

## 4.7 Case study 7 (CS7 United Kingdom)

<b>Concept focus</b>	Density Development of inquiry skills
<b>Inquiry skills</b>	Planning investigations Developing hypotheses Working collaboratively
<b>Scientific reasoning and literacy</b>	Not assessed
<b>Assessment methods</b>	Classroom dialogue Teacher observation Self-assessment Presentations
<b>Student group</b>	<b>Grade:</b> lower second level <b>Age:</b> 12-13 years <b>Group composition:</b> co-ed, groups of 2-3 (teacher-selected, mixed gender and ability); 30 students in total <b>Prior experience with inquiry:</b> Yes, but limited prior experience with inquiry based skills approach.

The **Oranges** activity was chosen as a stand-alone inquiry to develop students' skills in *developing hypotheses* and *working collaboratively*. The students engaged in small-group discussions to agree on a question and data to collect, which a spokesperson described to the teacher. In this manner, the teacher assessed the group's ability to form a question. For assessment of working collaboratively, the teacher prepared a five-level rubric for assessment of participation, communication and explanation.

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

The **Oranges** SAILS inquiry and assessment unit was implemented between two topics and was unrelated to either. It was done as a standalone lesson. This was to give the teacher the freedom to concentrate solely on the inquiry learning approach. Although knowledge of density and forming a hypothesis may come out of the lesson, the teacher was not looking for the content learning to be the main focus.

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

Three skills were identified for assessment:

1. Developing hypotheses
2. Working collaboratively
3. Working beyond the original research question.

To assess these skills, the students engaged in small-group discussions and when the groups had agreed a question a spokesperson came up to the teacher to inform him of the question and the data that was going to be collected. In this manner, the teacher assessed the ability to form a question and agree as a group. Those groups that were struggling (i.e. did not come up in the allotted time) were noted by the teacher and then while the others agreed a method, they were supported by the teacher.

The class engaged in self-assessment at the group level, using the school system of a colour scale (red/amber/green) for evaluation of effort and a numerical scale (1/2/3) for identifying success. In this way, the groups rated themselves as a whole. The teacher noted after the lesson that a range of grading was observed, demonstrating honesty of opinion during this assessment method.

To address gender issues, the teacher ensured that all the groups were of mixed gender (although this was established by the teacher rather than made overt). The teacher asked that each group nominate two spokespeople, one girl and one boy, so that they could both give their opinion on how well the group worked. This was to establish implicitly that while there may be a different approach or opinion both were equally valued.

The assessment by the teacher was done during the practical using teacher observation of the group discussion and implementation of their plans. The teacher listened to the proposed hypotheses and experimental plans, and provided assistance where required. The teacher used a rubric to assess student participation, but in a single lesson did not intend to evaluate all students individually, rather aimed to assess up to one third of the class.

### (iii) Criteria for judging assessment data

The class was told that they were being judged on effort, resilience and ability to keep trying to move the investigation forward even after an initial answer was produced. The participation was given a level from 1-5 during the lesson (Table 1). The prepared rubric score potentially provides summative data that can be followed through the year. At no point was it the expectation that all students would be seen in just one lesson and in actual fact about one in three students were given a score.

The homework was to prepare a poster demonstrating what they had discovered. This was given a tick by the teacher to acknowledge it. The posters were then given a question that enabled reflection on the discoveries at the start of the following lesson.

**Table 1: Assessment of working collaboratively**

Level	Participation	Communication	Explanation
1	Thoroughly involved but in a thoughtful and polite way	Talks politely and helpfully to other group members and takes instructions well	Is heard clearly explaining the practical to others or is able to clearly and concisely answer teacher questions using appropriate language
2	Wants to be very involved but not allowing others to get involved	Talks to other group members about what is going on, may be a little bossy	Is heard trying to explain the practical but with some hesitancy and or mistakes or can answer questions posed by teacher to a certain extent
3	Will try to help but needs to be encouraged by peers	Not saying much but is following instructions	Finds explaining the practical difficult but does try gives a good description of activity
4	Will get involved if asked by the teacher	Saying very little and not responding to others	Cannot explain practical but does try describing what the group is doing
5	Refuses to help with the practical	Not saying anything and not listening to others in the group	Cannot explain practical and is not sure how to describe what it is the group is doing

### (iv) Evidence collected

#### Teacher's opinion

The learners thoroughly enjoyed the style of lesson. They all showed excellent engagement (including those who are usually less involved). The group discussion seemed to be of a much higher quality, as they were not tied down to a search for "the answer" but more in control. They were happy to be able to offer "small answers" to their questions and then reflect on the whole body of knowledge that they had generated.

The teacher prepared a rubric for assessment of students' skill and notes that "if I had wanted to evaluate/assess the whole class I would have been unsuccessful but as I set up to see about 1/3 it was relatively straightforward to use."

### Sample student artefacts

The homework was an artefact of a poster demonstrating what they had discovered. It was only given a diligence score. Figure 1, Figure 2 and Figure 3 show some examples of the students' work.


