Filtration by a … constructivism point of view!!

Proposal for an experiment on filtration based on a constructivism teaching & learning approach[†], by Vicky Malotidi, MEdIES Secretariat

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Introduction & Objectives of the activity

The activity is about testing filtration with various water mixtures (e.g. water & soil; water & watercolor, etc.) in order to show that filtration is s process for the separation of suspended particles in a liquid. More specifically, the objectives of the activity, for the students, are the following:

- To understand the process of filtration.
- To develop the skills of setting up an apparatus.
- To explain the importance of filtration in the water treatment process.
- To practice the skills of making analogies.
- To find out the role of filtration in the natural processes and particularly, within the water cycle.
- To adopt an informed attitude towards protection of water resources from pollution from hazardous substances directly dumped in the water or buried in the ground (hazardous solid waste).

In this presentation an attempt was made in order to see how we can implement a simple experiment such as the present one, following a ***constructivism approach***: Words and ideas develop and change in meaning as children get older and as science progress over cultural and historical time. As our minds constantly try to make sense of our everyday experiences we build up "mental models" which begin to fit with incoming sensory data. The "core" of the *Constructivism teaching & learning approach* is that:

"Children come to school having already shaped their own ideas about the world; they are not 'tabula rasa'. Therefore, they need time, appropriate support and enabling learning environments to reformulate, when needed, their ideas according to the scientific ones, and to construct their own meanings".

Constructivism has as main principles the building of knowledge by the learners themselves with the appropriate coordination and support by the teacher, and thus, students' active involvement in the teaching and learning process.

A teaching model for conducting experiments based on constructivism includes five basic phases:

(a) Students' **Motivation**

(b) **Elicitation** of students' ideas

(c) **Reformulation** of students' ideas

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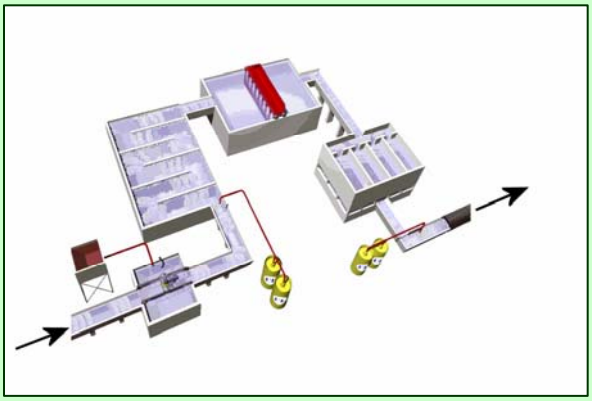
More info about the seminar at www.medies.net (see MEdIES Meetings).

(d) **Implementation** of the 'new' ideas
(e) **Reflection**

A. Motivation of students

In this phase students are introduced to the topic and the educator tries to challenge their interest and motivation on it. To this end, the educator could start with presenting relevant photos, slides, pictures, etc. and ask students to brainstorm on the "common thing" among them. For example, in the particular case, there could be photos of a coffee machine, a sketch of the water treatment process or a more "direct" photo of a paper filter (see the images below).



B. Elicitation of students' ideas

The educator should find out what are students' ideas about filtration; to this end, students may work in small groups or, in pairs, and:
- write three sentences using the word e.g. filtration or filters, or,
- brainstorm on relevant questions such as:

"How we could clean up water from suspended particles in it?" or
"Do what the water treatment process includes" or even,

"What do we think about filtration/filters?" ...

The educator may collect their answers, ideas and sentences on the board. With this way the **"picture of what students think about the topic"** is becoming clearer. We could also discuss their answers and then present the activity. By this way we enter to the next phase.

C. Reformulation of students' ideas

Students work in small groups and conduct the experiment after having being informed and provided with all necessary details and guidelines.

They should be provided by the educator with a relevant worksheet. On the worksheet they may write:

- their hypothesis BEFORE start experimenting,
- their observations DURING the activity,
- their finding, at the END of their work,
- comments, etc.

For instance, in the particular experiment students should make hypothesis on what they expect to observe by the end of each filtration.

EXPERIMENT WORKSHEET Name / Group ……	Date ……	
Questions	What do you EXPECT to observe on the filter and in the water (in the cylinder) after the filtration? Explain WHY	What DID you observe on the filter and in the water in the cylinder after the filtration? Explain WHY
Mixture 1: water & soil	……	……
Mixture 2: water & water colour	……	……
Mixture 3 ...	……	……
Observations	……	
Comments	……	

When all groups finish their work, the educator stimulates them to start a discussion in class sharing whether their hypothesis were right or wrong and he/she encourages them to draw conclusions. This will help them to reformulate

their ideas, if needed (regarding the substances that can or cannot be separated by water through filtration).

