

## 4.2 Case study 2 (CS2 Turkey)

<b>Concept focus</b>	Features of acids and bases pH and indicators
<b>Activities implemented</b>	Activities A-E
<b>Inquiry skills</b>	Planning investigations
<b>Scientific reasoning and literacy</b>	Scientific reasoning (observation, classification, making comparisons) Scientific literacy (understanding acids and bases that are found in everyday life)
<b>Assessment methods</b>	Classroom dialogue Teacher observation Student devised materials
<b>Student group</b>	<b>Grade:</b> 7 <sup>th</sup> grade (lower second level science class) <b>Age:</b> 14-15 <b>Group composition:</b> co-ed (18 students), groups of 3-4 <b>Prior experience with inquiry:</b> None

In this implementation, the teacher did not provide worksheets and instead students prepared their own documentation for the inquiry. Assessment of student's skills in *planning investigations* was achieved through teacher observation. Students' *scientific reasoning* capabilities and *scientific literacy* were assessed through classroom dialogue. The teacher identified five key criteria for success – students' answers to questions, measurements, categorisation of samples, understanding of use of pH paper and suitable examples from daily life.

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

The **Acids, bases, salts** SAILS unit was implemented in full; the learning sequence followed the steps described in the unit with no modifications. The students formed friendship groups; however, the teacher made some changes to equalise the number of students in the groups. Then, the teacher asked students questions to motivate them, such as "what do you eat at breakfast, lunch and dinner?" The teacher asked follow-up questions related to students' answers, for instance, students said "sweet, sour or bitter" and the teacher responded "why do you feel this sensation? Why does it have this taste?" After the new question, some of the students said that these foods consist of different substances. So we can say that during this warm-up activity every student's answer shaped the teacher's next question.

For the next activity, the teacher gave the students some materials: vinegar, lemon, orange, carbonated water, yoghurt and toothpaste. The teacher explained what the students needed to do with these materials (eating and drinking). Some students said that they should not do tasting in the laboratory, so the teacher explained to the students that in this situation they would observe the materials and categorise them according to their properties. The students were already familiar with the given materials. They measured the pH values of the materials with pH paper and then constructed the pH scale using the values obtained. Next, the teacher gave an indicator obtained from red cabbage to each group. The students observed the colour changes when they dripped indicator into each material. Then the students classified materials according to the colour change. The teacher chaired a discussion about why this colour change happened and why the colours of materials were different. After the discussion, the students wanted to determine whether the materials were acid, base or salt. The teacher guided the students in all processes.

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

The skills assessed included *scientific literacy* (answering questions posed by teacher, understanding real world context of acids and bases), *planning investigations* (taking measurements) and *scientific reasoning* (classification, inferences). The teacher guided each group and assessed the groups through observation. However, the criteria for assessment were not shared with the students before the lesson. In addition, the teacher asked each group some questions, for example “what do you think about this?” or “why do you think that?”

### (iii) Criteria for judging assessment data

The teacher assessed the students according to following criteria:

- Whether or not the groups of the students answered correctly questions asked by the teacher
- Whether or not measurements were correctly obtained from pH scale
- Whether or not the students correctly categorised samples as acids, bases or salts.
- Whether or not the students made the inference that acids change pH paper to red and matter that bases change pH paper to blue.
- Whether or not the student gave some examples, which are related to daily life.

### (iv) Evidence collected

#### Teacher opinion

- Indicators obtained from red cabbage should be prepared by the teacher or students before the class to avoid losing time and any difficulties, which the teacher may have in classroom management.
- The students know more about acids than about bases. I think it will be good to work on mainly with bases. Bases can be forefront.
- It is a good method to assess with short answer questions. Since these questions gather students’ attentions in a while, and the students express themselves more comfortably and clearly.

