

## 4.5 Case study 5 (CS5 Hungary)

<b>Concept focus</b>	Nutritional composition of food Making food choices
<b>Activities implemented</b>	Activity B: Food cards Activity C: The washing line Activity D: Testing for fats
<b>Inquiry skills</b>	Planning investigations Working collaboratively
<b>Scientific reasoning and literacy</b>	Scientific reasoning (making reasoned decisions) Scientific literacy (critical thinking; collection and analysis of scientific data)
<b>Assessment methods</b>	Classroom dialogue Teacher observation Worksheets Student devised materials (group work placemat)
<b>Student group A</b>	<b>Grade:</b> 8 <sup>th</sup> grade, lower second level <b>Age:</b> 14-15 years <b>Group composition:</b> mixed ability and gender; 24 students <b>Prior experience with inquiry:</b> No prior experience with inquiry
<b>Student group B</b>	<b>Grade:</b> 9 <sup>th</sup> grade, upper second level <b>Age:</b> 15-16 years <b>Group composition:</b> mixed ability and gender; 22 students <b>Prior experience with inquiry:</b> Several prior experiences with inquiry

This case study outlines two short implementations – one with lower second level students and one with upper second level. The teacher adapted the tasks to reflect the knowledge and ability of the students. The skills assessed were *planning investigations*, *scientific reasoning* and *scientific literacy*, in particular making reasoned decisions and critical thinking. The teacher prepared rubrics for evaluation of some skills, and used observation and on-the-fly interactions to provide formative feedback throughout the activities.

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

The **Food and food labels** SAILS unit was implemented in two separate classes, by an experienced pilot teacher. The unit was implemented in part, due to time constraints; a single 45-minute lesson period was used in each class.

The following activities were carried out:

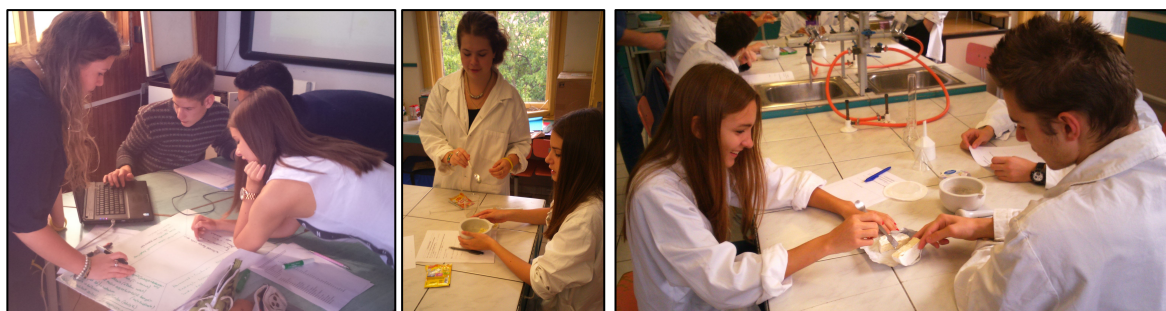
- Exercise 1: The lower second level class prepared food cards (Activity B: Food cards) and carried out Activity C: The washing line (Figure 1).  
One reason for the modification was that ready-made food cards were not available, but making cards with illustrations was an interesting activity for the younger class of students. Each group had a laptop computer with Internet connection to look up the nutritional composition data. The students were given a link to the appropriate online database.



**Figure 1: Lower second level students carrying out Activity C: The washing line**

Implementation with the upper second level class looked at three tasks (Figure 2), for which the teacher provided worksheets (Figure 3):

- **Exercise 2: Packed lunches**  
Use of an online database allowed the students to choose items for the lunchbox from a greater range of foods: [http://www.fogyas.info/tapanyag-kaloria-energia-tablazarat\\_kcal-kalkulator.php](http://www.fogyas.info/tapanyag-kaloria-energia-tablazarat_kcal-kalkulator.php)
- **Exercise 3: Analysis of the composition of packets of food**  
Meals were analysed using theoretical data analysis in which the students answered questions similar to those in the original Activity B: Food cards.
- **Exercise 4: Determination of fat content**  
Similar to Activity D: Testing for vitamin C in the original unit. DCPIP solution was not available but the students had recently learnt to separate mixtures and they were likely to be able to select and follow the procedure to separate fat.