D. Implementation of the new ideas

At this phase students are encouraged to use their 'new' knowledge in real-life situations. They could discuss about filtration's necessity: from making coffee at home to activities of public services such as the water treatment process, that includes the process of filtration as well.
Furthermore, we can discuss about the **analogies** that are "hidden" in the experiment. For example, students can be stimulated to identify the natural phenomenon similar to the "man-made" process filtration; that is percolation *(percolation of water through the soil)*. They may brainstorm on the links between the activity and various issues e.g. the pollution (soil, color, etc. can represent solid waste, soluble pollutants, etc.) The following table might help in the identification of the activity's analogies, which is an important process within the framework of a constructivism educational methodology.

Analogy 1 *What could soil represent in the mixture?*	Soil →	…….. …….. ……
Analogy 2 *What could water colour represent in the mixture?*	Water colour →	…….. …….. ……
Analogy 3 *Can you think of a phenomenon similar to filtration taking place in nature?*	Apparatus used →	…….. …….. ……

E. Reflection

Students compare their initial ideas about the process of the filtration, its implications, and so on, with the ones they had in the beginning (see phase B). The educator encourages them through questions such as: "What were you thinking in the begging about …?", "What are you saying now about…?" "What made you change or not, your mind?", etc.
The groups exchange also ideas and experiences about the implementation of the experiment i.e. what was easy or not; do they think they had enough time?

what they might change the next time they are about to make a filtration-experiment, etc.

Some notes for the educator

Experiments are important teaching tools for introducing and involving learners to scientific methods of work. They involve a number of cognitive processes such as hypothesis, observation, data recording and elaboration, making analogies, deducing conclusions. Therefore, they contribute to the development of critical thinking. Furthermore, they enhance learners' creativity and empowerment and stimulate their interest and enjoyment.

Within the framework of ESD experiments should be simple, easy to conduct using everyday equipment and materials and, of course, closely linked to everyday phenomena and issues.

Experiments do not necessarily mean experimental activities based on laboratory conditions and/or rigorous physics or chemistry. Activities that follow the steps of the experimental method (hypothesis - activity - data elaboration - conclusion) are included in such a method as well.

The briefly presented process for conducting an experiment following a constructivism approach can be applied e.g. in the activity of the educational package: "Water in the Mediterranean" (which actually is on the topic of filtration as well).

Filtration

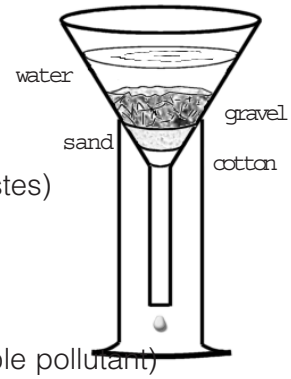
Part of the hydrological cycle is the filtration of water through soils. Water percolates into soil and permeable bedrock. The soil's texture and structure influence the infiltration capacity. Filtration is the process followed in order to separate particles suspended in a liquid. The filters used in water treatment are usually made of layers of sand and gravel.

Activity

Experiment with filtration.

Materials/Equipment

- funnel
- sand
- gravel
- cotton
- cylinder
- soluble coffee beans (for representing solid wastes)
- mixtures:
  1.water + soil
  2.water from a pond
  3.water + watercolour (for representing a soluble pollutant)
  4.water + detergent
  5.water + cooking oil



((4b))

Procedure

1. Set up the apparatus as in the figure above.
2. Pour mixture No 1 into the funnel.
3. After the mixture is filtered what do you observe?
   Stir the content of the cylinder with a stick. What do you observe?
   Take a sample from the content of the cylinder and observe it using a microscope.
   Note down your observations.
4. Empty the cylinder.
5. Repeat the experiment with mixtures No 2, 3, 4 and 5, after replacing the gravel, sand and cotton.
6. Place a few grains of coffee between two layers of cotton and gravel and pour water. Observe the results.

Can you think of a phenomenon similar to this experiment occurring in nature?

Objectives

- To discover the role of filtration in the natural process of «purification» of water. (C)
- To explain the importance of filtration in the water treatment process. (C)
- To develop skills for assembling an apparatus. (P)
- To develop skills for making analogies (experiment-percolation). (P)
- To adopt an informed attitude against polluting water by pouring hazardous substances in it or in the ground. (A)

If an aquifer becomes polluted with substances such as synthetic chemical compounds and toxic metals, it may remain polluted for generations, a continuing hazard to man and the environment.

2 hours

Physical Sciences (Chemistry), Earth Sciences (Geology), Life Sciences (Biology)

filtration, percolation, pollutants, contaminants, aquifer, water treatment