The purity of different watersources

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INTRODUCTION

1. ***Motivation:***

On the app Instagram we found a post about a pond which was named a pool. The person with the nickname “danisnotahobbit” said he wrote a paper about these pools for school “I wrote a paper about these kinds of pools several years ago for a class when they were just prototypes. These pools have a natural filtration system which runs based on the plants that are in the pool that five the water nutrients that allow it to not only be crystal clear, but you are also able to drink the water because it is so clean. And the best part is that once the initial filtration system is installed and calibrated, it maintains itself and eliminates the need for chlorine or constant maintenance like salt water pools.”

The statement that the water would be as clear and drinkable as normal tap water surprised us, we did not quite believe it. If this is the case, then any pond or lake or even a container of rainwater in an environment where these plants grow could easily be cleaned and there would be no more need for toxins. We found a company in Wageningen called “lilyPond” (<http://www.lilypond.nl/service/>) that sells this kind of pools and that gave us enough motivation to start the investigation: is this water really of such high quality?

1. ***Research question:***

What is the essential difference between tap water, water from a pond and water from a pond with a biological filter (plants); concerning the purity and the drinkability of the water?

1. ***Background information:***

**Biology**

The biologic water quality refers to the number and types of plants, algae, fish, birds and bacteria that live in the water. To measure the water quality, there has to be measured on 173 places in big waters (such as the North Sea). Measurements are, depended on what type of measurements, done every day or every month.

**Methylene blue experiment**

Methylene blue can be used to research the biological quality of the different types of water. To do this, there has to be put 50 ml water together with a methylene blue solution (concentration of 0.05%) in a little container or bottle, which is sealed away from the air. When this is done, there has to be looked at how long it takes for the water to decolour. In pure water, the water shouldn’t be decoloured in 96 hours. When the decolouring process is completed in faster than 96 hours, it shows that the water isn’t clean.

**Instagram post by ‘danisnotahobbit’**

“*I wrote a paper about these kinds of pools several years ago for a class when they were just prototypes. These pools have a natural filtration system that run based on the plants that are in the pool that five the water nutrients that allow it to not only be crystal clear, but you are also able to drink the water because it’s so clean. And the best part is that once tie initial filtration system is installed and calibrated, it maintains itself and eliminates the need for chlorine or constant maintenance like salt water pools.”*

**pH-meter**

The pH of pure water should be 7. Water is considered acidic when it has a pH lower than 7. The normal pH of surface water should be between 6.5 and 8.5 and the pH of groundwater systems is 6 to 8.5. Pond water should have a pH that is between 7 and 8.5. The pH of drinking water should preferably be in between 7.8 and 8.3. Water is considered basic when it has a pH greater than 7.

1. ***Hypothesis:***  
   There is not an essential difference between the purity and drinkability of tap water and water from a pond with a biological filter (plants); there is however a difference in purity and drinkability of water from a pond and water from a pond with a biological filter (plants) and there is also a difference in purity and drinkability between tap water and water from a pond.
2. ***Organisation of research:***

In order to decide how clear the water from the swimming pond was, it is going to be compared to other water sources. First of all, it is going to be compared to tap water, because the company claims the pond water should be as clear and drinkable as tap water. It is also going to be compared to the water from the Berendonck which is a swimming pond. This pond is thought to contain excellent swimming water. Lastly, the water is going to be compared to water from our own school pond.

The purity of the water is determined based on 4 different methods; the pH-value, how much oxygen the water contains, how clear the water looks and what the water looks like under the microscope.

The pH-value is going to be tested by using a pH-meter and special pH-paper to determine the pH-value of the different water sources. The results will be written down in a special table

The amount of oxygen “consumption” will be determined by using methylene blue, which is an indicator for biological oxygen “consumption” of the water. After a few days some of the samples will be bluer than the others, which will indicate the amount of oxygen that has been “consumed by the water. The exact blue-ness of the water is going to be measured by using a wave length meter. 

The clarity of the water is going to be determined by looking at the water in the bottles to look for any impurities. The clarity of the water is also going to be determined by looking at the water under a microscope.