**Figure 2: Upper second level students carrying out unit activities**

The unit was implemented in classes where the topic matched the syllabus. The topic of the students' regular classes was "Materials" and within that, they had prior knowledge of mixtures and compounds and procedures to separate them into component substances. Organic chemistry had not yet been studied and nutrition had not been discussed recently. The exercises and assessment methods were designed with these considerations in mind.

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

The skills assessed in this case study were *planning investigations* (including implementation), critical thinking (a key skill in building *scientific literacy*), *scientific reasoning* (making reasoned decisions) and analysis and use of scientific data (*scientific literacy*). The teacher prepared rubrics for evaluation of some skills, and used observation and on-the-fly interactions to provide formative feedback throughout the activities. The teacher utilised the "window" method of structured peer-peer dialogue, whereby students each contribute their ideas on the frame of the "window," these are then discussed and a final group decision is reached and placed in the centre of the window.

### I. Packed Lunch

What will you put in a lunch box to cover one third of one's daily nutrient and calorie intake?

*Core questions: What criteria will you use? List them in this box.*

Use the nutritional value table.

- Write your ideas on your side of the "WINDOW".
- Discuss the individual ideas in your group.
- Prepare a lunchbox suggestion together – write it in the middle section of the window.

*Copy the suggestion here.*

*Do not forget to mark the quantities and the nutritional values.*

- What problems did you observe while working on the exercise? Describe them briefly

### II. Comparing foods

We bought three foods: bread sticks, camembert cheese and instant soup.

Each food has a label showing the proportional values (value per 100 g) of the most important nutrients contained in the food. Write these in the form.

**1) Bread sticks:**  
Protein: .....  
Carbohydrate: .....  
Fat: .....  
Fibre: .....  
Salt: .....

**2) Camembert:**  
Protein: .....  
Szénhidrát: .....  
Carbohydrate: .....  
Fibre: .....  
Salt: .....

**3) Instant soup:**  
Protein: .....  
Carbohydrate: .....  
Fat: .....  
Fibre: .....  
Salt: .....

**Which food has the highest content of each nutrient?**  
*Put an X in the correct cell.*

		Bread sticks	Camembert	Instant soup
Absolute quantity (quantity in the packet)	<i>Protein</i>			
	<i>Carbohydrate</i>			
	<i>Fat</i>			
Proportional content (quantity in 100 g)	<i>Protein</i>			
	<i>Carbohydrate</i>			
	<i>Fat</i>			

### III. Experimenting with food

Plan an experiment to separate the components of the foods.

List the studied procedures used to separate mixtures:

Which component is the easiest to separate from the others? Explain.

Which method would you use?

Write down the steps of the experiment.

**Figure 3: Worksheets used for upper second level class, exercises 2-4**

### (iii) Criteria for judging assessment data

#### **Scientific literacy (critical thinking)**

Critical thinking is an important component of 21st century skills and a pertinent part of *scientific literacy* in the context of food quality. For the 14 year olds, critical thinking was evaluated with reference to Exercise 1, but individual assessment was limited to a few students. A four-level rubric was devised, which detailed the expectations at each performance level (Table 1).

**Table 1: Assessment of critical thinking**

Emerging	Developing	Consolidating	Extending
Mostly correctly orders a sufficient number of food cards for each nutrient with no interpretation.	Correctly orders a sufficient number of food cards for each nutrient, draws appropriate conclusions about individual groups of nutrients and occasionally about combinations of 2 nutrients.	Mostly correctly orders all available food cards and draws appropriate conclusions for a combination of 2 or 3 groups of nutrients. Brings up considerations of quantity in discussion.	Mostly correctly orders all available food cards and draws appropriate conclusions about all groups of nutrients in combination. Makes a valid point about quantity in discussion.

#### **Scientific reasoning (making reasoned decisions)**

This skill builds upon critical thinking. In Exercise 2, the 16 year-old students appraise situations and make decisions in connection with the contents of the lunchbox. Decision-making is preceded by teamwork using cooperative learning, where the “window” features both individual opinions and the decision of the team. The teacher observed the process of making the decision. Individual students’ active contribution to the team’s decision is part of their performance (Table 2).

**Table 2: Assessment of making reasoned decisions (scientific reasoning)**

Emerging	Developing	Consolidating	Extending
Mentions ideas but does not write them down. Does not respond to the arguments of others.	Mentions ideas and occasionally writes them down. Occasionally responds to the arguments of others.	Speaks and writes ideas in the form of decisions and occasionally supports these ideas with arguments. Represents a critical stance in discussion.	Speaks and writes ideas in the form of decisions and invariably supports them with appropriate arguments. Adopts or refutes others’ arguments as appropriate.

