

Stockholm Junior Water Prize

Hungarian competition, 2017

*„Tanks of Water”*



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## **1. SHORT ABSTRACT**

In this essay, we would like to talk about the water footprint and its reduction. This is an extremely important topic, but it is also relatively unknown. So we decided we would create a board game to help people to learn about it. We made a trial run of this game with the help of other schoolmates, and we wrote down our observations and analyzed them. With the help of 17 students from our high school, we were able to test this board game during the week dedicated to World Water Day. Students between 15 and 16 enjoyed playing the game, and they provided much positive feedback. Students between 19-21 have a more mature approach, and they had great thoughts about the pictures. With the help of our game, the players were able give more thought to the ways in which their eating habits and lifestyles consume water. The students learned quite a bit about their water footprint. They were shocked by the data, for e.g. the water footprint of chocolate, meat and Adidas shoes, which are made of fishing nets. They liked our game because of its creativity, the uniquely decorated homemade water drops made from paper, the pictures and the tasks. However, they found the game a little slow, and they missed the greatest prize. In order to further develop the game, we collected the players' proposals while making our own observation. At the end, both we as the game makers and the students who played the game, enjoyed the experiences. We also became more conscious of water and invisible water.

## **2. STATEMENT OF WORK**

The work was divided between the three of us. We searched for sources, made and tested the board game and evaluated the observations made during the test games. Ildikó Hanga who is our biology teacher, checked the Hungarian of this report, and we translated it into English. Gábor Endresz, our English teacher, checked the English version. Kristóf's mother who is a trainer of teachers, helped us with the preparation of the educational testing and evaluation of the game.

## **3. INTRODUCTION OF THE STUDENTS**

Anna Tari (15): My favourite subjects are Chemistry and English. I really like animals and their wellbeing is very important to me. In the future, I want to be a veterinarian.

Nikolett Szabó (15): My favourite subject is Art. I am a vegetarian. Sometime in the future, I would like to be a volunteer for Greenpeace. My second language is English. I love animals.

Kristóf Stefán (15): My favourite subjects are Biology and Chemistry and I am pretty good in Math too. In the future, I would like to continue my studies in Chemistry at a university. I would like to be a chemical engineer.

#### **4. EXTENDED SUMMARY**

The concept of the water footprint (invisible water, virtual water) was introduced by John Anthony Allan, a professor at King's College London. The professor was studying how water-intensive products could effectively reduce the water requirements of water-stressed areas by importing. The water footprint measures water use and mankind's need for water resources in each country. It takes into account the quantity of water used directly and indirectly, during a product's manufacturing. As high school students, we would like to emphasize to our peers the importance of the water footprint. The easiest way to reach pupils nowadays is by games and the current modern pedagogical methods encourage the use of games in education. That is why we decided to create a board game and to test it. Our goal was to introduce the concept of the water footprint and possible ways to save water.

Between March 21st and 24th we were able to play with 17 students on 4 different occasions. During the games, we wrote an observation log. As we assumed they would have had a good time when they played. The students between 15-16 made lots of funny comments. The students between 19-21 played more maturely, and they had great thoughts about the pictures. Also, their previous knowledge was able to show off. The age of the players greatly influenced the progression of the game. With the help of our game, 3 of 17 players were able to realize the impact of eating and lifestyles choices in their lives. The students learned lots of new information about the water footprint. During the game the players were able to learn the lesson and activate their desire to help. We made note that it's worthwhile to play with students from different age groups. Moreover, we should make a more motivating prize system. We should broaden our card selection with Activity-like possibilities.

At the end, we as the game makers and the students thought this was a worthwhile experience. We also became more conscious of water and invisible water. Our goal is to never reach a water game over.

## **5. INTRODUCTION**

“If we fail the water war, we will lose the climate war. Water is the most endangered natural treasure and also an irreplaceable resource” -declared János Áder, the Hungarian President of the Republic, at the event of the Water Summit 2016. The UN States formulated 17 major sustainable development targets, with 169 sub-targets, in the so-called Post-2015 Agenda. The Sustainable Development Goals are new and universal, and from 2015 they should be taken into account when determining the development policies of the UN States (Post-2015 Agenda). One of these goals is: "Clean water and basic sanitation". The most important task of the 21st century is to preserve the earth's freshwater stocks and change mankind's water wasteful way of life. A noteworthy fact is that in 2016 there are still more than 600 million people in the world who have no access to an adequate quality of drinking water.

