

What is WATER QUALITY?

Water is everywhere in our planet and it is indispensable for all forms of life (also human). In our daily life **we consume much more water than the one we drink!** For example, to produce **1 kg of beef meat we need 15 000 liters of water** or to produce your jeans we need 3000 liters of water.

You might be surprised... Of course the water used for crops does not have to be as clean as the one in your tap. The water used to grow cotton or dye your jeans blue is not pre-treated in a water plant. Nevertheless, all that makes a lot of water to circulate through human use. Most of times, the water is released again when is still polluted. It pollutes rivers, aquifers and poisons wild animals. **Depending on the use, water will have different type of pollution and will cause different problems.**



Fertilizers & plant nutrients

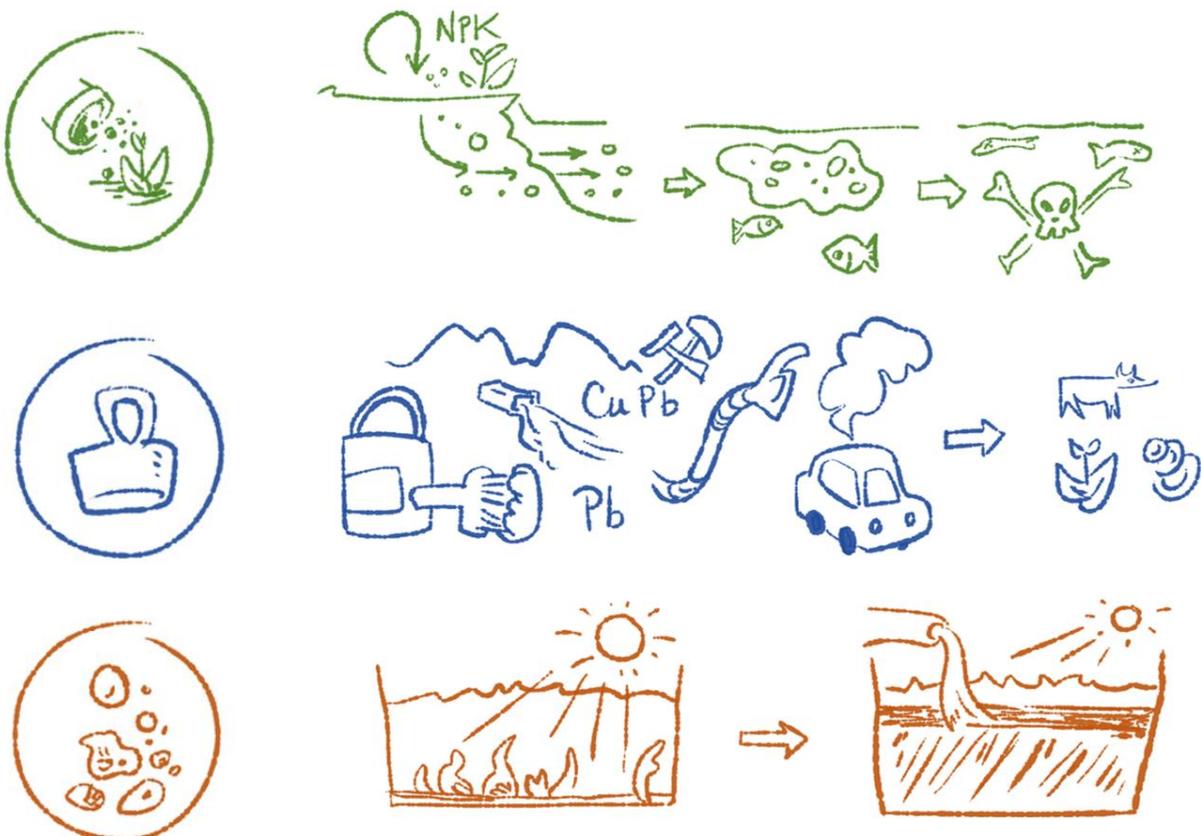
Nowadays, agriculture uses plant fertilizers to feed the plants and get more yield per year. The water used in the field can run away and arrive to rivers, lakes, seas... **This will cause other plants to overgrow such as algae.** When algae grow too much, they cause an unbalance in the ecosystem that is called **eutrophication**. If algae grow too much, they will end up blocking the light to enter into the water body. They will deplete all the oxygen, killing the fish and other living aquatic organisms.