#### **Scientific literacy (collecting, evaluating and using scientific data)**

This collection of skills, that forms the basis of *scientific literacy*, was assessed during Exercises 2 and 3. In Exercise 2, an online database was used to select foods for the lunchbox. The database contained calorie and nutritional composition data for various types of food. Every data point was calculated for 100 grams of the given food. For the exercise comparing packets of food, the data were taken from the labels on the packaging. For the table, the students had to find the group of the chosen food and the data for that group, and compare the results. Since the table showed a lot of data, the students first had to decide which of these to use, and the decision was based on the arguments of individuals in the group. For ready-made meals, distinguishing between proportions (per 100g) and absolute quantities (dependent on size of packaging) could present difficulties.



### **Planning investigations and their implementation**

In Exercise 4, the students worked in teams to plan an experiment to establish the fat content of a particular food. They used their prior knowledge and practical experiences to choose the appropriate method of investigation and the tools and materials – in the right quantities – needed to carry out the experiment. The evaluation of the students’ performance included their safe use of experimental equipment and the method of calculating the results based on the data, as detailed in the four performance levels in Table 3.

**Table 3: Assessment of planning investigations**

Emerging	Developing	Consolidating	Extending
Does not have any ideas about how to plan the investigation or actively participate in the teamwork. Follows the calculation of the answers passively.	Has some ideas about how to plan the investigation and what method to use but has no confidence in implementation. Needs help to calculate the answers.	Chooses an appropriate method of investigation and can support the choice with arguments. Can plan the details of the investigation. Can calculate the answers correctly.	Speaks and writes ideas in the form of decisions and invariably supports them with appropriate arguments. Adopts or refutes others’ arguments as appropriate.

### **Working collaboratively (communication and collaboration)**

In Exercise 2, these skills were evaluated similarly to the window method based on the students’ tables and written work. In Exercise 4, the investigation was in part planned individually in writing and in part by oral communication in groups. The assessment of the latter involved the observation of the team focusing on a few students (mostly those with learning difficulties). The teacher identified criteria for four levels of performance (Table 4).

**Table 4: Assessment of working collaboratively**

Emerging	Developing	Consolidating	Extending
Written communication lacks confidence, information or is entirely absent. Communicates more fluently in speech but lacks purpose.	Communicates fluently in writing but some information is missing. Attempts to express independent opinion but lacks confidence. Oral communication is more fluent and usually has purpose.	Communicates fluently in writing and expresses independent opinion with confidence. Communicates fluently and with purpose in speech but the arguments are not always apt. Listens to others and occasionally reflects on their opinions.	Communicates fluently in writing and expresses independent opinion with confidence. Communicates fluently and with purpose in speech and presents apt arguments. Listens to others, reflects on their opinions, shows flexibility and gives in to arguments if appropriate.

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

#### **Teacher’s opinion**

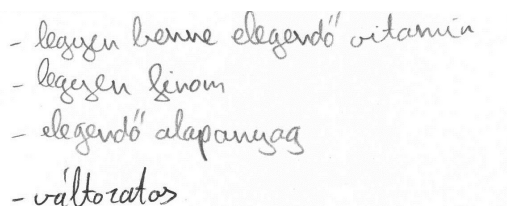
For assessment of students’ skill in critical thinking, two assessment methods were employed. First was on-the-fly interactions, where we observed some students during the activity and gave oral feedback. Secondly, the students answered the questions in writing, which was a source of individual evaluation.

## Sample student artefacts

### Scientific reasoning (making reasoned decisions)

In addition to the “window” method, the students also filled in individual worksheets. This skill was evaluated by looking at the student response to the core question on worksheet I. Packed lunch (Figure 3): “What criteria will you use? List them in this box!”

Figure 4 shows an example of performance at an emerging level. It contains some general observations, but few facts or data. An example of decision-making at a developing level is shown in Figure 5, which demonstrates more differentiated knowledge but not sufficiently detailed in either quantity or quality. Figure 6 shows an example of work at an extending performance level. This student names specific foods, argues based on evidence and calculates answers.

