C1 and C2 Inclusion: We burn sugar and Carbohydrates as providers of energy for metabolism – Starch and sugar

1 Main question

These experiments will give students insight into the metabolism of carbohydrates in the human body. It will be shown that many of our foods contain carbohydrates in the form of starch, sucrose, and glucose (sugar). The experiments also deal with the enzymatic cleavage and subsequent degradation processes of polysaccharides.
Students will become acquainted with the characteristic detection reactions for carbohydrates and the principle of catalyzed reactions.

2 Integrating the experiment into the teaching context

2.1 Basic principles

Students are often already familiar with metabolism in humans from elementary school. They have prior knowledge of what we should eat in order to be active. Food provides the energy for life. Students have already learned about the main constituents of food – fats, carbohydrates, and proteins – and can combine them to prepare a balanced and healthy meal, for example, for breakfast. In building on this knowledge, relationships will be established between the subject areas of nutrition, substance transport, respiration, and energy conversion. The topic of catalysis is covered via enzymes (C1 We burn sugar – Catalyst).

2.2 Relevance to the curriculum

Areas of expertise in selected curricula from Saxony-Anhalt

Biology in grade 7/8
Explaining system and system levels based on the example of humans, taking their environment into account

- Presenting metabolic processes in consideration of the interaction of the corresponding organ systems and explaining the significance for performance
- Conducting and logging experiments to detect nutrients
- Recognizing the correlation between an unhealthy lifestyle (for example, poor nutrition, alcohol and nicotine abuse, lack of physical activity, vaccine fatigue) and possible diseases as well as a decrease in quality of life, and deriving conclusions for one’s own behavior

Chemistry in grade 9/10
Describing chemical processes for producing vital substances
- Describing the controllability of chemical reactions through the use of catalysts

Home economics
5/6 Leading a healthy lifestyle and maintaining wellbeing in a household

7/8 Selecting foods and evaluating their health benefits

9/10 Examining and evaluating nutritional behavior

The students will …
- know the constituents of food in a wide variety of foods.
- know the path taken by food in the human body.
- be able to carry out detection reactions for carbohydrates and explain the observed phenomena.
- be able to summarize the basic principles of energy conversion through catabolism.
- be able to apply the principle of sugar combustion to the metabolic processes.

2.3 Experimental variations

The experiments for detection and hydrolysis of starch (C2 “Verification of starch and sugar in unchewed and chewed bread”) do not require much material or time, and they can be integrated into lessons as student experiments that can be conducted individually or in pairs. Because of the complexity of the overall topic of nutrition, digestion, and cell metabolism, teaching methods are available to spur students to action. These methods provide additional material for background information in addition to the experimental approach.

The “Sugar can be burned” experiment (C1 “Catalyst”) demonstrates that sugar can be burned and that a catalyst is necessary for this. Students will first try to light a sugar cube. Then they will light a sugar cube sprinkled with ash in a tea light holder. To verify water, they will hold a cold test tube over the flame for a few seconds. This leads to the conclusion that a catalyst is required to burn sugar. This provides a good starting point for discussion of the enzymatic processes in human metabolism. Catalysis and catalysts can also be addressed.

Typical examples of such approaches could be learning at workstations or group puzzles. These methods are also well suited to the different learning paces and progress rates of individual students. The hints allow students to work at different levels. Visualization of how to conduct the experiments provides support in the sense of inclusive lessons.

3 Additional information on the experiment

You will find additional media for preparing or for further study of this experiment on the Media Portal of Siemens Stiftung: https://medienportal.siemens-stiftung.org.
(See the teacher instructions from Experimento | 10+: C1 We burn sugar and C2 Carbohydrates as providers of energy.)