

### 4.3 Case study 3 (CS3 United Kingdom)

<b>Concept focus</b>	Global warming Examining evidence that by its nature will be incomplete and conflicting
<b>Activities implemented</b>	Activities A-B
<b>Inquiry skills</b>	Forming coherent arguments Working collaboratively
<b>Scientific reasoning and literacy</b>	Scientific reasoning (argumentation) Scientific literacy (analysis and interpretation of scientific data)
<b>Assessment methods</b>	Classroom dialogue Teacher observation Peer-assessment
<b>Student group</b>	<b>Grade:</b> Year 10, upper second level <b>Age:</b> 14-15 years <b>Group composition:</b> similar levels of ability (set 2 of 8, performance as expected for their year and age); mixed gender class with mainly mixed gender groups; multicultural <b>Prior experience with inquiry:</b> Yes, prior experience with inquiry. Students had experienced “Spaghetti” – the cooked food inquiry – in previous year and also completed a variety of investigations as part of KS3 and GCSE so had some experience of working in groups in a collaborative way prior to this unit.

The activity was implemented, without modification, for assessment of students’ skills in *forming coherent arguments* and *working collaboratively*, as well as their *scientific reasoning* and their *scientific literacy*, through using scientific information to form arguments. The success criteria were set out in the rubrics for peer-assessment of the tasks, and the teacher provided formative feedback during the class discussions. This enabled students to identify the elements of their attainment and how they could improve their work.

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

When implementing the **Global warming** SAILS inquiry and assessment unit, adaptations were deliberately kept to a minimum in order for the teacher to evaluate it as it had been written. This inquiry and assessment unit was designed by one of the partners as part of the pan-European research project SAILS – hence the occasional non-English text remained. The teacher explained this to the students and pointed out that the meaning in the diagrams were quite clear, even with these non-English bits of text. Students were briefly reminded about their previous learning about the process of global warming. This unit had a good real life context and this made it relevant to them.

The students were organised into mixed ability groups and mixed gender groups of four. It should be noted that the class were already organised in sets of similar attainment (set 2 of 8 in the year) – there was a limited spread of ability and no students identified as having specific special needs. The class group were attaining at a level expected of this age group. The groups were generally of mixed gender, which was achieved by the teacher making minor adjustments to the existing groups. The teacher allocated the groups to work together on this occasion, while acknowledging some groups worked most effectively in friendship groups. For example, the teacher felt that for one group of Asian Muslim girls, they were more likely to express themselves openly in a single sex, same faith group. The choice of which individual would work within which group was based on the teachers in depth knowledge of the individual students over a period of time and understanding of how they tended to work in class as individuals and within groups. An effort was made by the teacher to

ensure that there were no obvious personality conflicts. This worked well. There was also an attempt to broaden the experiences of some groups of students who had tended to choose to work together so placing these students within other groups was to give them experience of working with a wider range of other students within the class group. The range of attainment within the class set was generally similar as this was a “set group” class based on their previous performance in the previous year’s tests and examinations.

The context and objective of the unit was explained to the students by the teacher, with reference to the three specific tasks and the assessment rubrics. The aim was to avoid excessive direction by the teacher so that student performance within this unit could be compared with the rubrics provided by the authors of the unit. The recommendation from the unit authors was to run the unit over two (one hour) lessons, allowing each student group to progress through the unit as they were ready. This aspect was adapted by the teacher for this class with a focus on Activity A: Interpreting the evidence in the first hour and Activity B: Forming scientific arguments in the second hour. On reflection, the task could include further research about global warming as part of a more focused homework activity.

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

The activity was used in order to assess students’ skills in *forming coherent arguments* and *working collaboratively*, as well as their *scientific reasoning* (argumentation) capabilities and their *scientific literacy* (using scientific information).

The teacher observed the students as they worked within their groups, although no notes were written down by the teacher at the time; a mental note was made and did influence the teacher’s judgment about how well students achieved in terms of the above skills. The teacher also drew on the student’s responses to questions asked during the activity and plenary to further inform his judgment along with an analysis of the written reports produced by individual students.