- 
- legyen benne elegendő vitamin
  - legyen finom
  - elegendő alapanyag
  - változatos
- *It should have enough vitamins*
  - *It should taste nice*
  - *Enough ingredients*
  - *Varied*

**Figure 4: Decision making at an emerging level.**

Lényegi kérdés: Milyen szempontok alapján tudnád összeállítani? Sorold fel ezeket az alábbi mezőben! C - vitamin, telítettség, zsír, koleszterin, szénhidrát, fehérje. Ezek alapján lehet összehasonlítani.

Core question: What criteria will you use? List them in this box!

**Vitamin C, saturated fat, cholesterol, carbohydrate, protein. These are the considerations.**

**Figure 5: Decision making at a developing level.**

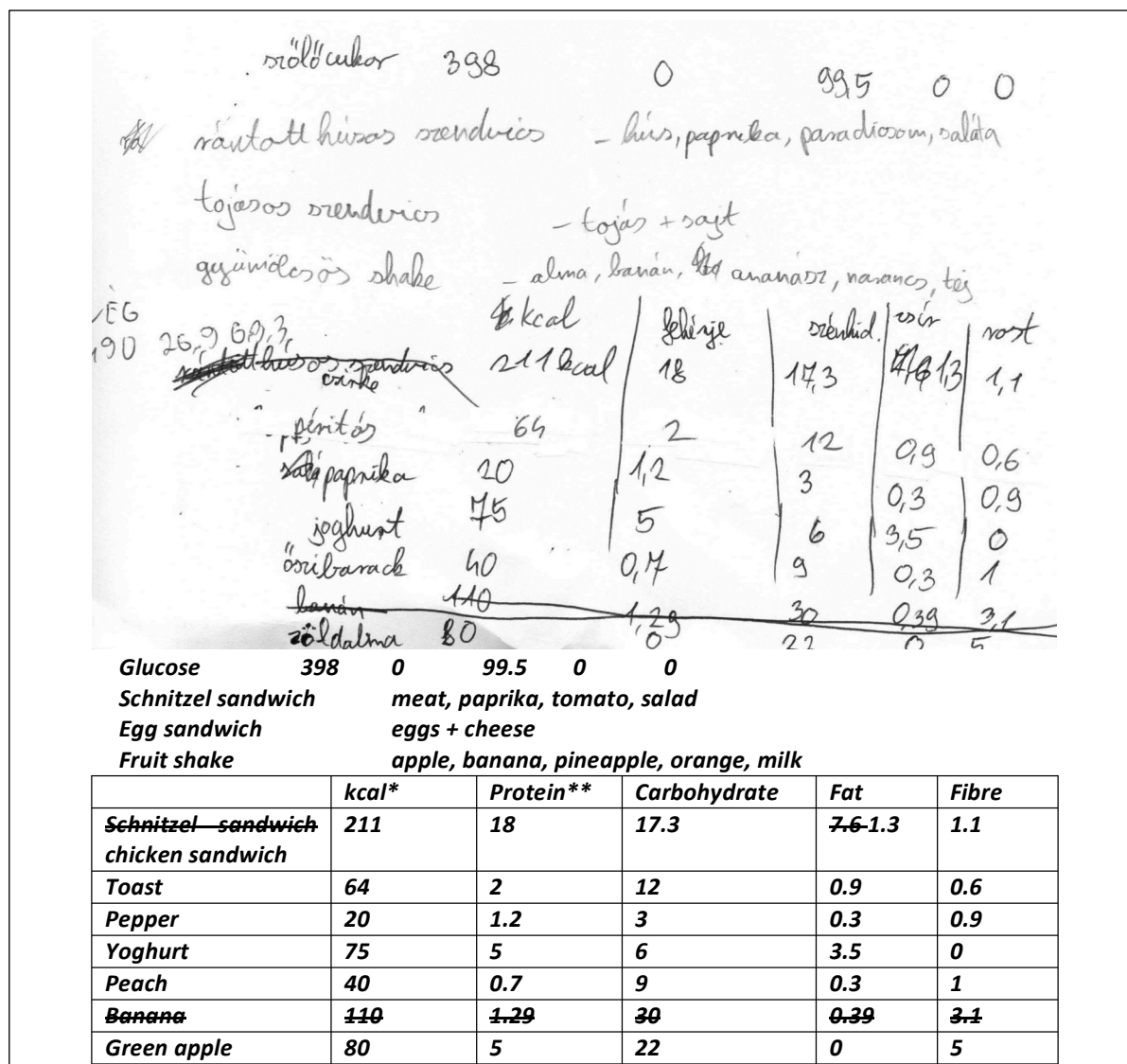


Figure 6: Decision making at an extending level.