1. ***Expectations:***

If there is no essential difference between the clarity and the drinkability of tap water and the pond water with biological filter (plants), but there is a difference between normal pond water, pond water with biological filter (plants) and the water from the Berendonck, then the methylene blue will lose its blue colour faster in the water from a normal pond and the water from the Berendonck than the special pond water with biological filter (plants) and tap water will lose its blue colour. Second of all, the pH of the tap water and special pond water with biological filter (plants), will be between 7,8 and 8,3 while the pH of the Berendonck and the water from the normal pond will be within a wider range, between 7 and 8.5.

There will also be more things visible under the microscope in the normal pond water and the Berendonck water as in the drinkwater and the pond water with biological filter (plants).

MATERIALS AND METHOD

1. Materials:
   1. Paper, pen, pencil and an eraser
   2. Pipette
   3. Beakers
   4. Demi-water
   5. 4 different types of water from 4 different sources (in this research they were mentioned above)
   6. pH-meter
   7. pH-paper
   8. pH-4 and pH-10 liquid to adjust the pH-meter
   9. Hermetic container to store the samples
   10. Methylene blue solution (0.05% in water)
   11. Wavelength meter
   12. Magnifying glass
   13. Microscope
   14. Glass slides (for the part with the microscope)
   15. Cover slip (for the part with the microscope)
   16. Tweezers (for the part with the microscope)
   17. Paper towels
   18. Lab coats and glasses
2. Set-up of research:

To measure the pH-value, 4 beakers are set up, with each kind of water in it. Also 2 beakers are set up, one with a pH-4 liquid in it and one with a pH-10 liquid. The pH-meter, a bottle of demi-water and a beaker for the water that is left after cleaning are also set up.

For the methylene blue experiment, four sample containers are set up with 50 ml of water into it and also a pipette is laid down to measure exactly 0,1 ml of the mehtylene blue solution. A beaker with the (0.05% in water) methylene blue solution is also needed.

To decide the clarity and for looking at the water under the microscope, 4 glass slides are prepared and two microscopes are set up (two people see more than one). The bottles with the four different types of water in it were also put on the table.

1. Method:

The project is split up into 3 parts, one part for every different test.

The first part is the measuring of the pH-value. First, the pH-meter has to be adjusted to neutral, by using a liquid of pH-4, then rinse the meter with demi-water and then adjust the meter again in a liquid of pH-10 to make sure the results are valid. Now that the meter is adjusted the water samples will be put into 4 different beakers and there will be a name on each beaker, so it is known which water is in it. Then a table is prepared with a column for what water it is and a column for what pH-level the water has. In this way the results will be organised in a proper way.

Second is measuring the level of oxygen “consumption”. 50 ml of water from all the different types of water have to be put into 4 different sample containers. Then, 0,1 ml of methylene blue solution

(0.05 % in water) has to be added to each of the 4 sample containers with a pipette. The sample containers have to be hermetically closed and put away. Every few hours, the sample containers have to be checked on, to see if any of the containers has lost their blue colour and the result has to be pictured or written down.

Third is looking at the water under a microscope. 4 glass slides have to be prepared by putting a drop of water on each of the glass slides and then carefully a cover slip has tu be put over each glass slide by using tweezers (to avoid fingerprints). The glass slide will be put under the microscope and the image which can be seen through the microscope will be drawn in a table, to compare the water types.

RESULTS

1. ***Observations and measuring results:***

While checking in on the sample containers with the methylene blue solution in it, a few observations have been done:

* + - 1. *The blue colour faded away faster in the sample containers which contained the water from the Berendonck and the water from the normal pond.*
      2. *The blue colour has not completely faded away in any of the sample containers.*

