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EMPLOYMENT OF EXPERIMENTS FROM THE FIELD OF CONSERVATION/ENVIRONMENTAL TECHNOLOGY IN THE DEVELOPMENT OF SELF-ESTEEM AND IDENTITY

ZASTOSOWANIE DOŚWIADCZEŃ Z ZAKRESU OCHRONY ŚRODOWISKA I TECHNOLOGII ŚRODOWISKOWYCH W ROZWIJANIU POCZUCIA WARTOŚCI WŁASNEJ I TOŻSAMOŚCI

Summary: Examples for the employment of experiments from the field of conservation/environmental technology in lessons are presented which aim at improving the development of ethical values and identity in classes of natural sciences and technology. At first, I want give a review about environmental problems of technical background should be in the centre of attention and on this basis, I would like to mention the following specific values from the field of conservation with which students or scholars should identify themselves. After this the subject water (surface water, groundwater, drinking water) is dealt with focusing on the aforementioned problems. Moreover, possible experiments are presented. They are supposed to contribute to the development of the ethical values above and are especially suitable for understanding social learning as described by Seilnacht, which presents a good alternative to conveying systematic scientific facts only. I would like to suggest a personal experiences Subject-specific scientific discoveries and emotional experiences should lead to a chain of action *via* a sequence of experiments (a "chain of action" according to Elsässer, applies to the development of values and identity) and thus *eg* to the conviction that every individual is responsible for preserving the basis of life. The suggested sequence of experiments and the related discussions promote - above all - the social aspect of learning.

Keywords: ethical qualities or values, environmental problems of technical background, specific values from the field of conservation with which students or scholars should identify themselves, understanding social learning, personal experiences, a chain of action via a sequence of experiments, examples for experiments

Streszczenie: W artykule opisano zastosowanie doświadczeń z zakresu ochrony środowiska i technologii środowiskowych na lekcjach, których celem jest rozwinięcie wartości etycznych i poczucia tożsamości w klasach o profilach przyrodniczych i technicznych. W pierwszej kolejności przedstawiono problemy środowiska o podłożu technologicznym, będące w centrum zainteresowania, a następnie, na podstawie, szereg szczególnych wartości z zakresu ochrony przyrody, z którymi studenci lub uczniowie powinni się identyfikować. W dalszej kolejności rozpatrzono problem wody (woda powierzchniowa, woda gruntowa, woda pitna) ze szczególnym uwzględnieniem wcześniej wspomnianych zagadnień. Zaprezentowano także możliwe do przeprowadzenia doświadczenia, które wspomagają rozwój wartości etycznych i są odpowiednie dla zrozumienia nauczania społecznego tak, jak opisał to Seilnacht. Zasugerowano, że osobiste doświadczenia związane z odkryciami naukowymi i wrażeniami emocjonalnymi zależnymi od przedmiotu badań prowadzą do łańcucha działań poprzez sekwencję doświadczeń ("łańcuch działań", zgodnie z Elsässer), a stąd np. do przekonania, że każda jednostka jest odpowiedzialna za zachowanie podstaw, na których opiera się życie. Sugerowana kolejność doświadczeń i wynikająca z nich dyskusja promuje przede wszystkim społeczny aspekt uczenia.

Słowa kluczowe: jakości i wartości etyczne, problemy środowiska o podłożu technicznym, szczególne wartości z zakresu ochrony przyrody, z ktorymi studenci lub uczniowie powinni się identyfikować, zrozumienie nauczania społecznego, osobiste wrażenie, łańcuch działań poprzez sekwencję doświadczeń, przykłady doświadczeń

Introduction

Lessons of natural sciences or technology and existing subject oriented models are often criticized in so far that they still focus largely on systematic and specialised knowledge [1].

Is this form of knowledge acquisition suitable for imparting values to the students with which they can identify themselves or according to which they are going to act later?

"Pure" knowledge about environmental problems does not necessarily lead to the effect that people actually act environment-conscious. We all have probably made this experience ourselves.

Since the development of values and identity is closely linked to personal experiences, to understanding learning, and to emotional and ethical components of personality development, it is vital to design a learning process which considers those aspects and not only the pure acquisition of facts [1].

In this article, examples for the employment of experiments from the field of conservation/environmental technology in lessons are presented which aim at improving the development of values and identity in classes of natural sciences and technology.