### Scientific literacy (collecting, evaluating and using scientific data)

Evaluation of this skill was based on student responses in the Comparing foods exercise (Figure 3). Students were asked to record the proportional values per 100 g of food in the provided worksheet (*chips* = potato chips, *camamber* = camembert cheese, *só* = salt, *leves* = soup), and to identify which food has the highest content of protein (*fehérje*), carbohydrate (*szénhidrát*) and fat (*zsír*) in absolute and proportional terms.

For example, Figure 7 shows work that is evaluated as consolidating level. The student has collected correct and sufficiently detailed data, differentiates between and marks proportions and absolute values (15 g, 12 g of product).

- 1) Chips: SÓSPA'LCIKA  
Fehérje: ...9.7g.....  
Szénhidrát: ...71.3g...  
Zsír: ...6.2g.....  
Rost: ...3.5g.....  
Só: ...1.43g.....
- 2) Camamber: (1 adagban) (15g)  
Fehérje: ...3.2g.....  
Szénhidrát: ...0.2g...  
Zsír: ...2.3g.....  
Rost: ...0g.....  
Só: ...0.3g.....
- 3) Só: LEVES (1 adagban) (12g)  
Fehérje: ...1.1g.....  
Szénhidrát: ...8.2g...  
Zsír: ...6.5g.....  
Rost: ...0.3g.....  
Só: ...0.8g.....

**Figure 7: Performance level of consolidating for collection and evaluation of scientific data. Sós pálcika = bread sticks, adagban = single portion, rost = fibre**

Further examples of collection and evaluation of scientific data are shown in Figure 8. The first example (Figure 8a) was assigned a performance level of “developing” as data collection is correct but incomplete and there are no signs of interpretation. For the other examples, the teacher assigned a performance level of “consolidating.” Figure 8b uses marks appropriate to the task (x) but the solution is incomplete, while in the example shown in Figure 8c the answer is incomplete but data are used as evidence and the interpretations are marked.

(a)

		Chips	Camamber	Leves
Abszolút mennyiség	Fehérje	9,7 g	3,2 g	1,1 g
	Szénhidrát	71,3 g	0,2 g	8,2 g
	Zsír	6,2 g	1,3 g	0,5 g
Fajlagos mennyiség	Fehérje			
	Szénhidrát			
	Zsír			

(b)

		Chips	Camamber	Leves
Abszolút mennyiség	Fehérje		X	
	Szénhidrát	X		
	Zsír		X	
Fajlagos mennyiség	Fehérje			
	Szénhidrát			
	Zsír		X	

(c)

		Chips	Camamber	Leves
Abszolút mennyiség	Fehérje	4,365 g	25,2 g	1,1
	Szénhidrát	31,95 g	1,44 g	8,2
	Zsír	3,3 g	18 g	0,5
Fajlagos mennyiség	Fehérje			
	Szénhidrát			
	Zsír			

**Figure 8: Examples of collection and evaluation of scientific data**

### Planning investigations (and implementing investigations)

This skill was assessed based on the final exercise, in which students determined the quantity of fat in some food. Students completed a worksheet (Figure 3), in which they were asked to write down the steps of their experiment.

Figure 9 shows an example of student performing at an “emerging” level. They list some of the steps but not all and quantities and measurements are not specified. An example of the developing performance level is shown in Figure 10, where the student lists the steps of the investigation mostly correctly and specifies quantities. However, an unnecessary step is included (*mixing with water*). An example at the consolidating level is shown in Figure 11; here the student lists the steps and procedures with quantities shown and correctly calculates the answer from the data. However, possible sources of error are not mentioned and the accuracy of the results cannot be estimated.

<p>Írjátok le a tervezett vizsgálat menetét!</p> <p>6. 10g-ot a morzsában szétörköltem 6. 10g-ot összekevertem a Hexán-nal lesűríttem 6. lezött üledéket megmértem (hogy mennyi ismételt mérés van)</p>	<p>Write down the steps of the experiment.</p> <p><b>Write down the steps of the planning investigation:</b></p> <ul style="list-style-type: none"> <li>- Smashed the salty sticks in a mortar</li> <li>- Mixed the smashed salty sticks with hexane</li> <li>- Filtered the mixture</li> <li>- Measured the weight of the dried residue</li> </ul>
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**Figure 9: Planning investigations at an emerging level.**