As high school students ourselves we want to raise the awareness of our classmates and our schoolmates about the importance of the water footprint. The biggest problem is that they haven't even heard about it yet. The easiest way to reach pupils nowadays is by games and the current modern pedagogical methods encourage the use of games for studying. Therefore, we decided to create a board game to help us reach this end.

## **6. WHAT IS THE WATER FOOTPRINT?**

The concept of water footprint (invisible water, virtual water) was introduced by a professor at King's College London, John Anthony Allan, when he looked at how water-intensive products could effectively reduce the water requirements of water-stressed areas by importing.

The water footprint measures water use and mankind's need for water resources in each country. It takes into account the quantity of water used directly and indirectly, during the manufacturing of products. It's possible to measure the water footprint of individuals, communities, business branches and products. For example, we are able to calculate our own water footprint with the help of this website:

<http://waterfootprint.org/en/resources/interactive-tools/personal-water-footprint-calculator/>.

Unfortunately Hungary isn't available on their list, so we have to choose one of our neighboring countries.

An average person living in an industrialized country drinks 2-3 liters of water daily, and consumes directly and indirectly 3000 liters of water to reach his/her daily food needs. Moreover we have to take into account the amount of water used during the washing of the dishes, showering, laundry, toilet flushing, watering, car washing, etc. which is the indirect water footprint of our devices.

The water footprint of an average Hungarian person is 2384 cubic meters per year, while worldwide the average is 1385 cubic meters per person per year. If we look at the daily consumption of the average Hungarian, we see that he/she consumes 3800 liters of water as food, through the products he/she purchase or uses directly! This is why we choose the title "Tanks of Water" for our game. It refers to the huge amount of water that is used daily. The water footprint of the South African countries and some parts of Asia are the lowest: 600-800 cubic meters per person per year, while the highest numbers are found in the American and European countries. The average yearly water footprint of an US resident is 2842 cubic meters. The Earth's fresh water resources are endangered not only by this excessive consumption of water, but also by the growth of population, climate change, pollution, soil pollution, economic growth, and ever changing lifestyles. If the whole population of the Earth (which is 7,2 billion people) were to use the same amount of water as the population of the Western countries, then we would need three and a half Earths. In 2050 there will have a population of 10 billion people on the Earth, and our freshwater resources are constant: 200 000 cubic kilometres. That is why it is imperative to put into effect the sustainable development goals described in the so-called Post-2015 Agenda. (see. above).

A country can have an internal and an external water footprint. The internal footprint is the amount of water obtained from domestic sources, while the other one refers to the water footprint of the imported products which consists of the amount of water used during the production and the transportation of the products. For example, Japan's water footprint is 1300 cubic meters per capita per year, but 77 percent of this amount comes from foreign countries.

The water footprint takes into account the amount of water used in crop production and in animal husbandry – these are the biggest water consuming sectors – which consists of green and blue water, and also grey water which is generated during farming, household maintenance and industrial production. Green water footprint means the amount of rainwater consumed during the production process. Blue water footprint is the amount of surface and groundwater consumed as a result of the production of a good or service. Grey water footprint is defined as the volume of freshwater that is required to assimilate the load of pollutants based on natural background concentrations and existing ambient water quality standards. We can search for the overall and detailed water footprint of different products on the waterfootprint.org site:

<http://waterfootprint.org/en/resources/interactive-tools/product-gallery/> .

## **7. HOW TO SAVE WATER?**

In order to lower our water footprint, we can do something every day. The direct water consumption can be reduced by water-saving techniques (aerator faucet<sup>1</sup>, Nebia shower head<sup>2</sup>, water-saving toilet, compost toilet), the correct use of water (showering instead of bathing), and the application of rainwater for irrigation.<sup>3</sup> To reduce the consumption of virtual water the solution is a conscious lifestyle (e.g.: the use of bicycles, recycling, second hand clothes instead of new ones, energy-saving), drinking tea instead of coffee and eating less meat. The water footprint of cars and clothing production, as well as of chocolate, coffee and meat production is enormous.