Which environmental problems of technical background should be in the centre of attention?

Sellin [2] mentions several technical key problems which should be dealt with in classes of natural sciences and technology, *eg*:

- production of essential goods which are recyclable, thus minimizing the exploitation of resources and the amount of waste; development and realisation of residue-free closed cycles for raw materials, auxiliary materials and products;
- development and implementation of traffic systems for the transport of people, raw materials, food and goods which reduce or eliminate the catastrophic consequences of traffic in form of consumption of landscape and resources, air pollution and noise;
- improvement of the condition of rivers, seas, and groundwater which have been contaminated by discharges, waste, pollutants and fertilizers; securing the supply with drinking and industrial water; keeping the air and soil clean.

On this basis, I would like to mention the following specific values from the field of conservation with which students should identify themselves:

1. development of readiness to critically question own needs and behaviour, to take responsibility for future developments, to act considerately towards other nations and future generations; these developments should have a lasting effect and should offer following generations the same opportunities in life as in our time; the central value of fairness not only between different generations, but also between members of different sections of the population, states and continents within one generation should be established; everybody ought to have the same access to globally limited resources, should be contaminating the world to the same (minimal) extent and has to be responsible for a similarly abundant supply of resources to the following generations [3];
2. future technological developments should, therefore, be based on quality and durability and be produced in such a way; the consumer should primarily select such products and thus help to preserve the basis for life for us and for future generations as described under [1];
3. based on the knowledge that anthropogenic pollutants contaminate the natural environment and therefore endanger the life and health of humans and animals alike, the conviction should arise that every single person, private person as well as producer, is responsible for preserving the basis for life; polluting the environment is not a peccadillo, but in most cases a criminal offence.

In this article, the subject water (surface water, groundwater, drinking water) is dealt with focusing on the aforementioned problems. Moreover, possible experiments are presented. They are supposed to contribute to the development of the values above and are especially suitable for understanding social learning as described by Seilnacht [1], which presents a good alternative to conveying systematic scientific facts only.

Seilnacht [1] structures the experiments as follows:

Experimental action during lessons should be divided into the following four parts; the initial phase which is supposed to provoke great astonishment, plays a crucial role:

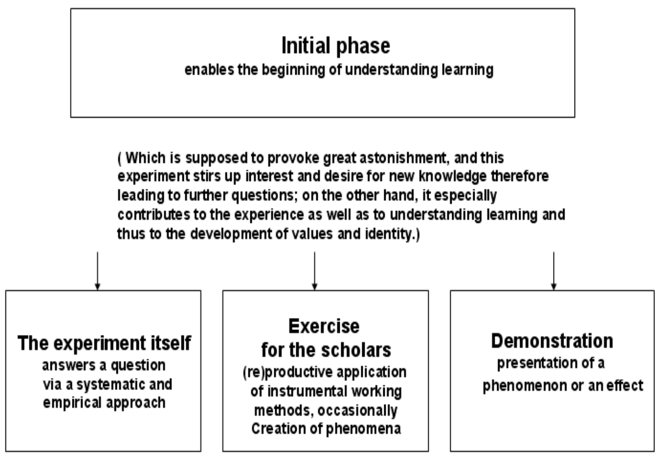

Fig. 1. Classification of experiments [1]

All forms of the experiment can be employed in lessons of natural sciences as well as in technical classes. The exercise for the students promotes pragmatic knowledge whereas the demonstration in teacher-oriented lessons supports systematic knowledge.

On the one hand, the initial phase experiment stirs up interest and desire for new knowledge therefore leading to further questions; on the other hand, it especially contributes to the experience as well as to understanding learning and thus to the development of values and identity.

Presentation of the experiments

Firstly, different variants for initial phase experiments (always to be demonstrated by the teacher) dealing with the topic water are presented. Secondly, suggestions for possible succeeding experiments are given which are derived from the observations of the initial phase experiment and which should be carried out as student experiments.

I would like to suggest the following didactic procedure since the aim is the development of values and the identification with the experimental values:
Elsässer [5] assumes that teaching and learning processes always take place on two levels:

1. The visible or surface structure of learning is the level most traditional didactic models concentrate on. It comprises all teaching actions, *ie* all action patterns of the lesson, social forms, steps in the lesson, use of media etc. The teacher's actions are always observable.
2. The complementary level is the basic structure of learning. It consists of a fixed chain of action which is necessary for every learner. The overall character of these chains is on the one hand determined by laws of educational psychology and on the other hand by the type of the educational goal and the contents, respectively.