<p>1. morzsátban összetörjűk 2. ráöntjük 5 cm<sup>3</sup> Hexán 2. Petrih csészébe öntjük és megmérjük 3. 1 Indulási tömeg 12 gram 4. elhanyagoljuk 100 cm<sup>3</sup> vízzel 5. lesűrítjük (szűrőpapír + szűrő)</p>	<p>1. Smashed in a mortar 2. Poured into a Petri-dish and measured it's weight 3. Mixed with 100 cm<sup>3</sup> water 4. Filtered (with paper filter)</p>
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**Figure 10: Planning investigations at a developing level.**

<p>Írjátok le a tervezett vizsgálat menetét!</p> <p>Sajt: súly: 62.99g sajtot felaprítjuk kis darabokra 50cm<sup>3</sup> hexánt adunk hozzá szűrőpapírral ⇒ lecsúsz a zsír a vízbe összemoszódik a sajt vakuummal lesűrítjük a hexánt a vízzel együtt megmérjük a megmaradt sajt súlyát és azt kivonjuk az eredeti súlyából és ennek az eredménynek lesz a százaléka eredeti súly - maradék súly = zsír súly 62.99 - 52.03 = 10.96 62.99      100% 10.96      x ----- 10.96 62.99 · 100 = 17.39% - ez a százalék</p>	<p><b>Cheese: weight: 62.99g</b> <b>slice the cheese to little pieces</b> <b>add 50cm<sup>3</sup> hexane to the pieces (hexane is a fat dissolver)</b> <b>shredding the cheese</b> <b>filtering the mixture with vacuum</b> <b>measuring the dried residuum, subtract it's weight from the original cheese weight, this result will be the total fat content.</b> <b>original weight – residuum weight = fat weight</b> <b>62.99 – 52.03 = 10.96</b> <b>62.99    100%</b> <b>10.96    x</b> <b>10.96/62.96 x 100 = 17.39 (% fat content)</b></p>
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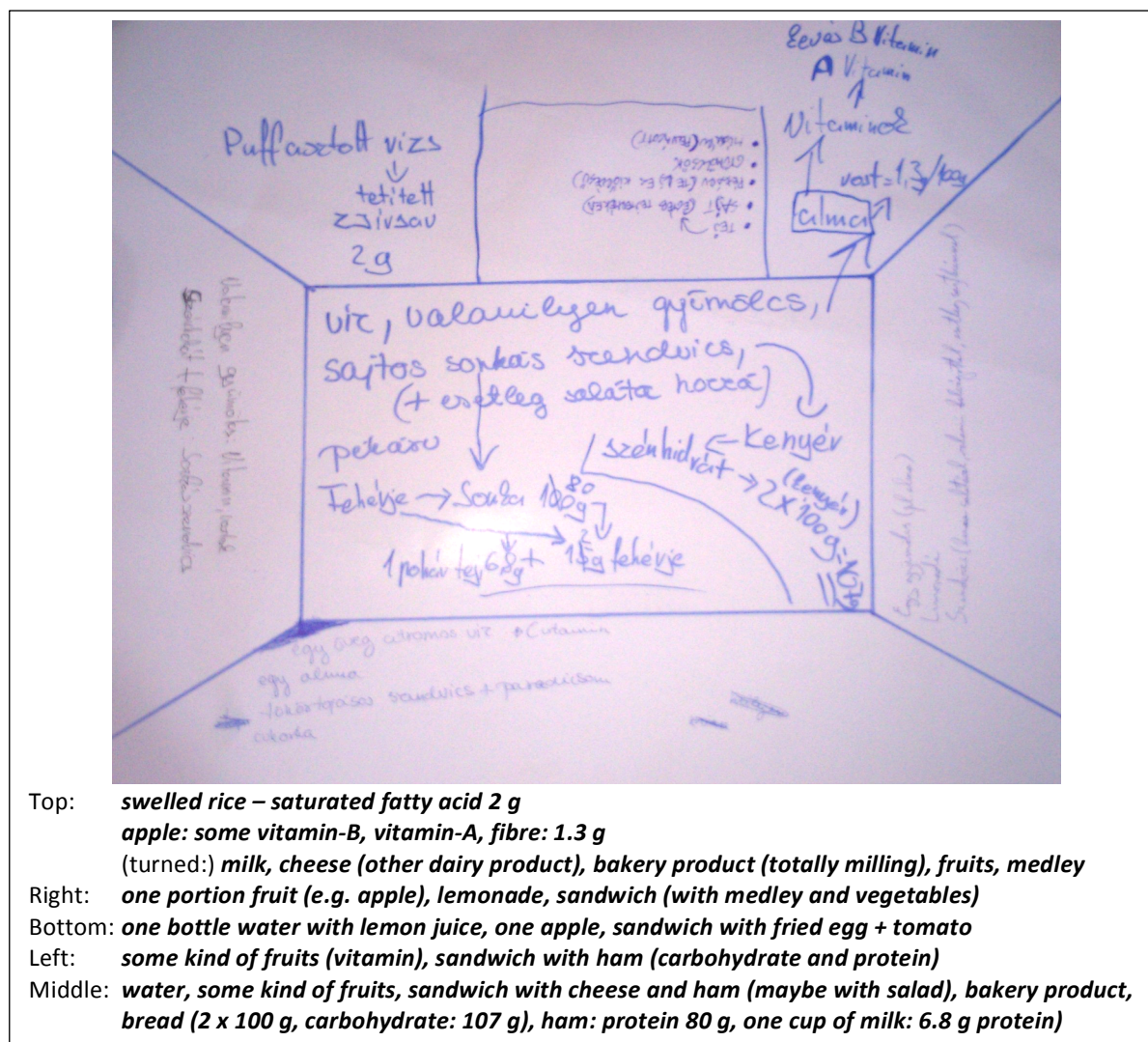
**Figure 11: Planning investigations at a consolidating level.**

