

Attachment 3: Original unit on sugars and enzymes planned according to ‘Chemie im Kontext (ChiK)’

Prior knowledge that the students have:

- They have a basic nutritional understanding of carbohydrates and sugars
- They have done detection tests and have experience of basic lab work and experimental setups

First unit			
Approx. time	Phases	Activity	Media/method
7 min	Contact phase (‘Begegnungsphase’)	The teacher lets the students taste different milks (1 = normal milk, 2 = plant-based milk, 3 = lactose-free milk); pupils articulate their perceptions of different flavours Some students may already say that they can’t drink milk and explain why.	Packages of different milks (names covered) Testing of different milks (milks & cups prepared in advance) Class discussion
10 min	Curiosity and planning phase (‘Neugier- und Planungsphase’)	The students will come up with ideas; it is likely they will know about plant-based and lactose-free milk. The teacher asks them what they think the differences are between the three milks and why some are okay for vegans (and others for lactose-intolerant people). Why can lactose-intolerant people only drink milks 2 (plant-based) and 3 (lactose-free)? The students suggest which kinds of milk are in the different packages; the teacher lifts the covers of the packages (and shows them via camera).	Collecting ideas in a mind map, e.g. with the help of an e-board (e.g. Miro-Board)
10 min		The teacher asks the students to find out and write down the information that they will need to answer the questions. Questions:	Camera Recording the questions on a board (keep a record of them for later reference)
10 min		<ul style="list-style-type: none"> - What is lactose? - What are the contents of the milks 1, 2, and 3? - What do milks 2 and 3 have in common and what are the differences? 	Discourse between teacher & pupils

3 min		<p>The teacher encourages the students to recall what they know about different categories of substances in food/macromolecules in food and asks the students which category they think lactose could fall in.</p> <p>The class states what categories there are (carbohydrates/proteins/fats)</p> <p>The class develops a plan for research and experiments that should be done in the next lesson.</p> <p>The teacher assists by showing the students a list of detection tests for different substances, e.g. sugars in general, tests for special sugars, tests for other sweeteners, Woehlk test for lactose, tests for proteins, carbohydrates, etc. that they may choose from.</p> <p>To do lists are made: they plan to test the different milks with different tests, e.g. test for sugars or the Woehlk test to see whether there is sugar or lactose in all milks.</p> <p>Homework: do some research and find out what <i>lactose</i> and <i>lactase</i> are.</p>	<p>List of possible experiments</p> <p>e-board</p>
		Teacher: organize material for experiments and try to include ideas from the students.	

Second unit			
Approx. time	Phases	Activity	Media/method
8 min	Elaboration phase I (Erarbeitungsphase I)	The teacher starts the lesson by showing two powders (lactase and lactose) and naming them lactase and lactose.	Visualizer/camera Petri dishes with lactose and lactase
10 min		The teacher asks the students to explain the differences, as they have understood them to be from their homework assignment. Collection of facts: <ul style="list-style-type: none"> - Lactose is a sugar; it's also called 'milk sugar' - Lactose is a disaccharide, meaning it is built from two monosaccharides - Lactase is an 'enzyme' - Lactase can split lactose - The students may have found additional information about both that can be discussed and added to a mind map The teacher refers to the e-board from the last unit to show the questions => combines the questions with the new facts => new synthesis is visualized on the e-board.	Open-class discussion Mind map from the last unit on e-board (e.g. Miro board) e-board
15 min		The students form hypotheses with the help of the teacher and put them on the e-board, e.g.: <ol style="list-style-type: none"> 1. lactose-free milk does not contain lactose 2. normal milk does contain lactose 3. normal milk with added lactase no longer contains lactose 4. plant-based milk does not contain lactose 5. a positive blind test containing water and lactose should turn salmon pink 6. a negative blind test containing water, but no lactose, should turn yellow Maybe further hypotheses, e.g. <ol style="list-style-type: none"> 7. when lactase is added, milk tastes sweeter than before The students decide on work packages: which testing has to be done? The teacher has set up the results table in advance on the board.	Open-class discussion e-board with a table for results Materials for experiments

7 min		<p>Each group does a different test (numbered task) plus task 0. The students proceed with testing: Task 0. All groups do the negative and positive blind tests to be able to compare results Task 1. Test lactose-free milk Task 2. Test normal milk Task 3. Test normal milk after adding a lactase tablet Task 4. Test plant-based milk</p> <p>The teacher multiplies tasks so that pupils work in pairs. For the tasks, three different strengths of lactase pills may be used by different groups to make it more difficult. The students fill in blanks in the table on the e-Board.</p> <p>Groups record their results on the board when ready. Groups report their findings to others; results are discussed. All hypotheses could be confirmed.</p> <p>The students should interpret their results as homework: Is there lactose in lactose-free milk? .. normal milk? .. plant-based milk?</p>	<p>Worksheets with experimental protocols and lab reports for noting individual findings</p> <p>Group presentations Class discussion</p>
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Third unit			
Approx. time	Phases	Activity	Media/method
3 min	Elaboration phase II (Erarbeitungsphase II)	The teacher starts the lesson by showing a package of lactase pills and asks what this medication is for; the students say that the medication contains lactase and describe what they know about lactose intolerance.	PowerPoint world map of lactose intolerance discussion between class & teacher
40 min		The teacher shows a world map with the occurrence of lactose intolerance and encourages class discussion: Why are there differences? Why does the prevalence of lactose intolerance appear to be increasing? We need more information and, therefore, will do a learning cycle: Station 1: Lactose is a disaccharide (lactose is a dimer of glucose and galactose; the bond can be split by lactase; you need water for it) Station 2: Lactase as an enzyme (get to know the general function of an enzyme by watching a video; understand that ‘-ase’ indicates the name of an enzyme; information about lactase optimums and occurrence in the body) Station 3: Why is milk not a common ingredient used in Chinese cuisine? (Loss of lactase throughout life; development of life-long lactase production in history when goats and cows were kept)	

Fourth unit			
Approx. time	Phases	Activity	media / method
10 min	Connection phase (‘Vernetzungsphase’), Re-contextualization	Unit starts with the mind map and list of questions from the first unit: Answer all questions based on the new knowledge. The class will use the mind map to collate all relevant information about lactose intolerance => the mind map will be corrected, where necessary, and information added.	e-board
20 min		If there are questions that cannot immediately be answered or require discussion, a think–pair–share process may be used to find an answer or argument with the help of notes from preceding units.	class discussion think–pair–share technique
10 min		The teacher and pupils add further interesting information to the mind map in a third colour, e.g. <ul style="list-style-type: none"> - Other enzymes that are genetically distributed differently in the world, e.g. alcohol dehydrogenase - Other reasons for veganism 	The teacher has prepared additional information (graphics, data, etc.) that they want to give, e.g. via PowerPoint, for example, distribution of other enzymes in populations