Students were grouped in fours, generally of mixed gender. However, the teacher believed that the effectiveness of each group relied on a full contribution by every student within the group. This meant each student being prepared to offer opinions and listening to and respecting the opinions of others. To support this approach the teacher decided that there needed to be two single sex groups in order to support the needs of the learners. One group of girls of Muslim faith were judged as more likely to take a proactive role within the inquiry approach if they were part of a single sex, same faith group. The decision to have this one group of girls was made from the teacher’s in depth knowledge of the individuals rather than cultural reasons. Other Muslim girls were considered to be able to work confidently and successfully in a mixed group and were placed accordingly.

Students would make their judgements by a group analysis of the text and peer-peer discussion. Students were encouraged to read about the topic in the time between the two (one hour) lessons allocated to the task.

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

The criteria were set out in the rubrics for the task, including skills assessed and levels of achievement. The teacher expected that students would identify from the data that the evidence suggests a strong connection between CO<sub>2</sub> and mean temperature rise. However the graph shows that while some data was achieved through real samples, the earlier data expressed within the graphs had been extrapolated. None of the students recognised this. It was too hard for them to understand this at this stage of their science experience. Students also needed a lot of guidance to consider that change is uneven and rather than dismiss the connection, students needed to look for other factors that might affect mean temperature.

Summative assessment was achieved by meeting the success criteria as described in the rubric provided. However, further experience is needed by the students to help them become more familiar with the criteria before, during and after the unit. The wording was tricky for them to understand what it really meant. This better understanding would have helped them with peer- and self-assessment. The students did not tend to refer to the criteria as they worked. The students need more support and reminding to measure their argument on its scientific validity, and then it might be likely that they might produce answers of a much higher order.

The teacher provided formative feedback during the class discussions (verbal feedback, which the students responded to), allowing students to identify the elements of their attainment and how they could improve their work. However, given a large class and one teacher, opportunities of this nature were limited. It is very time consuming to get to every group.

Again the teacher runs the risk of students getting confused by the complexity of the assessment process and struggling to understand why they might not have achieved a specific outcome. The rubric descriptions of quality need more time and student discussion so they understand what quality means for each aspect. The development of more tasks, in different contexts, using similar rubrics might allow students to make the appropriate connections and developing the principles and specific inquiry skills within different contexts over time.

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

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

Engaging students in the task was something of a challenge because it was very wordy with a lot of dense text. The unit needs more visual appeal to make it look more interesting and less scary. References to the non-English text language had to be made with a number of groups on a number of separate occasions, despite the earlier whole class explanation. I should have just removed these bits of text and replaced with English.

Maintaining student engagement while they tried to read the large amount of text in detail and understand it was a considerable issue. The amount of text and the way it was set out on the page was not inviting or easy to understand and as a result the majority of the students missed the significance of what was being presented. The students were clearly skimming the text and the detailed meaning was not being recognised. The text needs to be set out in a more user-friendly way, possibly with some visual clues to support the written text. There could be a partly completed table or writing frame where the students could extract key information from the text and reorganise it using a table or writing frame to help them comprehend the complex information that was being presented to them and spot things relevant to their argument.

Identifying the specific tasks within the text was an issue. Students were able to identify the first task fairly easily, but most of them failed to identify where the second task was. They also struggled to handle the two arguments simultaneously. When asked to prove that global warming is down to CO<sub>2</sub> increase, most of the students would agree with this claim. However, when asked to justify "beyond all doubt," they were now no longer sure. They were not able to justify their claim.

The emergence of Student A in the preliminary text, before the tasks were set, in contrast to Student B only within the second task caused confusion. If students are to rationalise the whole task, an overall picture of two students with conflicting opinions might have been more useful. The class would have been reminded that there could be contrary opinion, especially as this was meant to be a key aspect of the learning within the unit.