#### Observer notes

The teacher gave materials such as vinegar, lemon, orange, carbonated water, yoghurt and toothpaste to students one by one. After giving each material, the students observed them and noted their observations. The teacher didn't give any worksheet, so students used a self-devised worksheet to record their observations. The teacher guided every group, as needed. All groups went through the same stages, they were assessed and feedback was given to the students. When the teacher made a judgement on the students’ skills, the teacher used the students’ artefacts and their observation notes. For instance, while the teacher was guiding the students, the teacher was observing their notes. If the teacher noticed any problem on the notes, the teacher gave feedback. Two examples of such feedback were “How did you categorise that?” and “Why did you choose that method?” Created groups were mixed in terms of gender. However, when students’ artefacts were examined, it was seen that some groups had more detailed observations than others. These were groups in which there were higher numbers of girls. In addition, the students enjoyed the activity, and all students were active and energetic during the activity process (Figure 1). The teacher’s encouragement and feedback motivated students. For instance, when some groups did not realise a colour change in the vinegar, the teacher and students talked altogether about why it did not change. After that, the teacher encouraged them to do the activity again.



Figure 1: Students participating in the implementation of the Acids, bases, salts SAILS unit  
Sample student artefacts

Observation	Diş Macunu=Elimizde oluşan his kaygandı. Kokusu ferahlatıcıydı, Tadı naneli? olduğu için acı ve tuzlu.
	<i>Toothpaste: We felt slippery and the smell of it was refreshing. Because its taste was minted, it was bitter and bizarre.</i>
Classification	Limon suyu, portakal suyu ve sirke tat olarak birbirine yakındır. Diş macunu ve karbonat birbirine yakındır.
	<i>The waters of lemon and orange had similar taste. Toothpaste and baking soda had similar taste</i>
Making comparisons	* Sirke ve limondan daha az ekşiydi.
	<i>The orange was less sour than vinegar and lemon.</i>
Building relationships with daily life	Naneli diş macunu - karbonatlı su = temizlik ürünlerinde kullanılan bircok madde, tuzlu su bu iki maddeye benzer.
	<i>Mint toothpaste and carbonated water: Many matters, which are used for cleaning products and salt water, are similar to these two matters.</i>

#### (v) Use of assessment data

The students did not have any difficulties in the activity. However, they had no experience with pH paper, so they did not know how to use this. The teacher gave feedback according to the students' answers and questions. In other words, while the teacher was talking to the student, he was assessing them, and gave some feedback to continue the process. For instance, although we dripped the same red cabbage indicator into each material, they turned different colours, and the pH paper showed different colours. Therefore the teacher asked "Why does this occur?" or "Which substances had similar pH papers?" Afterwards the students checked their pH papers and drew a number line for their pH scale, as shown in Figure 2.

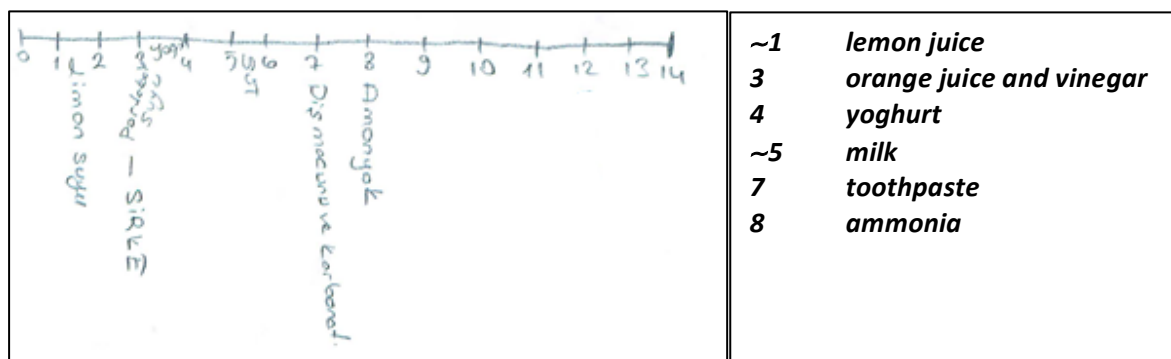


Figure 2: Example of pH scale constructed by a student