## **8. ENVIRONMENTAL EDUCATION AND A NEW PEDAGOGICAL METHOD**

According to a study conducted in 2006 by Attila Varga students have the most positive attitudes towards water, animals and plants. These subjects may represent a powerful motivation for environmental education. They have worse attitudes towards waste, energy, and contamination.

Teaching through board games is an indirect pedagogical method, writes author Dorottya Váczi in her book. We can reach the development goals in a playful way without it being perceptible. The board game can help in developing a variety of skills, such as negotiation skills, attention, self-discipline, memory, problem solving, and decision-making in real life situations. A board game allows the players to learn about any theme through photos, interesting facts, and good and bad activity patterns. When the students themselves make their own board game, it provides extra benefits, because they have to find the necessary background information.

Our aim was to introduce the concept of water footprint and the optional water-saving tips and to start an awareness-raising process by creating our own board game.

## **9. HYPOTHESIS**

We presuppose that our schoolmates will enjoy the game and that by playing this game they might be able to bring up their own water-related experiences or lifestyles. We're curious to see during the test games, if the age of the players has any kind of impact on the progression of the game. We assume that we can involve test players in the development of the game. We also hope that they will learn something new about the water footprint by participating.

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<sup>1</sup>aerator faucet – it is a water saving device which mix air into the running water

<sup>2</sup>nebia shower – the head of the shower is designed by the idea of rocket engines, the water is atomized  
[http://hvg.hu/enesacegem/20150812\\_Nem\\_eleg\\_a\\_tus\\_alatt\\_vizelni\\_a\\_zuhanyozs](http://hvg.hu/enesacegem/20150812_Nem_eleg_a_tus_alatt_vizelni_a_zuhanyozs)

<sup>3</sup>Here we can find another concept of grey water – this water is slightly polluted in the households for example: rain water, water from the washing machine. Grey water could be recycled for flushing the toilet.

## 10. TANKS OF WATER

### a THE MAKING OF THE BOARD GAME

We bought cardboard and different kinds of stickers, and we began to brainstorm about how to make a board game. We decided to create a playing field representing the Earth and formed the continents from newspapers to emphasize recycling. As the water footprint is our subject, we decided to have the players move on footprints. We glued the continents onto a piece of A2 blue cardboard, and we cut out the yellow footprints as stepping stones. Then we randomly drew question marks and exclamation marks on the footprints, and we marked stop, forward and backward fields, too. We even put a short cut into the game. We then looked for interesting images linked to water saving, water shortage, water resources, water purification and the water footprint. These pictures were printed out as cards and an exclamation mark was printed (!) on the other side of the cards. When a player pulled one of these cards he/she was asked to tell how that picture relates to the topic. We made a different set of cards for the questions, these cards have a question mark (?) on them. When a player pulled one of these cards he/she had to answer a question. Each question has 3 possible answers, one of which is correct. These cards were also printed with a question mark on the back of the cards. If a player gives a correct answer, he/she receives a drop of water, because water is a treasure! The water drops were cut out of blue cardboard. These drops were uniquely decorated. We prepared two kinds of water drops. One kind is decorated with white drawings while the other kind has a 'smiley' sticker. When a player collects 5 drawn water drops he/she gets a 'smiley' drop.

### b THE PREPARATION OF THE TEST GAMES

We agreed that one of us will be the quizmaster and other two will be observers during the trial game. The quizmaster would read the questions and three possible answers from the card. The correct one was highlighted. We took pictures as we prepared the game and of a trial game. **Annex No1.** The observers will follow the progression of the game based on different aspects of the game. **Annex No2.**

We observed if our schoolmates enjoyed the game, what they learned from our game, and if they were able to call up their own water-related experiences or lifestyles. We're curious to see if the age of the players had any kind of impact on the progression of the game. We wanted to make use of their reactions and opinions in the further development of the game. We made a summary of the concept of water footprint that the players could read before the game. **Annex No3** We also created the rules for the game. **Annex No4**



c THE RESULTS OF OUR EXAMINATION

Between March 21st and 24th we were able to play with 17 students on four different occasions. The average game lasted 36 minutes. The players were randomly selected from our high school. During the games, two of us kept observation logs about the behavior of the players. We monitored their reactions during the game. After the game we then shared our insights and experiences with each other and with our mentors.