Heavy metals

They can dissolve in the water and enter in your body and accumulate there. Heavy metals interfere with photosynthesis in plants or the respiration in animals. For example, **copper ions (Cu^{2+}) do not let plants use the energy of the sun.** Mining nowadays uses dissolved acids and water to extract metals from rocks. The drainage is sometimes bad and these metal ions can go to water sources. **Heavy metals are also used in paints, gasoline and computer parts.**

Turbidity

Water is turbid when you cannot see through. In rivers, water can be turbid because there are **particles suspended blocking the light.** **Without enough light, plants cannot grow** and this affects the entire ecosystem: from bacteria to fish.



Colorimetric tests

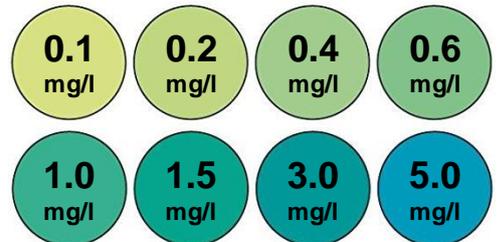
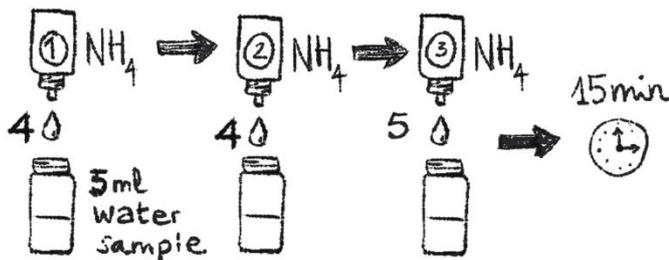
We can test the quality of the water easily in the laboratory. We will use low cost methods and we can learn from our **tests if there are any water pollutants**. This way we can treat the water or fix the problem in the environment in specific ways.

Most chemicals are invisible in the water. To visualize them, we will add something to the water that **makes color only when the chemical is present**. It is a bit like when we find very bright red little frogs in the jungle forests, the color tells us that they are very toxic and poisonous. If we see no color, there is no chemical present. The more color we will see, the more chemical will be. These are **COLORIMETRIC TESTS**, and allow us to measure the quantity of the chemical because **the concentration is linearly proportional to the color intensity**.

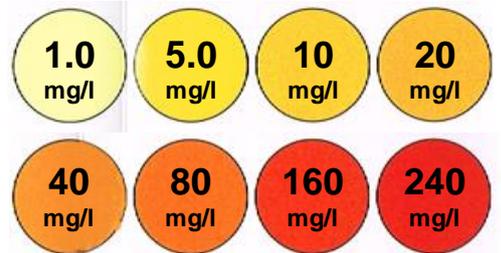
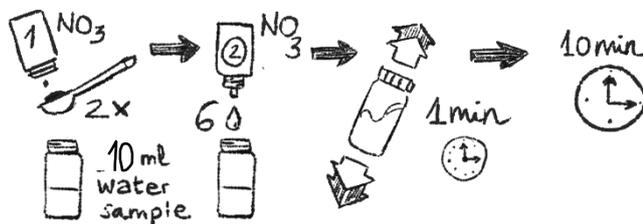


How to measure fertilizers & plant nutrients

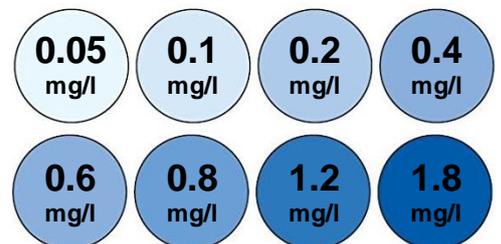
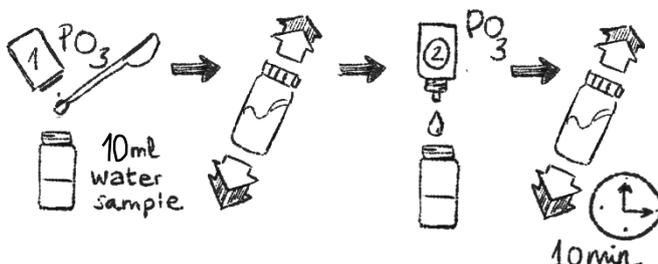
NH₄ ammonia



