This resource has been developed through the SAILS Teacher Education Programmes (2012-2015) but was not developed as a finalized SAILS Inquiry and Assessment Unit. These materials are shared to inspire further use of inquiry and assessment of inquiry skills in the science classroom.
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Title: decomposition of starch in saliva

Level: 14-15 years of age
Course: science, biology
Time: 90 min.

1. Theme
The task is related to the subject of metabolism. The students have acquired knowledge of cell and body metabolism earlier. They are already familiar with healthy diet and the problems of unhealthy eating. They know the most important nutrients. They understand the properties of materials and energy. All of them understand laboratory procedures, the basic handling of the most common chemicals and compounds.

2. Contents
All throughout, we will use elements of inquiry based learning:
- Prior knowledge of students
- Inquiry guided by the students
- Consideration of alternative methods and approach
- Questions to support independent learning
- Solving of unstructured problems
- Group work

Depending on the skills of the students and their prior knowledge the task can be unstructured or half structured.

3. expected readiness and skills
- Presuppositions
- Planning experiments
- Measurement
- Recognizance of connections
- Recognizance of variables
- Observation of experimental processes
- Communicating observations
- Cooperation in a group
- Utilization of scientific knowledge in everyday life

4. Learning goals (expected results)
- The deepening of knowledge of the gastrointestinal system, through experimentation
- The understanding of enzyme functions
- Processes that modify enzyme function
5. **Learning activity**

**Defying the problem:**

Carbohydrates are the essential nutrients of the human body. These are the prime source of energy in our body. If we do not get sufficient energy, we become tired, headache kicks in and we begin to long for sugary foods: chocolate cookies, donuts, sugary soft drinks appear in our minds. However it matters what sort of carbohydrates we provide our body with. Starch contained in bread, potato or rice provides more than half of our calorie requirement.

Their digestion begins in the oral cavity. How could one prove that enzymes in the saliva begin digestion to simple sugars? Does temperature affect the enzyme's function?

**Unstructured task**

**Recommended activity during the lesson**

**Attunement:**
- Talking about the student's eating habits: favorite foods, drinks
- Changes in nutritional habits: (canteen, fast food)
- Nutritional pyramid
- Starch containing foods

**Assessment of prior knowledge:**
- The role of nutrients taken up by the body
- Cellular metabolism
- Chemical composition of cells
- Plant structures that contain starch
- Detection of starch

**Work form:**
- Group work

**Teacher's instructions:**
- In groups of 3-4, design and carry out an experiment to detect enzyme activity and to determine amylase function.
Equipment available for the experiment:

Required equipment: accessories for water bath, pipettes, white ceramic, test tubes, test tube holder
Required materials: starch solution, Lugol’s-solution, purified water, saliva

Teacher’s instructions:
- After formulating the inquiry questions, consult with the teacher!
- Plan the step by step procedures!
- Perform the experiments and write down the observations!

Teacher support:
- Formulation of interpretative questions (constant, variable)

Performing the task:
1. Selection of materials and equipment
2. Planning of the process and designing of the experiment
3. Taking account of the variables

Helpful questions:
- What materials can be detected with the Lugol’s-solution?
- What is the structural explanation of the color change?
- What does starch decay into due to the amylase in saliva?
- What environmental conditions are required for the enzyme to work efficiently?

Mathematical skills:
- How could the color change be depicted on a graph in correlation to time?
- What instruments are suitable for measurement?

Experiments:
The demonstration of enzyme function through the action of amylase on starch
The effect of temperature on the process

Recording of steps:
- Writing of protocol
- Table chart

Partially Structured Task

In case the students fail to continue the task, the following instructions are recommended:

Teacher support for carrying out the experiment
- How can it be determined that the decay of starch has begun in the saliva?
- How does temperature affect enzyme functions?
- How fast is the starch decay process?
- What factors determine enzyme activity?
Teacher’s support for interpretation

Constants and variables: Identify the various variables during the experiment: independent variable (that changes), dependent variable (that is observed) and the constant variable (that can be taken as constant during the experiment)

How can you detect amylase in saliva?
What material can be detected with Lugol’s-solution?
What is the structural explanation for color change?
What does starch decay into due to amylase?
What factors determine enzyme activity?

Supportive questions to aid the experiment.

Steps of the experiment

Preparation of saliva solution:
1) Put 1dl of purified water into a plastic cup!
2) Wash mouth with 0,5dl of water and spit it into the cup!
3) Repeat the process!