After we collected the data, the players were divided into three different age groups, and the results are displayed according to that. The data is presented per capita, because the 15-16 age group consists of 10 people, while the 17-18 age group had 4 people, the 19-21 age group was represented by 3 people (Diagram 1). We tried to avoid the distortion of the varied sample size.

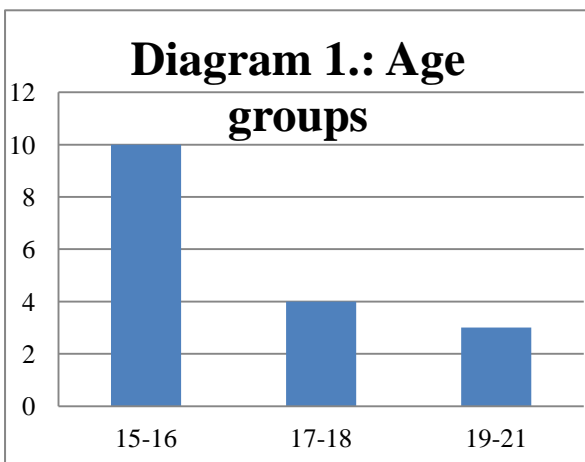


Diagram 1.: Age groups and the number of players (own research)

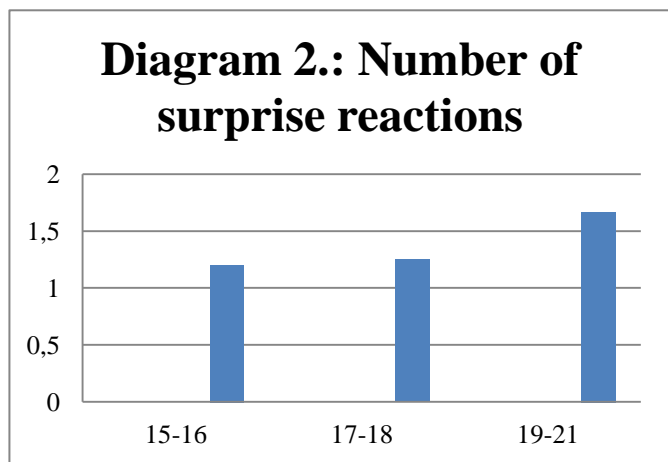


Diagram 2.: Number of surprise reactions in each of the different age groups, average per capita (own research)

We were curious whether they would be surprised because of the interesting facts or by huge amounts of water consumed in the production of different goods and products, or by surprising pictures. We observed that older players (19-21 years) were surprised more than the youngsters.

We were able to play with 17 students on four different occasions. They all got 86 water drops, which means 5 drops per person on average. Those who gave a correct answer for a fact or picture card received one drop of water, so the players gave 5 correct answers on average. (Diagram 3. and Diagram 4.)

As the Diagram 3. shows the picture cards were most correctly answered by the age group of 17-18 year olds.

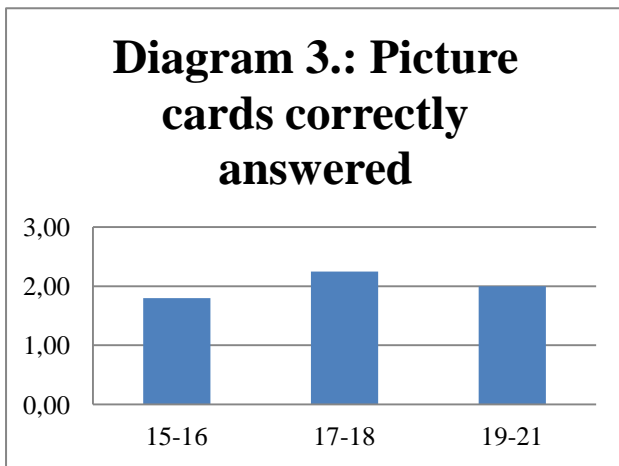


Diagram 3.: Picture cards (!) correctly answered by different age groups, average per capita (own research)