<p><b>? What makes an orange Sink or Float?</b></p> <p><i>Question we asked</i> How much does the orange weigh? Is the skin heavy?</p> <p><i>How we answered</i> To answer the question: How much does the orange weigh? we had a weighing scales and tested/weighed the orange. But to make it a fair test we weighed 3 oranges. The highest weighed was 263g.</p> <p>To answer the question Is the skin heavy? we peeled the skin off one orange and weighed them. We did this 3 times. The highest weight was 59.5g.</p> <p>Lastly we filled a jug of water half-way and dunked one orange with skin on. The results were: float</p> <p>Our last test we did was dunk an orange without the peel in water. The results Sink.</p> 	<p><b>What makes an orange sink or float?</b></p> <p><b>Question we asked</b> <b>How much does the orange weigh?</b> <b>Is the skin heavy?</b></p> <p><b>How we answered</b> <b>To answer the question "how much does the orange weigh?" we had a weighing scales and tested/weighed the orange. But to make it a fair test we weighed 3 oranges. The highest weighed was 263 g.</b></p> <p><b>To answer the question "is the skin heavy?" we peeled the skin off one orange and weighed them. We did this three times. The highest weight was 59.5 g.</b></p> <p><b>Lastly we filled a jug of water half-way and dunked one orange with the skin on. The results were: float</b></p> <p><b>Our last test we did was dunk an orange without the peel in water. The sults: sank</b></p>
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Figure 1: Student poster, example 1.

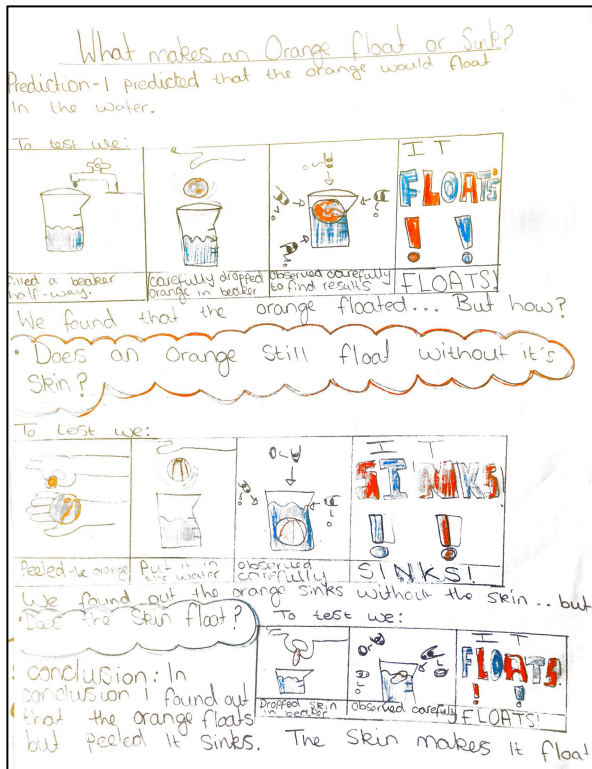


Figure 2: Student poster, example 2.

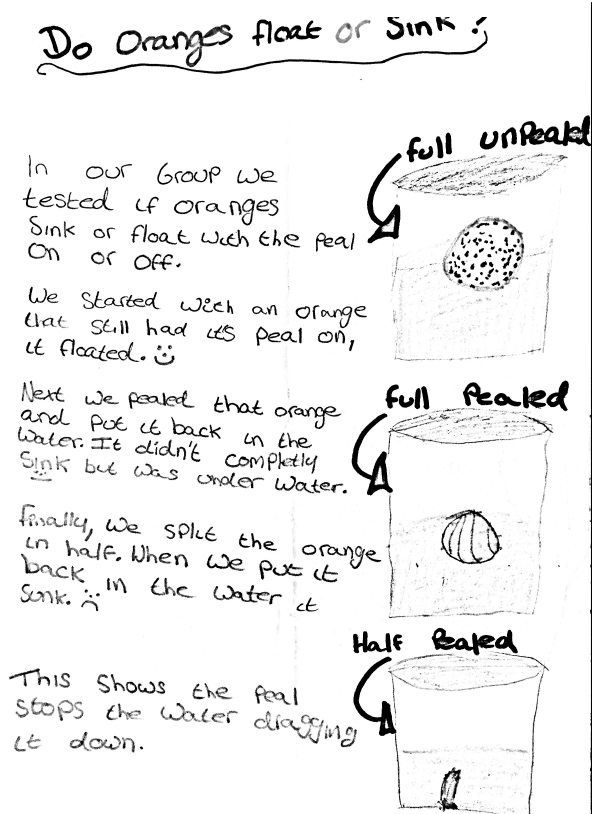


Figure 3: Student poster, example 3.

What makes an orange float or sink?

**Prediction:** I predicted that the orange would float in the water.

**To test we:**

Filled a beaker halfway, carefully dropped orange in beaker, observed carefully to find results, **FLOATS**

**We found that the orange floated ... but how?**

**Does an orange still float without it's skin?**

**To test we:**

Peeled the orange, put it in the water, observed carefully, **SINKS**

**We found that the orange sinks without its skin... but**

**Does the skin float?**

**To test we:**

Dropped skin in beaker, observed carefully, it float

**Conclusion:** In conclusion I found out that the orange floats but peeled it sinks. The skin makes it float.

Do oranges float or sink?

In our group we tested if oranges sink or float with the peel on or off.

[diagram full unpeeled]

We started with an orange that still had its peel on, it floated ☺

Next we peeled that orange and put it back into the water. It didn't completely sink, but was under water.

[diagram full peeled]

Finally, we split the orange in half. When we put it back in the water it sunk ☹

This shows the peel stops the water dragging it down.

[diagram half peeled]

**(v) Use of assessment data**

The teacher intends to try to develop a tracking sheet that is kept by the student in their book.

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

Give students time to develop ideas – the practical is actually extremely quick and much of the inquiry and assessment was completed in the latter parts of the lesson.

Make it clear what the teacher is looking for at the start of the investigation in order to remove the burden of a quest for the one and only “right” answer.