NO₃ nitrates



PO₄ phosphates

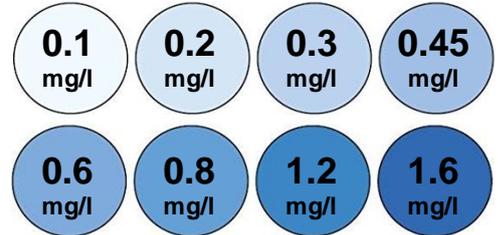
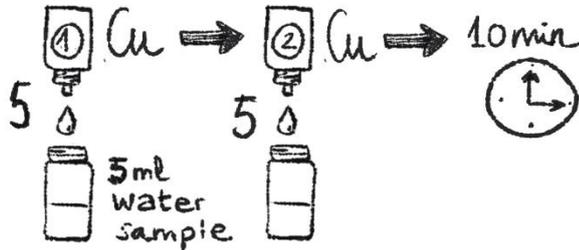


Colorimetric tests

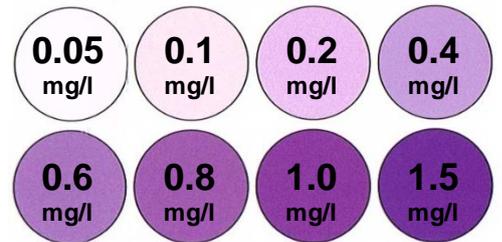
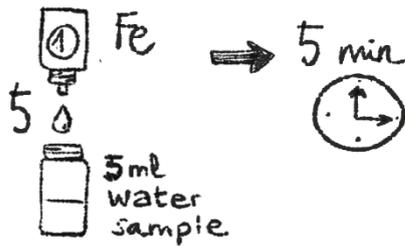


How to measure heavy metals and iron

Cu
copper



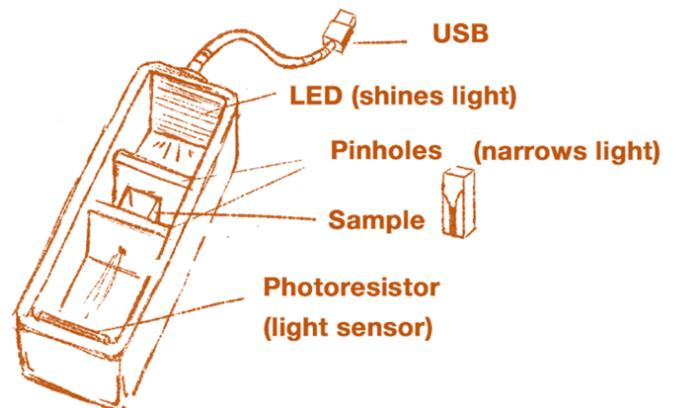
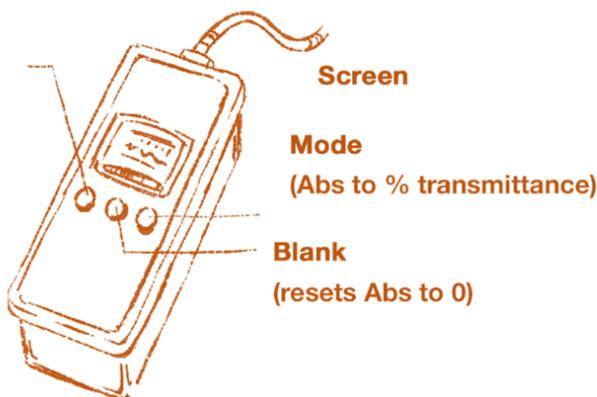
Fe
iron



How to measure turbidity

To measure turbidity, we can use a spectrophotometer. It will measure how much light goes through clean water and compare it with your sample. Clean water has zero absorbance. You need to calibrate the spectrophotometer first with clean water. **When the WATER IS TURBID, the ABSORBANCE IS HIGH.**