According to Elsässer, the following chain of action applies to the development of values and identity:

1. analysis of existing values in relation to a social, moral, aesthetical etc. problem which is being discussed (in our case the problem of environment-conscious acting). Identification of values and development of value hierarchies which are weighed against each other;
2. suggestions for the inclusion of a new value or the change of the value hierarchy *via* consensus (inductive from the persons or deductive from the text);
3. participation in the decision for a newly found value definition which is then related to the preceding values;
4. transfer of found values by every individual, by the community or by a committee.

Subject-specific scientific discoveries and emotional experiences should lead to a chain of action *via* a sequence of experiments and thus *eg* to the conviction that every individual is responsible for preserving the basis of life. The suggested sequence of experiments and the related discussions promote - above all - the social aspect of learning.
Suggestion for a sequence of experiments:

Starting off with the emotionally impressive, lethal effects of pollution, the question about the scientific context, *eg* the effects of the pollutants (initial phase experiment), shall be answered on the basis of the sequence above. This also applies to the question about possibilities of pollutant identification (succeeding experiments), and about the social context, *eg* how the substances get into the environment or the body. As a consequence, the question might arise how to avoid contaminations or how to remove pollutants from the environment, thus leading to the issue of technological possibilities (succeeding experiments).

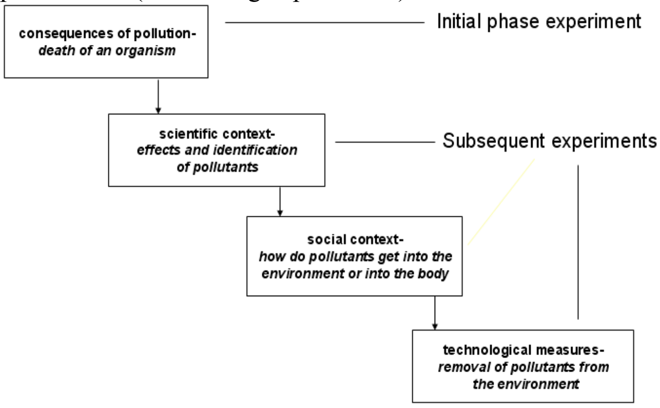

Fig. 2. Sequence of experiments

So, environmental-technological measures and their principles for the removal or avoidance of contaminations can be easier imparted, be accepted as a necessity and as a value. A mere presentation of technological measures, technologies and processes without the mentioned background information is less likely to achieve the desired effect.

Initial phase experiment

The life-threatening or lethal effects of pollutants are demonstrated in a teacher experiment on the basis of the processes in contaminated water.

Variant 1 - Inhibition of enzymes

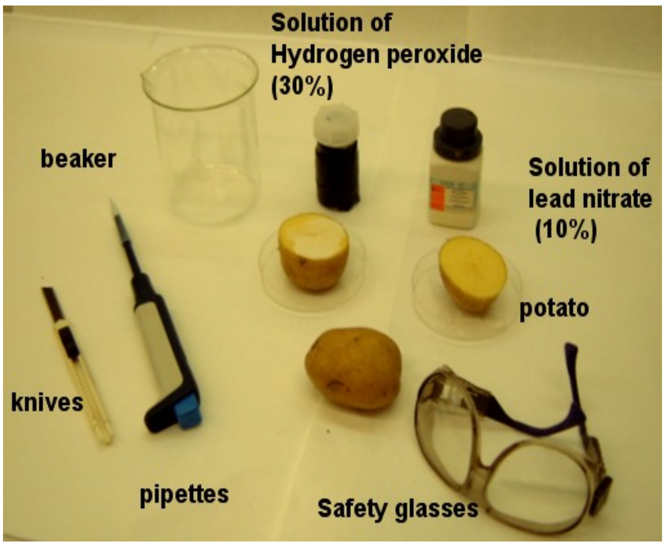

Fig. 3. Inhibition of enzymes

Theoretical background

Enzymes are protein molecules working as biocatalysts which are responsible for the control of all essential processes in the body. Heavy metals inhibit the catalytic effect by combining irreversibly with an enzyme.

Consequently, the enzyme becomes ineffective; it is not able to bind to the substrate anymore and the specific metabolic process is inhibited. This can lead to serious damage, to slow dying or even to sudden death.

