C1 We burn sugar – Cellular respiration and respiratory chain

1 Sugar can be burned

1.1 Apparatus and materials

- 1 bowl, aluminum (fireproof base)
- 1 lighter (gas igniter)
- 1 scrap of paper
- 1 sugar cube
- 1 tea light
- 1 test tube, glass, 13 cm
- Water

Attention: After you have completed the experiment, return the materials or dispose of them properly as instructed by your teacher.

1.2 Safety information

The materials may be used only as instructed by your teacher or as described in the experimentation instructions.
For this experiment, be aware of the following risks:

- Take care when working with the lighter that you don't burn yourself or start a fire.
- The sugar cubes are not suitable for consumption. They get hot during this experiment, so don't burn yourself.

1.3 Conducting the experiment

- Take the tea light out of its metal cup.
- Place the sugar cube in the metal cup and try to light it with the lighter.

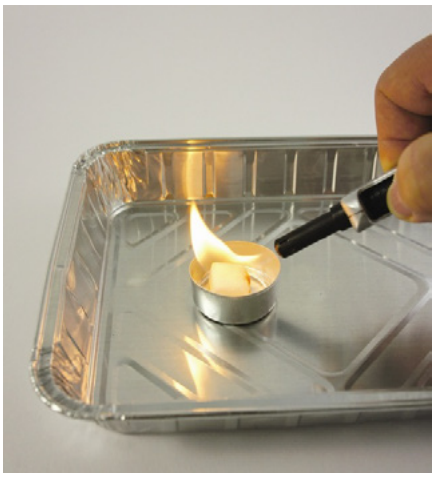

Fig. 1: Attempt to light the sugar with the lighter flame.

- Place a piece of paper (approx. 1.5 cm x 1.5 cm) on the sugar cube, ignite it, and wait until it is completely burned.
- Rub some of the paper ash onto the surface of the sugar cube.
- Push the remaining ash into a pile on one side of the sugar cube.
- Now hold the lighter flame against the side of the sugar cube with the ash until the sugar cube melts and caramelizes.

Fig. 2: A piece of paper is placed directly on the sugar.

- Make sure to heat the sugar in the hottest part of the lighter flame. (Hold the sugar only in the foremost third of the flame tip!) If you hold the sugar too low in the blue section of the flame, the flame may be too cold to ignite the sugar.
- It is not possible to ignite the sugar cube until the brown molten mass mixes with the ash.
- Now hold a test tube filled with cold water about 2 – 3 cm above the flame.
- Do you notice a change in the test tube?

Fig. 3: The cold test tube above the sugar flame.

1.4 Observation

Write down a summary of your observations.

1.5 Analysis

a) Explain your observations.
b) Formulate a reaction equation or word equation for the burning of the sugar.

1.6 Questions

a) What is the name of the reaction type to which combustion processes belong?
b) What happens at the particle level during combustion?
c) What properties must the reaction partners have in a combustion process?
d) What effect does the ash have in our experiment?

2 Verification of reaction products in the air that is breathed: Substance A

2.1 Apparatus and materials

1 test tube, glass, 13 cm

Attention: After you have completed the experiment, return the materials or dispose of them properly as instructed by your teacher.

2.2 Safety information

The materials may be used only as instructed by your teacher or as described in the experimentation instructions.

2.3 Conducting the experiment

Breathe on a clean test tube.

2.4 Observation

Write down a summary of your observations.

2.5 Analysis

Explain your observation.

2.6 Questions

a) What is the name of the gas (substance A) in the exhaled air that condenses on the test tube?
b) This experiment verifies a reaction product of human metabolism. What substances are converted in the body and how do they get there? How do these starting substances get into your body for further conversion?

3 Verification of reaction products in the air that is breathed: Substance B

3.1 Apparatus and materials

- 1 drinking straw
- Mineral water containing a lot of carbon dioxide
- 3 pH test strips
- 3 plastic cups, 100 ml
- Water (distilled water, if available)*

*Tap water (a pH value of about 7.0 – 7.5 is perfectly suitable).

Attention: After you have completed the experiment, return the materials or dispose of them properly as instructed by your teacher.

3.2 Safety information

The materials may be used only as instructed by your teacher or as described in the experimentation instructions.
Remove all water-sensitive materials from your workspace.

3.3 Conducting the experiment

- Prepare the cups and pour
  pure water into the first cup,
  pure water into the second cup,
  and, if available, mineral water into the third cup.
- Put a pH test strip into each cup.
- Exhale air into the second cup through a straw.
  Keep blowing until at least one color on the pH test strip changes visibly. That can take 5 - 10 minutes.
- Ascertain the pH values for all three water samples by comparing the color of the test strips with the color scale on the package. Note down the values.

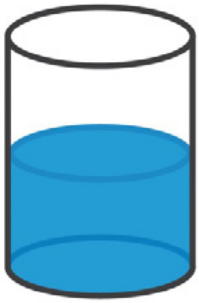

Fig. 4: Distilled water.

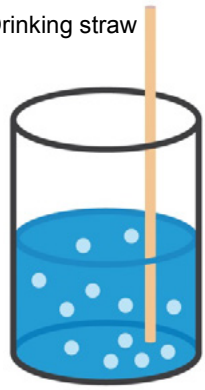

Fig. 5: Water with exhaled air.

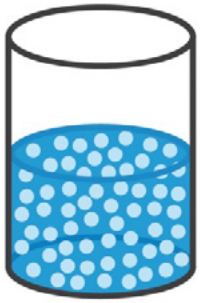

Fig. 6: Mineral water.

3.4 Observation

Write down a summary of your observations.

3.5 Analysis

a) Explain your observations.
b) What is the name of the gas contained in the air exhaled by humans and which can be verified by this experiment?
c) What is the gas escaping from the mineral water?
d) This experiment verifies a reaction product of human metabolism. What is the name of the starting substances of these reactions? How do these substances get into your body for further conversion?

3.6 Questions

What are the processes that take place in the human body for breaking down the carbohydrates that are absorbed with food? Explain them.