### Working collaboratively

The students engaged in peer-peer structured dialogue, in which they used a placemat to record individual contributions and to decide on a group response. These were evaluated by the teacher to assess how the students cooperated and collaborated. In this way, it was possible for the teacher to evaluate student performance individually and as a group.

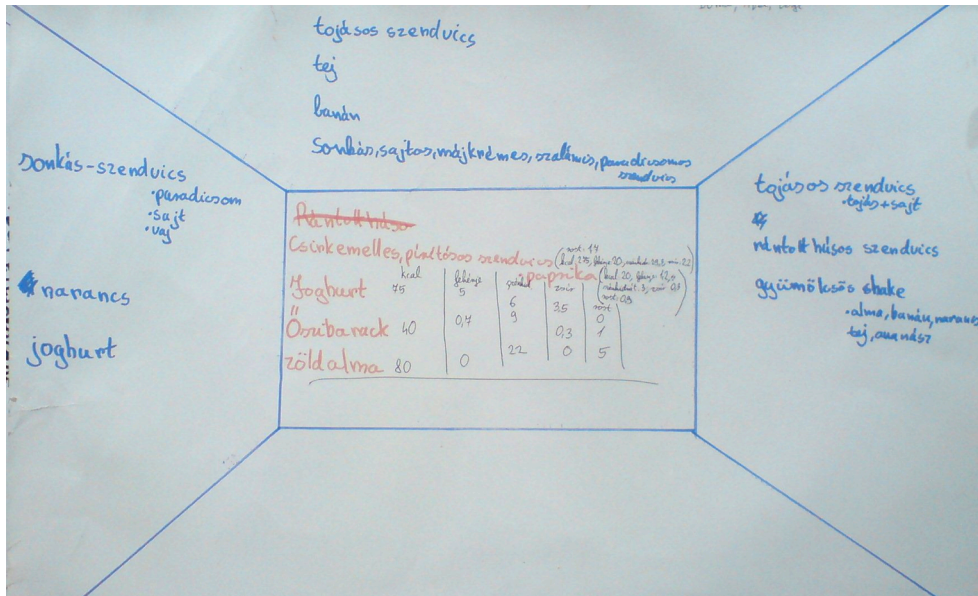
In the first example, Figure 12, the student working at the top of the page gave a detailed proposal covering quantities (*consolidating level*), while the student opposite, for instance, wrote only two sketchy ideas (*developing level*).





**Figure 12: Working collaboratively, example 1**

In the team shown in Figure 13, the individual students' ideas were rather superficial and incomplete but they put a reasonable answer together in the end (*developing level*).