The potato is part of a living plant. As a storage organ and organ for vegetative reproduction, it contains many different enzymes which catalyse different chemical reactions *eg* the fission of hydrogen peroxide (catalysis and enzymatic catalysis are topics in chemistry and biology).

Materials/chemicals/equipment

- potato
- solution of hydrogen peroxide (H_2O_2, 30%)
- solution of lead nitrate (10%)
- pipettes
- Petri dishes
- knives

Carrying out the experiment

The potato is cut into two halves (A and B). Two to three drops of hydrogen peroxide are given onto half A. Two drops of lead nitrate are put on half B before placing two to three drops of hydrogen peroxide on the same spot.

Results

On half A you can observe a strong chemical reaction which proves the full effectiveness of the enzymes and thus the state of being alive. Hydrogen peroxide is decomposed, therefore releasing oxygen. This leads to an intensive, noisy development of white foam which covers the potato half. The released oxygen can be identified with the help of the "glowing splint" test.

$$2H_2O_2 \longrightarrow 2H_2O + O_2$$

No chemical reaction can be observed for half B, *ie* there is no visible release of gas. This means that either there are no enzymes (which is highly unlikely since half A contained some) or they have become ineffective.

Evaluation

The enzymes of the potato act as biocatalysts for the fission of H_2O_2. Therefore, the strong chemical reaction on half A could be observed.

Lead as a heavy metal changes the binding sites of the enzymes. Consequently, the substrate (H_2O_2) cannot be bound and converted on half B. Hence, no release of gas can be observed. It is an irreversible inhibition of an enzymatic reaction. Heavy metals have a similar effect in the human and animal body. The intake of certain mercury compounds lead to an immediate blocking of the enzymes of the respiratory chain causing death by suffocation within several minutes. It is possible to perform experiment variant 2 to prove this (however not with mercury compounds because of the safety regulations).

Possibilities for succeeding experiments

Having observed the initial experiment students could ask themselves for example the following questions:

- Which pollutants get into the water?
- Who are the persons responsible?
- How do pollutants get into the water?
- How do they enter the human food chain?
- How do you identify the pollutants?
- Which concentrations are harmful for organisms?
- How can you avoid contaminations?
- Which possibilities exist to improve the condition of a stretch of water?

Most of these questions can be answered with the help of simple experiments to be carried out by the students themselves. Examples are going to be presented in the next paragraph.

For safety reasons, poisonous substances should always be substituted by non-toxic or less toxic pollutants (Please pay close attention to the safety regulations). Other questions such as the one regarding the persons responsible can be answered with the help of other teaching methods.

Identification of water pollutants

Chloride [4]

Theoretical background

Chloride is part of many salts, especially table salt (= sodium chloride, NaCl), of hydrochloric acid (HCl) and other chemical compounds (*eg* it is released when PVC-plastics are burned).

Most of the chloride gets into the water *via* final lye of the potash mining industry and via the fertilizer industry. However, most anthropogenic sewages contain chloride: effluents from the industry as well as water from sewage plants, agriculture and households. Huge amounts are added to the water (especially groundwater) by the application of road salt during winter. Chloride is not injurious to health in "normal" quantities. The WHO (World Health Organization) set the threshold value for drinking water to 0.35 g of chloride per litre which is equivalent to 0.58 g table salt per litre.

However, meeting this standard does not necessarily mean that no damages occur. As an example, the growth of plants is affected by high salt concentrations in the water because osmotic processes of water- and substance uptake are disrupted.

Although chloride itself is only toxic in high concentrations, it is nevertheless an important "indicator" for water pollution: the higher the amount of chloride, the higher on average is the concentration of other and more dangerous pollutants.

And: chloride cannot be extracted from the water by using methods like filtration or sedimentation because almost all chloride compounds are highly water-soluble. As a consequence, the discharge of chloride into the water accumulates. Water usually contains a natural amount of chloride; the amount depends on the geological background. However, the concentrations are - apart from mineral springs - very low compared with the high concentrations caused by humans.

Research method

Chloride reacts with silver nitrate ($AgNO_3$) forming the slightly soluble silver chloride AgCl. Adding drops of $AgNO_3$-solution to chloride-containing water leads to a slight or distinct clouding or to the development of a pasty white precipitate. The precipitate can be filtered. After drying, you can calculate the chloride concentration in the water with the help of the weight of the dry precipitate. (This method is very precise, but requires a specific filtration unit). It is easier to carry out the following method:

You compare the clouding of a water sample after addition of silver nitrate with the clouding of water samples containing a known amount of chloride.