Detecting amylase
1. Put 1ml of saliva solution into a test tube!
2. Add 2ml 0,1% starch solution to the test tube!
3. Put the test tube into a 37 Celsius temperature bath!
4. Take samples every 5 minutes and put a drop from it on the white ceramic plate! Add a drop of Lugol’s solution!
5. Repeat the above mentioned until change appears

Helpful questions:
What do you observe when adding the Lugol’s solution?
What difference appears compared to the first sample at the end?

Experimental steps:
How does temperature affect the decay of starch?
Carry out the experiment with:
1. Place the test tube into icy water
2. Place the test tube into boiling water
What difference do you observe?

Recording of the steps taken: table chart
The decomposition of starch with amylase

<table>
<thead>
<tr>
<th>Experiment Change</th>
<th>Starch solution + saliva</th>
<th>Starch solution + purified water</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 min</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

How does the temperature affect the experiment?

<table>
<thead>
<tr>
<th>Time</th>
<th>icy water</th>
<th>boiling water</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 min</td>
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<td></td>
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<tr>
<td>20 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 min</td>
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</tr>
</tbody>
</table>

6: Evaluation:
Support for the formative evaluation
Before the task:
  • Laying down the evaluation principals
    Understanding the task
    Formulating inquiry questions
    Setting up the experiment
  • Assessing prior knowledge

During the experiment:
  • Observing the activity: How do the students work in group?
  • Observing the planning: Setting up the experiment, formulating inquiry questions
  • Manual work: Experimental process

After the task:
  • Feedback, evaluating the work done
  • scientific knowledge
    Understanding enzyme function
    Understanding the conditions of enzyme function
    Starch content of foods
  • developing casual thinking
  • developing oral expression
  • carrying out an experiment
  • assembling a work portfolio (protocol, pictures, video)
**Aspects of formative evaluation**

<table>
<thead>
<tr>
<th>aspects</th>
<th>skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral expression</td>
<td>- You use the terminology accurately and confidently.</td>
</tr>
<tr>
<td></td>
<td>- You know the terminology, but sometimes fail to use it.</td>
</tr>
<tr>
<td></td>
<td>- You do not know the terminology.</td>
</tr>
<tr>
<td></td>
<td>- You can communicate in accordance to the situation.</td>
</tr>
<tr>
<td></td>
<td>- You do not communicate in accordance to the situation.</td>
</tr>
<tr>
<td>Designing and implementing an</td>
<td>- You can carry out the experiment, you make accurate observations,</td>
</tr>
<tr>
<td>experiment</td>
<td>you understand the connections and you record your observations</td>
</tr>
<tr>
<td></td>
<td>in writing or depiction.</td>
</tr>
<tr>
<td></td>
<td>- With help, You can carry out the experiment, you make accurate</td>
</tr>
<tr>
<td></td>
<td>observations, you understand the connections and you record your</td>
</tr>
<tr>
<td></td>
<td>observations in writing or depiction.</td>
</tr>
<tr>
<td></td>
<td>- You are unable to carry out the experiment, make accurate</td>
</tr>
<tr>
<td></td>
<td>observations, you don't understand the connections and you don't</td>
</tr>
<tr>
<td></td>
<td>record your observations in writing or depiction.</td>
</tr>
<tr>
<td>Casual thinking</td>
<td>- You are able to identify and recall connections.</td>
</tr>
<tr>
<td></td>
<td>- With little help, you are able to identify and recall connections</td>
</tr>
<tr>
<td></td>
<td>- You are only able to identify connections with help and support</td>
</tr>
<tr>
<td>Logical thinking</td>
<td>- You are able to follow an occurrence and can understand the</td>
</tr>
<tr>
<td></td>
<td>reasons behind it, you use induction and deduction.</td>
</tr>
<tr>
<td></td>
<td>- With help, You are able to follow an occurrence and can understand</td>
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<td></td>
<td>the reasons behind it, you use induction and deduction.</td>
</tr>
<tr>
<td></td>
<td>- With help, You are able to follow an occurrence and can understand</td>
</tr>
<tr>
<td></td>
<td>the reasons behind it, you don't use induction or deduction.</td>
</tr>
</tbody>
</table>

**7. Taking the task further:**

It becomes possible to utilize the skills and knowledge gathered by the students in later instances:

- Blind test: How does the process work without the presupposed material
- How many experiments are needed for all the process variations?
- How does pH change affect enzyme activity?
- The skill acquired during the experiment can be utilized in other experiments.

Inductive thinking, finding similarities.