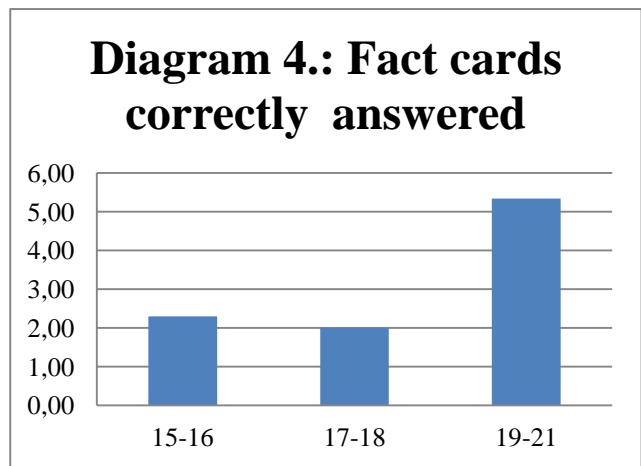


Diagram 4.: Fact cards correctly answered by different age groups, average per capita (own research)

As Diagram 4. shows the fact cards were most correctly answered by the 19-21 year olds. We experienced that students between 19-21 played more maturely, and they had great thoughts about the pictures. Also their deeper knowledge was able to surface. (One of them even knew that March 22nd is World Water Day.)

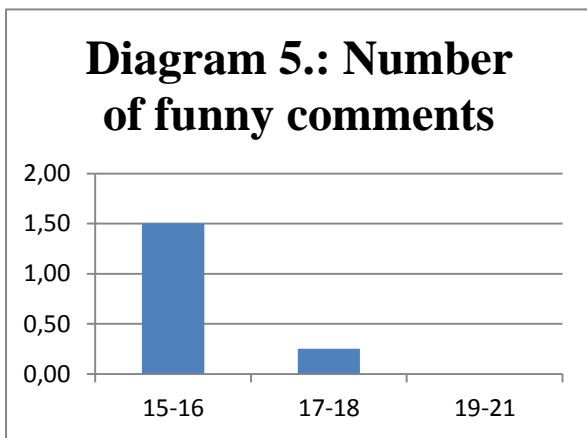


Diagram 5.: Number of funny comments by different age groups, average per capita (own research)

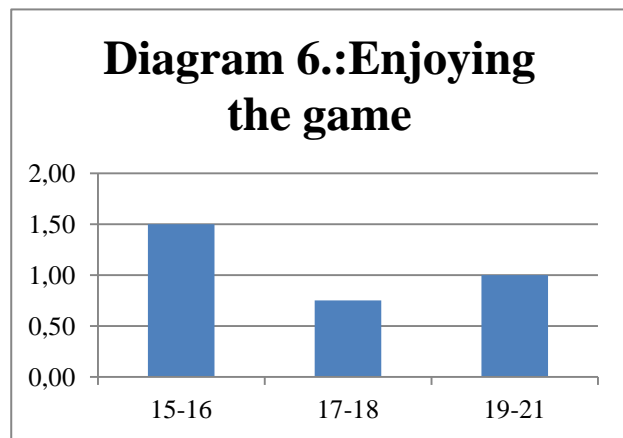


Diagram 6.: Enjoying the game by different age groups, average per capita (own research)

As the Diagram 5. shows, the 15-16 year olds tweeted the most funny responses and Diagram 6. shows that they enjoyed most the game itself.

With the help of our game, 3 of 17 players were able to realize the impact that their eating habits and lifestyles made on their water footprint. It is a small, step and it must be improved. One 15-year-old girl was surprised with her water footprint. Her main courses were often rice, fried cheese and snitzel. She thought her water footprint was small, but she realized that it was not true. Another girl (21) noticed her friend who is vegan had a low water footprint.

The game was evaluated by the players and they gave an average mark of 4.76 on a scale of 1-5.