Materials

- test tube rack and 10 test tubes,
- a sheet of black paper,
- a pair of scales (a beam balance + a set of weights is sufficient),
- a measuring cylinder (1 dm^3 or ½ dm^3) or a litre measure,
- table salt,
- silver nitrate ($AgNO_3$),
- distilled water.

Carrying out the experiment

1. Preparation of comparative solutions

Consideration: If 0.355 g chloride is equivalent to 0.585 g table salt, then 1 g chloride is equivalent to 1.65 g table salt.

- Solution 1000 (contains 1g or 1000 mg chloride per litre): weigh 1.65 g table salt and dissolve it in 1 dm^3 distilled water
- Solution 500 (contains 500 mg chloride per litre): take 25 cm^3 out of “solution 1000” with a disposable syringe and add 25 cm^3 distilled water (or fill up to 50 cm^3 with distilled water)
- Solution 300 (contains 300 mg chloride per litre): take 15 cm^3 out of “solution 1000” with a disposable syringe and add 35 cm^3 distilled water (or fill up to 50 cm^3 with distilled water)
- Solution 200 (contains 200 mg chloride per litre): take 10 cm^3 out of “solution 1000” with a disposable syringe and add 40 cm^3 distilled water (or fill up to 50 cm^3 with distilled water)
- Solution 100 (contains 100 mg chloride per litre): take 5 cm^3 out of “solution 1000” with a disposable syringe and add 45 cm^3 distilled water (or fill up to 50 cm^3 with distilled water)
- Solution 50 (contains 50 mg chloride per litre): take 5 cm^3 out of “solution 1000” with a disposable syringe and add 95 cm^3 distilled water (or fill up to 100 cm^3 with distilled water)
- Solution 40 (contains 40 mg chloride per litre): take 4 cm^3 out of “solution 1000” with a disposable syringe and add 96 cm^3 distilled water (or fill up to 100 cm^3 with distilled water)
- Solution 30 (contains 30 mg chloride per litre): take 3 cm^3 out of “solution 1000” with a disposable syringe and add 97 cm^3 distilled water (or fill up to 100 cm^3 with distilled water)
- Solution 20 (contains 20 mg chloride per litre): take 2 cm^3 out of “solution 1000” with a disposable syringe and add 98 cm^3 distilled water (or fill up to 100 cm^3 with distilled water)

Please pay attention to a clear labelling!

2. Preparation of the silver nitrate solution

You will get a calibrated silver nitrate solution (0.1 mol/dm^3) when you dissolve 1.7 g $AgNO_3$ in 100 cm^3 distilled water. Keep the solution in a brown or green bottle because $AgNO_3$-solution decomposes in light.

3. Further preparations

Mark the 10 test tubes (1 to 9 for solutions 500 to 10, tube 10 for the water sample). Provide: water sample, disposable syringe, diluted nitric acid (HNO_3)

Carrying out the experiment

- Transfer 10 cm^3 of each comparative solution to the corresponding test tube; transfer 10 cm^3 of the water sample to test tube 10. If the solutions are cloudy it is often sufficient to wait until the suspended matter has deposited. Another possibility is to filter the solution (The best is to start off with the higher diluted solution, so you do not have to clean the syringe in between).
- Add 5 drops of nitric acid to all test tubes, then add 1 cm^3 $AgNO_3$-solution to each test tube.
- After shaking the test tubes compare the clouding of the water sample with the comparative solutions. If your sample contains more than “solution 100” you might dilute your water sample with distilled water in order to achieve a more precise result for the chloride concentration; you just have to calculate again.
- Also compare your result with tap water!