Sample:
Saves results on screen

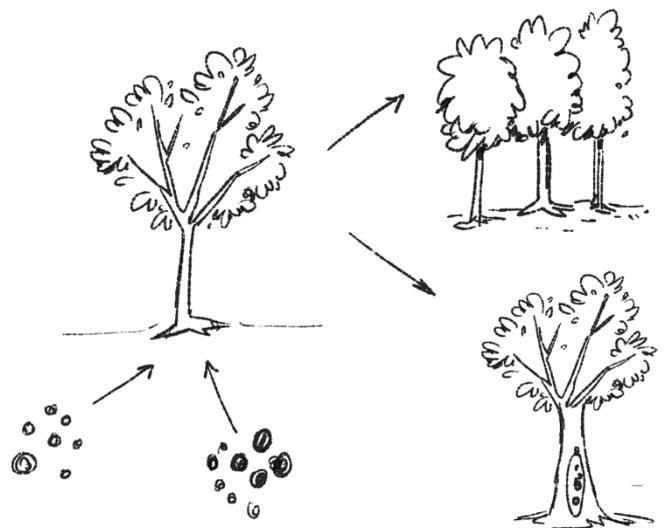


Treatment of WATER

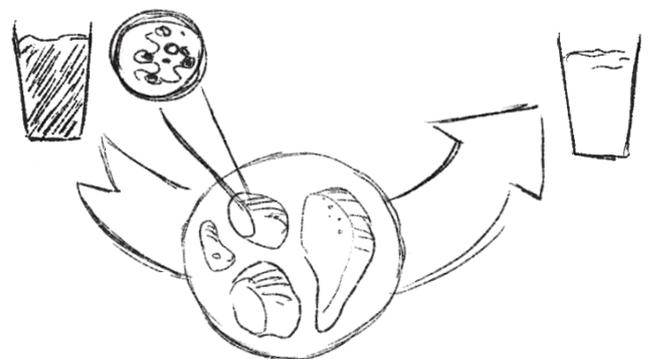
Depending on the problem of water, we might have to treat it in different ways. Nature can clean the water but sometimes we produce too much pollution or we would like to use very clean water. There are different ways to treat the water:

1/ Bioremediation: using life: Many chemicals that are toxic for us can be used by other organisms. **Fertilizers can be used by plants and other organisms.** Other pollutants that are of similar kind can be used by bacteria or other life forms. To remove fertilizers from the water, we can use suspended algae. They can degrade the fertilizers in the water and use them to grow.

Other plants that can absorb heavy metals. They can tolerate them and concentrate them in their leaves and stems. Usually these plants are harvested and destroyed in special places. These heavy metals can be used and recovered. This method can be very useful because plants can be easily monitored, but the limitation is that the cleaning process is only limited to the surface area and depth occupied by their roots



2/ Activated charcoal, the superfilter: It is made by treating wood or charcoal at very high temperatures. This makes tiny holes inside the charcoal creating a big surface inside. **This surface is “sticky” to almost anything that is dissolved in the water or air and therefore can clean many general problems.**



3/ Sedimentation and filtration: to clean up the water and remove **the solid part suspended in it.** We can use living organisms to filter the water, such as plants, or use other filters as sand or cotton

Treatment of WATER

Which pollutants (if any) have you found in your water sample?



Turbidity?



Heavy metals?

Which method would you use to fix it?



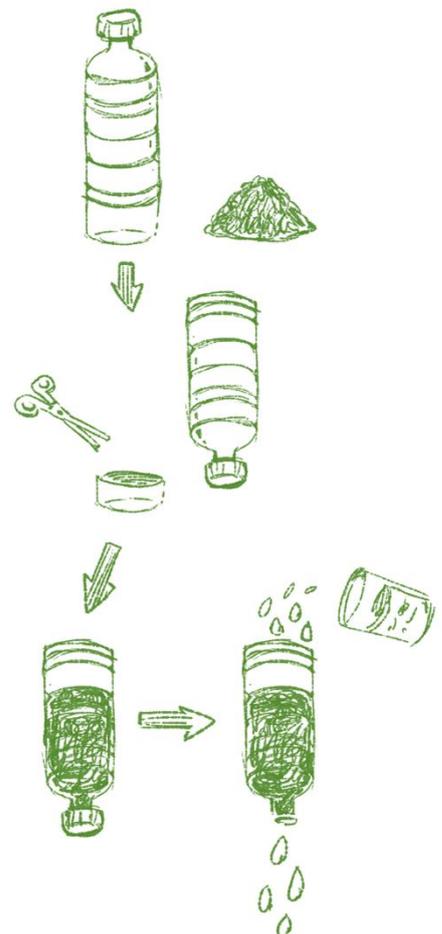
Fertilizers & plant nutrients?

Building your own water filter

If your water sample is polluted, you can clean it easily building yourself a water filter. You need first to take a plastic bottle and cut out the bottom part. Place a piece of cloth next to the lid, and top up with the filtering materials that you choose.

You can use different filtering materials to test (sand, cotton, activated charcoal and plants).