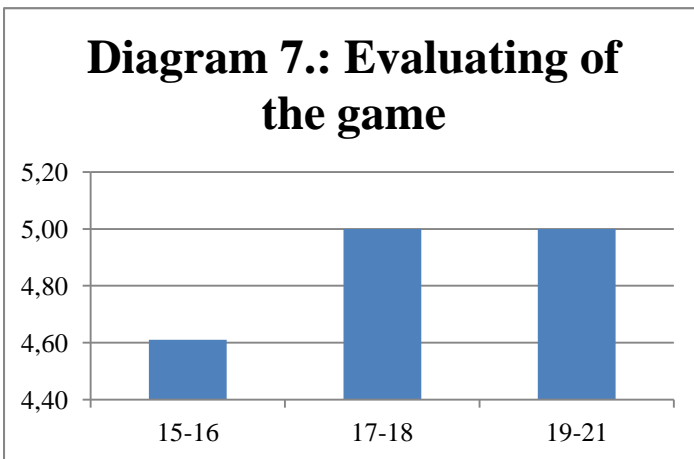


Diagram 7.: Evaluating our game on a scale of 1-5 (own research)

The older players evaluated the game highly. As we see, the youngsters enjoyed it more (Diagram 5 and Diagram 6.) but the older ones evaluated it more highly.

At the end of the game we asked them what they have learned.

- Many new facts (5 people),
- Concept of water footprint (4 people),
- The water footprint of 1 kilogram chocolate is higher than the water footprint of 1 kilogram of beef(4 people),
- The oceans are cleaned from abandoned fishing nets because of special recycled shoes made by Adidas (2 people).

The students learned lots of new information about their water footprint.

#### d ADDITIONALLY OBSERVED EXPERIENCES

As we – the observers and the quizmaster – had assumed, the students enjoyed themselves and made lots of funny comments. We enjoyed it when they were surprised because of the interesting facts and pictures. It was also interesting to see how the different age groups reacted in different ways.

We realized sadly that the students didn't make the connection with their own water consumption in school or at home. It was hard to keep within the allotted time, but we had to (45 minutes), because the students were playing with us instead of going to their lessons. Also, it was hard to gauge the reaction of one boy whose face was hard to read.

e NOTICEABLE COMMENTS - (PEDAGOGICAL REFLECTION)

Player A: - “Let’s create a new kind of stepping stone where we get a bar of chocolate!”

Player B: - “You have seen that chocolate has a huge water footprint.” (age group of 16-17 boys – **a lesson learned**)

Player C: - “From the Poles (North or South) we should have carried ice to the thirsty Africans.”  
(16 years old boy – **desire to help, but a bit flippant**)

Player D: - “Did you make this board game because today is the World Water Day?” “ Asked a girl  
(21 years old girl) (**Activated previous knowledge**)

At the end of the game, we solicited **the players’ opinions** about our game. What did you like?

What did you not like?

What did you like?	What did you not like?
4 people – Formulating the water drops	2 people – lack of significant prize at the end
3 people – the game itself	2 people – some countries were missing from the map
1 person - the creativity of the game	1 person – slow process of the game
1 person – the pictures	
1 person – interesting facts	
1 person – the tasks	

We were curious to know **their suggestions** too. How could the game itself be improved. 8 students of 17 gave us improving ideas to make the game better. We are very glad to see these!

2 people – More action stepping stones, specially at the end part of the road	1 person – More accurate map
1 person – Higher prize at the end	1 person – More information on the summary
1 person – New stepping stone to get chocolate on it	1 person- Activity like possibility for playing
1 person – More change in the direction of moving – forward and backward	

## **11. EXPERIENCES OF THE TEST GAMES**

The water footprint as a topic is so vast that we weren't able to introduce it deeply enough. There is much more knowledge and data that still could be used in the game. Currently there are 48 fact cards (?) and 17 image cards (!) but it could easily be doubled.

As we assumed, the students enjoyed playing the game and even made lots of funny comments (let say tweets), mainly students between 15-16. Students between 19-21 took a more mature approach, and they had great thoughts about the pictures. Also their previous knowledge was able to surface. The age of the players greatly influenced the progression of the game. The game was evaluated by the players, and they gave an average mark of 4.76 on a scale 1-5. The students learned lots of new information about the concept of a water footprint. They liked our game because of its creativity, the uniquely decorated homemade water drops made from paper, the picture cards and the fact cards. But they found the game a little slow, and they missed being able to win a significant prize at the end. As we assumed, 3 of 17 players were able to realize how their eating habits and lifestyles impacted their water footprints. During the game the players were able to learn the lesson, and activate their desire to help. As we suspected, we could involve test players in the development of the game. (8 people).