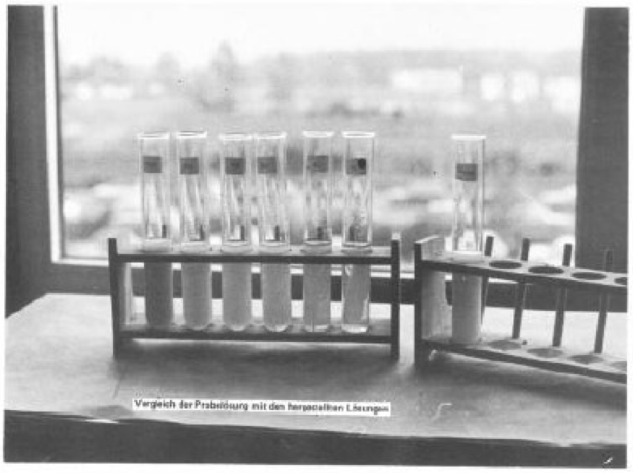

Fig. 4. Determination of the concentration of water pollutants - chloride [4]

Identification and determination of concentration of other pollutants

Theoretical background

Nitrite (NO_2^-), nitrate (NO_3^-), ammonium (NH_4^+) and phosphate (PO_4^{3-}) are plant nutrients which are washed out from the soil into the water as a result of over-fertilization. As a consequence, the growth of plants - especially of plankton - can increase enormously.

Since bacteria need oxygen above the sediment for decomposing dead plant material, over-fertilization leads to a lack of oxygen in these stretches of water. Anaerobic decomposing processes take over, releasing toxic breakdown products (*eg* hydrogen sulphide) which cause the death of many organisms especially animals. The process is called eutrophication meaning that the balance in the stretch of water has been upset.

Dissolved nitrite can be easily oxidized to nitrate. If this happens in the human body then the necessary oxygen for this is taken from the blood. This leads to tiredness, exhaustion, shortness of breath and in very serious cases *eg* to infant death. The concentrations of nitrite and other ions have to be limited in the drinking. How many of these ions we take in *via* food is hardly quantifiable.

Materials

Fig. 5. An analysing kit

The carrying out of the experiment follows the easily comprehensible descriptions of the fast-analysing kit which comprises a booklet with an illustration of the different ions, their harmful effects and current limiting values. The residues from the experiments can be easily disposed of *via* the sewage system. The analysing kit also offers the possibility of group work and is suitable for field experiments.

Results

The determined concentrations should be compared with the limiting values of the different stretches of water.

Evaluation

Comparing limiting values, statements about the level of contamination of the water and resulting consequences can be made. The students should be informed that more precise analyses carried out by authorized expert laboratories are much more laborious and expensive.

Path of pollutants into the human food chain

Theoretical background

The aforementioned nitrite (NO_2^-), nitrate (NO_3^-), ammonium (NH_4^+) and phosphate (PO_4^{3-}) can be taken in *via* both contaminated drinking water (*eg* from private wells) or food. The ions are directly transferred from the over-fertilized soils *via* the plants into the human food chain. Even more polluted are most of the food plants which have been brought up directly on artificial substrates for cultivation. Nitrites (NO_3^-) are deliberately added when meat and sausages are salted. Yet, the actual effect of preservation can also be reached by using pure table salt only. Sausages and meat only acquire the light-red colour through nitrite since it reacts with the proteins of the muscles. Certain types of fresh sausage (ham sausage, ham, smoked sausage spread) are often heavily salted.

Experiment variant 1

Materials

- strongly fertilized soil sample,
- unfertilised sandy soil for comparison,
- cucumber or white radish from greenhouse cultivation,
- knife, grater, sieve,
- beakers,
- distilled and desalted water,
- filtration rack, funnel and filter paper,
- *eg* Aquanal-Ökotest water lab by Riedel-de-Haen or other fast-analysing kits for water analysis.

Carrying out the experiment

1. Water is added to about 100 g of each soil sample; then everything is thoroughly shaken and filtered afterwards. Next, the filtrate is analysed for different ions with the help of the analysing kit. The results for the different soils are to be recorded and compared with each other.
2. The cucumbers or radishes respectively have to be peeled and grated. Then, the obtained juice has to be pressed through the sieve. After filtration the amount of ions has to be determined analogously to the soil samples.

If the concentrations are too high (the analysing kit has been devised for water samples and low concentrations), the juice has to be diluted. The dilution process has to be incorporated into the calculation of the concentrations.

Results

The results are taken down and compared with each other. They can deviate enormously from experiment to experiment.

Evaluation

A comparison with limiting values is hardly or even not at all possible. Statements about the degree of contamination and resulting effects can only be made semi-quantitative. The concentrations of ions in vegetables are often many times higher than the limiting values for drinking water. The reason for this are their high concentrations in the soils used in greenhouse cultivation. From the results you can learn that it is healthier to eat home-grown vegetables which are being harvested in the appropriate season.