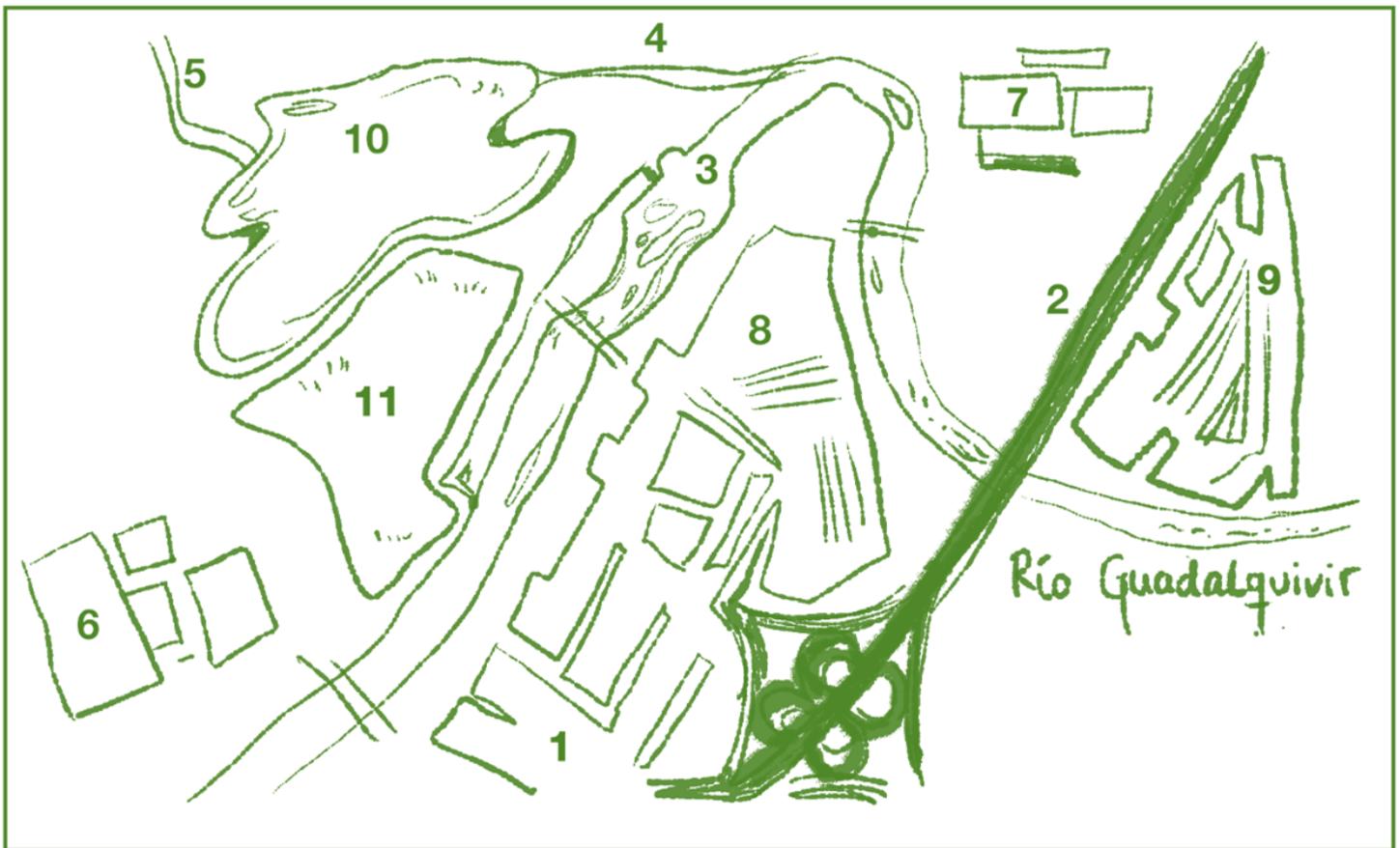
DO NOT FORGET TO WRITE DOWN the results of your COLORIMETRIC TESTS BEFORE and AFTER you pass your water through the filter. Now that you know what is the problem of your water, you can make it go through your filter and measure again the colorimetric tests. Is your water cleaner? Which method worked better?



Environmental Intervention

The most effective way of counteracting pollution in the environment is not treating water, but rather studying the problem and **attacking the source of it**. For it, researchers, governments and activists often survey the waterbodies to fast identify changes in the water quality and fight the problem. **The important thing to remember is that there is not only one solution to a problem, but many.** Some of them will present bad outcomes too.

Let's take this example of this river in Sevilla, where your water was taken:



1,9 towns // 3,4,5 rivers // 2 road // 6,7,8 farming // 10 lake.



Environmental Intervention

1/ What was the problem in your water sample?

2/ How to treat the water?

3/ Look at the map from where the water was taken... How could this water be polluted?

4/ How would you solve this problem in the environment? Try to find some specific problems and find solutions and alternatives with different views.

Divide in these groups:

- **Activists**
- **Politicians**
- **Farmers**
- **Water management company**
- **Citizens**