We noted that it's worthwhile to play with students from different age groups, so that the less serious attitude of the youngsters is tempered by the mature attitude of the older ones. The summary of water footprint (Annex No 3) should be completed with more data (e.g.: green, blue, grey water footprints and values). Moreover we should make a more motivating prize system. Our suggestion, for example, is gradually acquiring water drops: after 3 water drops a player gets a bag of wheat seeds after 3 bags of seeds a player gets a bag of flour; after 3 bags of flour, a player gets a loaf of bread (of course, we think about drawings as well). The players proposed more action stepping stones. It was a good idea because this would allow the players to get much more drops of water during the game, which in turn can be exchanged for higher prizes. We should broaden our card selection with Activity like possibilities or other kinds of exercises (like: find out, draw, do it)

At the end, both we as the game makers and the students gained some good experience. We also became more conscious of water and invisible water. Our goal is to never reach a water game over.

## 12. ANNEX No1.

### PICTURES

Photo 1:

Water drops drawn with white.



Photo 2:

Playing field: the map of Earth and the yellow footprints as a road to move.



Photo 3: Picture cards.

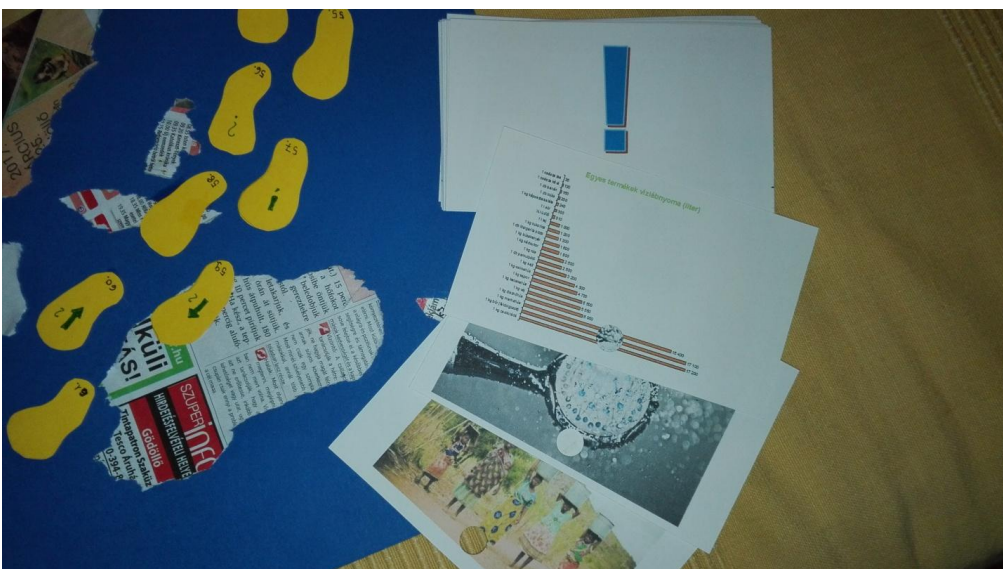


Photo 4: During the game.



Photo 5: Some of the Fact cards (?)

What is the definition of the water footprint?

- a) It gives us how much water we can pour into a footprint.
- b) It gives us how much water needed directly and indirectly to produce a certain product.**
- c) It shows u show much water you drink in a day.

In which country is the water footprint the largest?

- a) France
- b) United States of America**
- c) Russia

How can you reduce your own water footprint? Give some examples!

less meat to eat, to use water saving devices

less coffee to drink, to use aerators on taps

to use bike instead of car, to buy second hand clothes

What do you think which is bigger the water footprint of 1 kg beef or 1 kg of chocolate?