The majority of the students struggled to stay on task with their small group debate and tended to look around or chat about something unrelated. Some of the groups struggled to put together a constructive discussion reflecting a balance of arguments. For example, where the graph showed temperatures went down, the students tended to dismiss the concerns about global warming. In short the subtlety of a balanced argument eluded most of them.

The instructions and rubrics were used unaltered. The rubric sheets were given to the students. Getting the students to engage with the descriptors was a slow process for a number of reasons. The students were unable to fully understand what the statements actually meant in terms of recognising success within what they were saying and doing. While the statements were understandable in terms of reading each word, the presentation was not user friendly and they were unfamiliar with the experience of interpreting what each statement meant. It would help if the rubrics were redesigned without numbers indicating a level but instead written in a way that explained how a specific skill grows from the embryonic early steps towards full accomplishment, appropriate for their age group and stage of learning. These descriptors need to be discussed with the students so they are able to recognise not just what the words meant but how they could use these descriptors to recognise success in their own work as part of their own reflection, but also understand what they were striving for next time. Instead of having each column as a “level” use words to indicate degrees of accomplishment such as “developing the skills,” “achieved the skills,” “exceeding the skills expected.”

The task was completed without the presence of an external observer. The teacher was simply able to interact with the students, to help focus their efforts, with limited opportunity to make notes before moving on to other students.

### **Sample student artefacts**

In the first session, students did not progress beyond tasks 1 and 2. The students engaged in peer- and self-assessment using the rubrics.

The teacher observed the class, and took some notes for use in assessing students’ skills after the lesson. The teacher examined student artefacts, consulted the notes taken during the lesson and recalled some observations mentally. These were combined for the overall assessment of each student.

For example, one student was probably the one who most carefully considered the conflicts in the written artefact. However, the teacher believed, based on observations at the time, that these written notes represent his personal analysis rather than a genuine interaction with other students. This student tends to work independently with a very strong work ethos, but is not so likely to consult others. This means his attainment against the criteria “collaborative working” is undeveloped.

### **(v) Use of assessment data**

There was brief feedback to the whole class lasting about five minutes, given by the teacher, at the time of the exercise. Rather than just highlighting where the information was (which the students appeared to be able to do) the debriefing tried to highlight that, for success against the stated learning criteria as set out in the rubric, the students need to take each of the two contrary arguments presented in the text and try to consider both points of view at once, rather than considering task 1 and reaching a conclusion, only to complete task 2 and reach a somewhat contrary conclusion.

There was generally an inability by the groups of students to analyse the evidence at a deep level and make comparison or draw out conclusions by recognising patterns and trends. They found this unit very challenging, possibly due to the way the evidence was presented. The teacher recommends that there is need for further scaffolding by including some kind of writing frame or stepwise process where the students can extract relevant information from the irrelevant and reorganise it in a manner that helps them to notice key pieces of information and engage in evidence based group discussion.

As stated earlier, the students are able to make a statement, backed up by some evidence. When prompted by the teacher through questioning such as “say a bit more about why you think that” they were able to tentatively articulate a contrary position and develop a contrary conclusion, although they still struggled to really understand the logical inconsistencies. With further scaffolding and mediation by the teacher, a few were then able to reach an overall conclusion, but they tended to lack the capability to “weigh up” the evidence, recognise relative merits and weaknesses and the probability of things.

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

1. Look at the text and use devices such as enlarging the text size, use bold and italics to highlight key important aspects of the task.
2. Add text boxes in home language replace elements that appear in other languages, as the students tended to be distracted by these minor inconveniences.
3. Use well-structured teacher questions, such as “are you saying... because...? Then tell me more about why you think this is the case” or “what evidence is there here to support that view?” The teacher should ask questions to explore students comments that seem to fail to weigh up evidence and re-focus students on the inconsistencies of their arguments. This will help them to realise that they need to examine contrary arguments together to come up with an overall judgement based on the available evidence. Students can accept one argument, because it appears to be backed up by evidence and then later accept a contrary argument using the same piece of evidence, without recognising the contradiction.