- Top: sandwich (with egg, salami, liver paste, tomato) milk, banana,  
 Right: sandwich (with egg and cheese, wiener slice), fruit shake (apple, banana, orange, pineapple, milk)  
 Left: sandwich (with tomato, cheese, butter), orange, yoghurt  
 Middle: fibre: 1.7, protein: 20, carbohydrate: 29.8, fat: 22

	kcal	Protein	Carbohydrate	Fat	Fibre
Sandwich with toast and fried pigeon-breast),	275	20	29.8	22	-
Paprika	20	1.2	3	0.3	0.9
Yoghurt	75	5	6	3.5	0
Peach	40	0.7	9	0.3	1
Green apple	80	-	22	-	5

Figure 13: Working collaboratively, example 2

In the third example, three of the four members of the team (but not the one on top) prepared detailed and well thought out plans (Figure 14). The end result of the teamwork was also adequate but not as detailed as the individual plans (*consolidating level*).

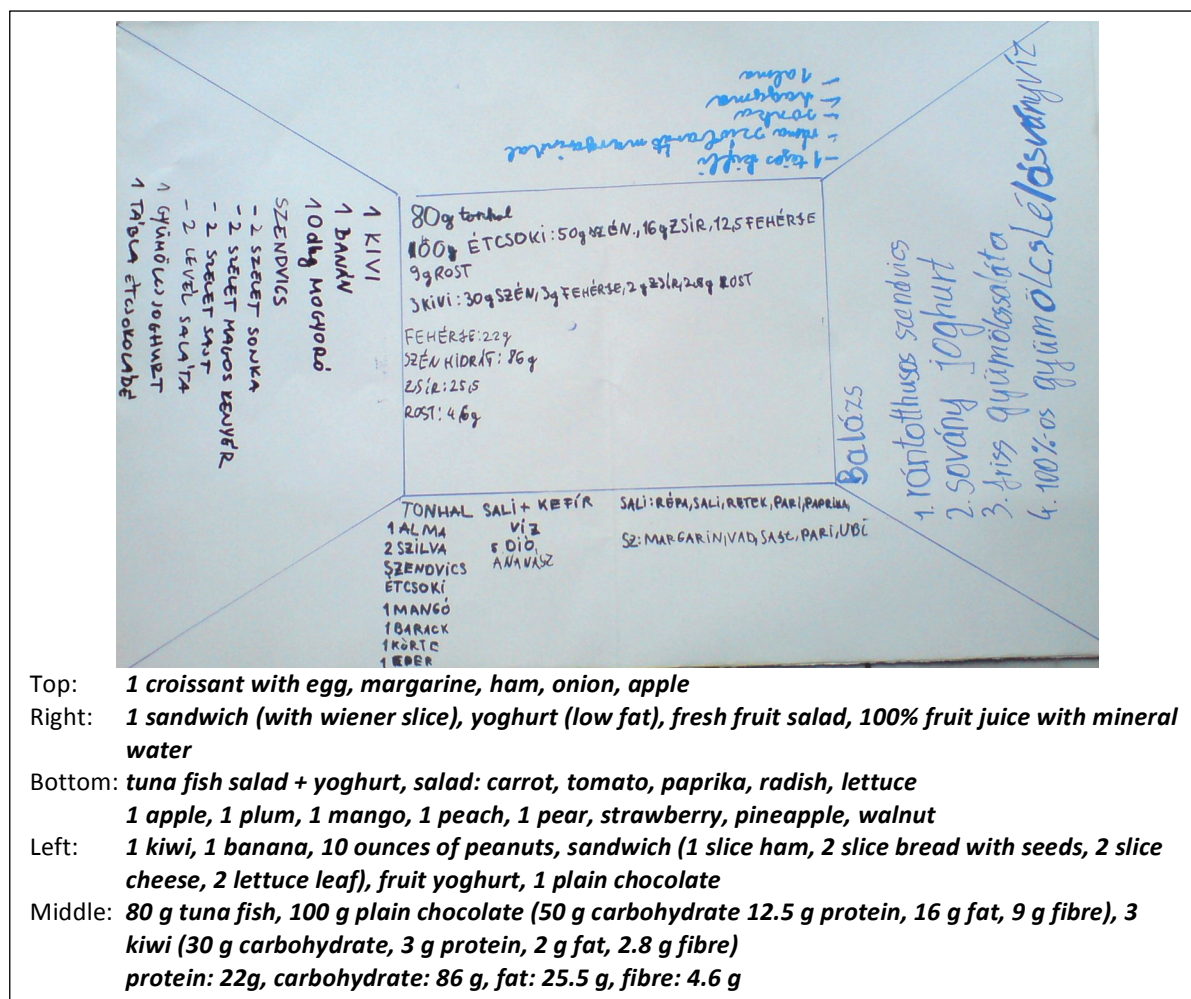


Figure 14: Working collaboratively, example 3