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## **TEACHING IDEAS SHARED FROM SAILS TEACHER EDUCATION PROGRAMME**

### **Rate of Changes**



*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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## Unit: Rate of changes

**Level:** 14-15 year-olds

**Duration:** 2 lesson (90 min)

### 1. Topic

The rate of changes happening in our environment depends on some factors. Getting to know and controlling them are very important in technology and in everyday life. In the task students examine such changes which happen with participating solid and liquid materials. These changes depend on the measure of surface of solid material, and the streaming near the surface of the solid material, the stirring. The examined melting and dissolving are physical changes, on the other hand the solving by an acid is chemical change. The task can be used in physics in connection with dissolving and in general the rate of changes, and in the chemistry during learning about the rate of chemical reaction.

### 2: Content

The tasks start with a funny and exciting experiment, it is unstructured but if it is needed the teacher can give instructions. Then groups have to define the factors which affect the rate of observed change. They have to work out an experiment in order to define the connections between the measure of the factors and their effects using quantitative aspects.

In the following task the groups work with two different materials but they have to use the previously defined factors and they have to observe and measure.

In the third part of the task the observed change leads to a similar result, the solid material solves. However a further change can be recognised, some gas releases.

The identification shows that a new material appeared, so a chemical change happened. The weight of the system reduced due to the realised gas, it can be measured so the process can be followed in this way.

### 3: Inquiry skills

- Safe and practical use of materials and equipment
- Forming and justification a hypothesis
- Planning an experiment
- Observation
- Measuring
- Collecting and handling data
- Drawing a graph
- Data/evidence based inference
- Analysing and sorting
- Effective communication
- Sense the connections between phenomena



#### 4: Suggested learning sequence

**1<sup>st</sup> stage:** Melting – Change of one material

*Melting of an ice cube*

Task:

- a) The groups get the same sized ice cubes. They have to melt these cubes in the same amount of water as quick as possible. Using the available tools on the base of their own ideas they have to find out procedures accelerating the melting.
- b) On the base of their observations they have to express (in written form) the factors used by them.
- c) On the base of previous statements they should plan an experiment in order to define the exact quantitative rate of the factors (shredding and stirring).

**2<sup>nd</sup> stage:** Dissolving – interaction between different materials (solvent and soluble material)

*Solving salt in water*

Task:

- a) Groups examine previously identified factors using rough salt and water
- b) Form hypothesis in connection with different experimental setting.
- c) Plan and carry out an experiment during this they should prove their previous idea.

**3<sup>rd</sup> stage:** Dissolving - *as a result of a chemical change*

*Dissolving limestone in acid*

1<sup>st</sup> task:

- a) Groups have to shred the limestone and separate them into three different sized samples (rough, middle, soft).
- b) Form hypothesis in connection with the solving time of the limestone samples.
- c) Examine the rates of change working with the help of measures chosen by them.
- d) On the base of observing changes make differences between three changes. Define the characteristics of chemical change.

2<sup>nd</sup> task:

Plan investigation in order to follow the chemical reaction in time, measure the rate of change.

Instructing questions:

- Which changes can be measured?
- Which measuring series should be carried out so that to follow the change?
- How can you draw the data measured in three samples on a graph?
- Which inferences can be made on the base of these graphs?
- Could the series of measures verify the hypothesis?

Tools and materials:

Ice cubes, rough salt, rough limestone, 20% hydrochloric acid, beaker, stirring stick, spoon, mortar, strainer with different holes.

## 5: Assessment opportunities – evidence of learning

### 1<sup>st</sup> stage: Melting

**Activity:** Observing and accelerating the melting of an ice cube

**Assessment (optimal achievement):**

Concept	Inquiry skills	Reasoning	Literacy
Inventing the factors affecting the rate of changes (increasing the surface and stirring) on the base of the previously acquired experiences.	Exact questioning with the goal of inquiring certain phenomena. Planning experiment appropriate for quantitative definitions on the base of (qualitative) observing phenomena .	Making conclusions on the base of experimental results. Using quantitative aspects and rating in connection with the factors and and their effects.	Make some connection between the observed change in experiment and the phenomena of everyday life and environment. (e.g. melting frozen foods or melting the Earth's cryosphere.)

### 2<sup>nd</sup> stage: Dissolving

**Activity:** Examining the solving salt in water, use of previously defined factors

**Assessment (optimal achievement):**

Concept	Inquiry skills	Reasoning	Literacy
Distinguishing the melting and solving on the base of different materials in participating in changes (solvent and soluble material).	Form hypothesis and experimenting in order to verify it Planning measurements, collecting and handling data (solving time in case of different size samples and stirring)	Analogical thinking, using a rule in a diffent context. Making conclusion using quantitative data (solving time in case of the same amounts)	Using the concepts of rate of changes in everyday life and in technology (e.g. cooking, medicines, fertilisers use).

### 3<sup>rd</sup> stage: Dissolving as a result of chemical reaction

**Activity:** Investigating the solving of limestone in acid

**Assessment (optimal achievement):**

Concept	Inquiry skills	Reasoning	Literacy
Distinguishing the solving as a physical change from the chemical change, recognising differences between materials before and after the reaction.	Forming hypothesis (sorting the rates of changes) Planning and safe accomplishing the experimental work (shredding the limestone, handling the acids). Controlling variables (grain size, strirring).	Comparing, identify the change (distinguishing materials and conditions before and after). Sorting (grain size, rates of reaction)	Transferring knowledge in everyday life (e.g. eliminating dirt and limescale with chemical methods, accelerating processes with increasing the surface, e.g. decomposition, shredding).

## 7: Transfer

- The acquired knowledge during the task can be used in experimental investigations of other chemical reactions as well (e.g. solving rate)
- There is a possibility to find connections between everyday life, environment and technology, for the sake of this homework can be given (e.g. connection between the falling apart polar ice cap and increasing melting rate.)

- The heat has a difficult effect on these examined changes, further experiments could be carried out to inquire it.