The students should be informed that more precise analyses carried out by authorized expert laboratories are much more laborious and expensive.

Experiment variant 2

Materials

- strongly salted types of sausage,
- unsalted salami (home-made) for comparison,
- knife, mince,
- beakers,
- distilled and desalted water,
- filtration rack, funnel and filter paper,
- *eg* Aquanal-Ökotest water lab by Riedel-de-Haen or other fast analysing kits for water analysis.

Carrying out the experiment

The sausage is cut up and ground down with the mincer. Equally heavy amounts are transferred into beakers and about 100 cm^3 hot water is added; then everything is mixed. After cooling down, the mixture is being filtered. After filtration the amount of ions in the filtrate is determined analogously to the soil samples.

If the concentrations are too high (the analysing kit has been devised for water samples and low concentrations), the juice has to be diluted. The dilution process has to be incorporated into the calculation of the concentrations.

Results

The results are taken down and compared with each other. They can deviate enormously from experiment to experiment.

Evaluation

20 g of sausage (one slice) often contains many times more nitrite than the limiting value for drinking water. As a consequence, those types of sausage should be bought which are produced along the lines of traditional recipes, *eg* salami which usually contains less fat than other types.

Removal of pollutants from the water

Theoretical background

Pollutants can be removed from the water with the help of different physical, chemical, or biological methods. Modern technologies in sewage plants and redevelopment measures for surface waters put these principles of natural science to practice. For example, the following methods could be employed:

- filtration (*eg* through a sand filter)
- adsorption (*eg* to activated carbon)
- precipitation (*eg* with iron- or aluminium salts)
- incorporation (*eg* by microorganisms)

Material

- thick glass tube, beakers,
- pierced stopper with a thin glass tube,
- cotton wool, fine seashore sand,
- ink-tinted water.

Carrying out the experiment

The ink-tinted water is transferred slowly into the glass tube which has been filled with seashore sand beforehand. The filtrate is collected in a beaker. The upper layer of the seashore sand and the colour of the filtrate are to be observed.

Results

The upper layer of the seashore sand turns into the colour of the "contamination" (ink). However, the filtrate is colourless and clear.

Evaluation

Sand can be used as a natural filter for many water pollutions.

Variant 2 (Absorption)

Materials

- Erlenmeyer flask, beakers,
- filtration rack, glass funnel and filter paper,
- activated carbon (granular),
- ink-tinted water.

Carrying out the experiment

A sufficient amount of activated carbon is added to the ink-tinted water. Shake well for several minutes. After decolourisation is observed, the fluid is filtered. The sound during shaking and the change of colour are to be observed.

Results

During shaking you can hear a rustling, hissing sound which is caused by water getting into the pores of the activated carbon. The water is gradually decolourised. The filtrate is a clear, colourless solution. Sometimes it may contain very small coal particles which might cause a grey colouring.

Evaluation

The contaminants are absorbed to the surface of the activated carbon where they are not recognizable anymore because of the black colour of the coal. If too much ink is employed, then the surface area of the activated carbon might not be sufficient to clean the water completely, thus not turning it colourless.

Variant 3

Materials

- Erlenmeyer flask, beakers,
- filtration rack, glass funnel and filter paper,
- aluminium sulphate, diluted NaOH,
- water contaminated with washing soap.

Carrying out the experiment

The water is being contaminated with soap, consequently having a greasy touch. A sufficient amount of aluminium sulphate and a few drops of NaOH are added to the contaminated water. Shake well. After having observed the development of a precipitate, the fluid is being filtered. The colour of the filtrate is to be observed. Check if the greasy touch of the soap can still be felt.

Results

A coarsely flocculent, white precipitate develops. The filtrate is colourless and does not have the greasy touch anymore.

Evaluation

Different components of the soap like *eg* phosphates form slightly soluble, coarsely flocculent precipitates in a basic environment (NaOH), *eg*

$$Al_2(SO_4)_3 + 2Na_3PO_4 \longrightarrow 2AlPO_4 + 3Na_2SO_4$$

The precipitates can be separated *via* filtration. If the components of the soap precipitate completely, then the filtrate will lose its greasy touch.

(Check out the experiment beforehand, because the soapy touch will not go away if wrong concentration ratios are used.)

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