or placard (a usual format in this class) are others reasons for this success. In addition, an important motivation in this young age group was the possibility to burn something.

Formative assessment has been implemented. However, the teacher used it in a traditional and very economical way. Due to the very small group of students, she was able to watch all groups carefully, to listen to the discussion in the groups and to give specific advice to the group with regard to the experiments. Rubrics were not used and the formative assessment was given on the spot. Peers shared their ideas and commented on the ideas of the other groups.

The teacher was satisfied that this unit gave rich opportunity to the students to work on their inquiry skills. One group investigated the topic of removal of oil, while another group looked at the effect of oil on feathers, wool and sand. A third group invented a technique for the removal of oil from water and a further group tried to burn down the oil on the water surface.

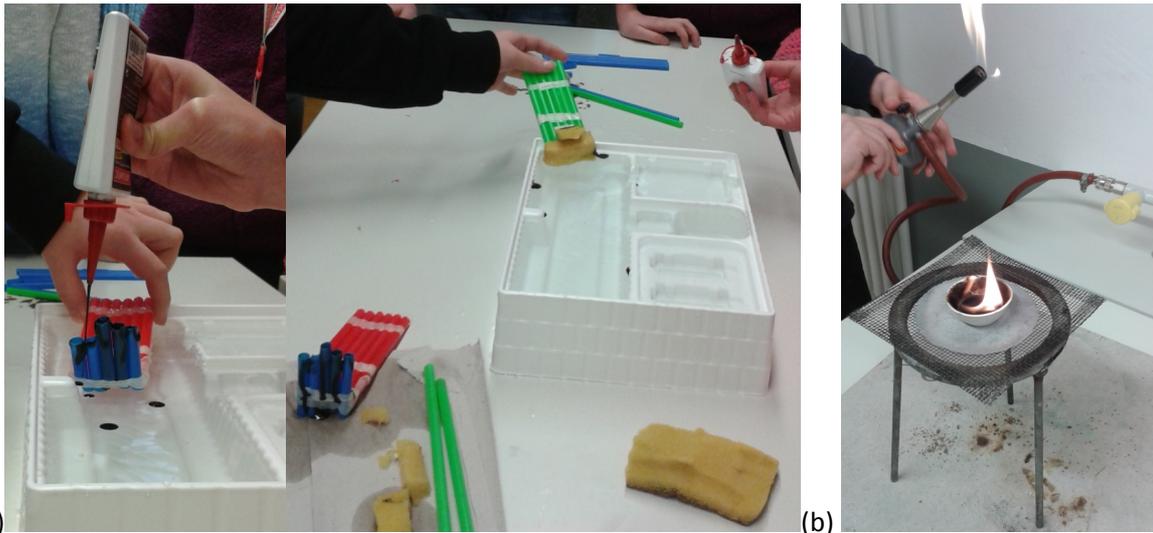
#### **Sample student artefacts**

During the class discussion, when students were generating ideas for their investigations, some ideas were recorded on the board (Figure 1).

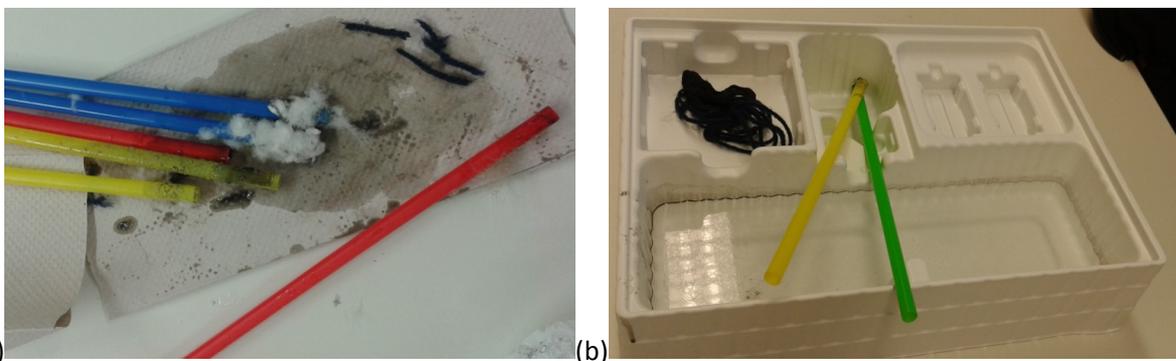
<p style="text-align: center;"><u>Wetter</u></p> <ul style="list-style-type: none"> <li>- Wind</li> <li>- Wellen</li> </ul> <p style="text-align: center;"><u>Beseitigung/Entsorgung</u></p> <ul style="list-style-type: none"> <li>- Dichte → Stoffen</li> <li>- Schwamm / Filter</li> <li>- Zusammentreiben</li> <li>- Verbrennen</li> <li>- (Chemikalien)</li> </ul>	<p><b>Weather</b></p> <ul style="list-style-type: none"> <li>- <i>wind</i></li> <li>- <i>waves</i></li> </ul> <p><b>Removal/disposal</b></p> <ul style="list-style-type: none"> <li>- <b>density → materials</b></li> <li>- <b>sponge/filter</b></li> <li>- <b>gather in</b></li> <li>- <b>incinerate</b></li> <li>- <b>(chemicals)</b></li> </ul>
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**Figure 1: Ideas recorded on whiteboard during discussion.**

Figure 2a shows an example of the investigation carried out by the group investigating methods to remove oil from water. They proposed that the use adsorbent material on a boat could be used to achieve the clean-up of oil. In the image, boat 1 (blue straws) pollutes the water with oil, while boat 2 (green straws) has a sponge equipped to remove the oil. Other investigations shown look at the burning of oil on the surface of water (Figure 2b), effect of oil on wool, feathers and sand (Figure 3a), and use of mechanical devices for removal of oil from water (Figure 3b).



**Figure 2: Examples of groups' investigations. (a) Investigation of removal of oil, (b) Burning down the oil on the water surface**



**Figure 3: Examples of groups' investigations. (a) Effect of oil on feathers, wool and sand, (b) Construction mechanical devices for removal of the oil, using straws.**

**(v) Use of assessment data**

As already reported, formative assessment strategies have been used with much caution. The teacher's feedback to students was based on observations and listening to the groups of students. She gave specific feedback to the experimental approaches. A kind of peer assessment has been used for the presentation of ideas for investigations.

**(vi) Advice for teachers implementing the unit**

The teacher recommends this unit for inquiry learning. Although, the unit is not specifically for a subject like physics or chemistry, it is a nice learning sequence covering several subjects and can be used in spare time, e.g. between teaching two topics requested by the curriculum. The discussions and preparation of the research questions and investigation plans was especially fruitful. As an idea of improvement the teacher suggests adapting the unit so that technical aspects concerning the removal of the oil are strengthened.