While looking through a microscope, these were the images visible in the water, presented in a table:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Water type | 0x enlarged | 40x enlarged | 100x enlarged | 400x enlarged |
| Water from a normal pond | It looks yellow with some small parts in the water. | Clear with some small black parts and a bigger pyramid-shaped thing. | Clear with some small, black pieces, a thin thread and the pyramid-shaped thing | As we enlarged with the pyramid in the middle, the pyramid-shaped thing is still visible and furthermore some small, black dots. |
| Berendonck water | Clear water with small white parts, a dead fly and a dandelion seed | Clear water with some small pieces of dirt | Still some pieces of dirt, also a bigger one with something red attached to it | Clear with some transparent parts of dirt. |
| Special pond water | Surprisingly clear with a few white or black dots | Clear with sometimes a small black dot and one thin black thread. | Still clear, only the thread is still visible, it looks like it is a piece of plant | Only the piece of plant is visible, the rest is perfectly clear. |
| Tap water | It is perfectly clear. | Clear. | It is perfectly clear without pieces of dirt! | Still clear. |

Methylene blue:

|  |  |
| --- | --- |
| Water type | ?? how blue it is….. |
| Normal pond water | 68.9% |
| Berendonck water | 74.0% |
| Special pond water | 74,9% |
| Tap water | 78.8% |

pH:

|  |  |
| --- | --- |
|  | pH |
| Normal pond water (biology pond) | 7 |
| Berendonck water | 7.5 |
| Special pond water from: lilypond | 7 |
| Tap water | 7.8 |

CONCLUSION AND DISCUSSION

1. ***Comparison between results and expectations***

The findings prove that the pond water with a biological cleaning filter had a pH of 7, which means it’s pure water, but it doesn’t have the pH which is preferable as drinking water (between 7.8 and 8.3), whereas this water is proven to be drinkable. Also, the pH of tap water is 7.8, which is exactly the pH it should have.  
The normal pond water had a pH of 7, which means it’s pure and the water from the Berendonck had a pH of 7.5, which would mean it’s not suitable to drink, but it is pure.

Further on the tap water and the special pond water were both clear and therefore looked clean underneath the microscope. The tap water looked clear but had some weird details, such as small black parts, which meant it didn’t look very clear. This is not as expected, because it was expected to not contain any dirt, because it should be suitable to drink.   
The Berendonck water looked cleaner than expected, but it did contain dirt, so doesn’t look suitable for drinking.

1. ***Feedback on hypothesis***

The hypothesis states the following: ‘there is no essential difference between the purity and the drinkability of tap water and pond water with a biological cleaning filter (plants), but there’s an important difference between normal pond water and pond water with a biological cleaning filter (plants) and also between the tap water and the normal pond water.’

The hypothesis is not completely true when looking at the findings, because in the findings there is an essential difference between the purity and the drinkability of tab water and pond water with a biological cleaning filter, because the pond water actually has a pH that stated that it is not actually drinkable, whereas, according to the results, it would be. Further on, what was seen under the microscope did fit with the hypothesis, because they both looked clear and clean.

There is an important difference between normal pond water and pond water with a biological cleaning filter, because the normal pond water looked dirty and wasn’t clean and the pH was 7, which also means that it is not drinkable.

There is also an important difference between tap water and water from the pond, because the pond water has a pH which states that the water is not drinkable, whereas the water from the tap is drinkable. Also, the water from the normal pond contained some pieces of dirt and the tap water did not.

This means that the hypothesis was almost true, but not completely.  
 ***III. Reliability and areas for improvement for the next research***

The results from this research are not completely reliable, because of the following points:

1. *The research has only been done once, so any results obtained from this research could be obtained wrong, as a result of coincidence or research mistakes.*
2. *The research does not contain the chemical oxygen “consumption”, only the biological oxygen “consumption”. This has probably influenced the results from the research.*
3. *The pH-meter was not adjusted 100% correct, so special pH-paper was used instead of a pH-meter. This has probably also influenced the results from the research.*

These points were also the points for improvement for the next research.

SOURCES

These were the sources that were used:

<http://www.vijverinsite.nl/filters.html>

<http://www.heldervijveren.com/nl/info-vijverwinkel/vijverprofessor-weetjes-tips-over-uw-vijver/vijverplanten/d/detail/planten-die-het-vijverwater-zuiveren>

<http://www.lilypond.nl/>

<http://www.heldervijveren.com/nl/vijverinfo/zwemvijver>

Also a page from Radbout University Nijmegen has been used. On this page it stated the percentage of methylene blue and also the meaning of the changing in colour.