- a) beef (15415 liters/ kg)
- b) chocolate (17196 liter/ kg)**
- c) the same

**13. ANNEX NO2.**

**OBSERVATION LOG**

	<b>Date of the game</b>	<b>Quizmaster:</b>	<b>Observer:</b>	<b>Class:</b>
<b>Aspects of observation</b>	<b>player 1</b> <b>name</b> <b>age</b> <b>gender</b>	<b>player 2</b> <b>name</b> <b>age</b> <b>gender</b>	<b>player 3</b> <b>name</b> <b>age</b> <b>gender</b>	<b>player 4</b> <b>name</b> <b>age</b> <b>gender</b>
<b>surprise of the facts</b>				
<b>funny tweet</b>				
<b>experience of water consumption at home</b>				
<b>correct answer of Picture card</b>				
<b>correct answer of fact card</b>				
<b>experience of water consumption at school</b>				
<b>playing with joy</b>				
<b>experience concerning eating habits</b>				
<b>experience concerning lifestyle</b>				
<b>coming up new idea</b>				
<b>boring during the game</b>				
<b>mentioning of objections</b>				
<b>evaluation of the game 1-5</b>				
<b>Suggestions for improvement</b>				
<b>What did you like?</b>				
<b>What did you not like?</b>				
<b>What did you learn from the game?</b>				



## 14. ANNEX NO3.

### SUMMARY OF WATER FOOTPRINT FOR THE PLAYERS BEFORE THE GAME

Water consumption in the past increased twice as fast as the world's population. The water footprint shows the total amount of water used both directly and indirectly through consumed products. We consume water not only when we drink, wash, cook and clean. Practically everything we touch, even the services we use, need water.

#### Some examples of the water footprint:

- A cup of coffee - 140 liters of water
- 1 kg wheat - 1000 liters of water
- 1 kg beef - 15000 liters of water
- 1 jeans - 6000-11000 liters of water
- 1 hamburger - 2400 liters of water

In Hungary, the average direct daily water consumption is 152 liters of water (eg. diet, sanitation, cleaning, irrigation). The average Hungarian person uses 3800 liters of water per day through food, products and he/she consume water! Now it is understandable why we named our game: "Tanks of Water", referring to the huge amount of water that is used daily. The total water footprint of Hungarians isn't small, but most countries use even more on a daily basis. The US consumes the largest amount of water per year (2.48 million liters of water per person per year). At the same time, 50 countries in the world are facing water shortages. If we want the whole population of the Earth (which is 7,2 billion people) to use the same amount of water as the population of the Western countries then we would need three and a half Earths. In 2050, there will be 10 billion people on the Earth, and our freshwater resources are limited: 200 000 cubic kilometers.

#### It is worth knowing

We use 2-4 liters of water daily for drinking and cooking. In addition, several liters of water are used for washing, bathing, cleaning and flushing the toilet (30-40 liters/day). If we take the recommended daily consumption of water (2-4 liters a day) it means we waste two weeks' worth of fresh drinking water down the toilet, while rain water would be perfect for this purpose. In addition, the rain is on hand, so you do not need to transport it to your house, or pay for it. The collection of rainwater requires some specific construction but the extra cost for this construction would pay for itself by reducing amount of money paid for a household's water bill.

Even if we aren't able to direct the rain-water to the bathroom, it is still worth building a rainwater collection cistern for irrigation.

**You can read more about this topic here:**

[Waterfootprint.org](http://Waterfootprint.org)

**You can calculate your water footprint here:**

<http://bit.ly/1dBLfi8>

## **15. ANNEX NO4.**

### **„TANKS OF WATER” - RULES OF THE GAME**

Time: 45-60 minutes

Recommended ages: 12+

Purpose of the game: Collect as many water drops as you can. To collect water drops, the players must answer the question correctly. The player with the most water drops wins the game.

Game progression: A summary of water footprint is available to the players during the game. The players will decide among themselves who will start and who will be the next player. The movement of the players is decided by throwing dice.

Field with a question mark (?): the player who steps here must choose a card with a question mark and answer the question. If the answer is correct he/she gets a water drop as a prize. If the answer is not correct no further action is taken.

Field with an exclamation mark (!): the player who steps here gets a card with picture on it. He/she should describe how the picture is related to the water issue. If the answer is acceptable he/she gets a water drop as a prize. If the answer is not acceptable no further action is taken.

Answer stealing is not acceptable.

When a player collects 5 drawn water drops he/she can exchange them for a ‘smiley’ drop.

End of the game: The game ends when a player reaches the finish line. This player gets two extra water drops as a bonus. In spite of this, the player with the most water drops wins the game.

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## **17. ASSISTANTS**

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Dalma Stefán – helping hand in translating and editing

Boldizsár Stefán – helping hand in the creative art

Péter Stefán – helping hand in the card printing

Andrea Nagy – helping hand in the experimental part of the research