WHAT´S YOUR IMPACT ON EARTH?

RIVER SOR

Once… there was water…

Agrupamento de Escolas de Ponte de Sor

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Once… there was water…

The water ... From all the resources present on our planet, indispensable to life and the development of societies, water is certainly the most abundant and, if there is a lack or degradation, the one whose penury will feel more crudely. It is then necessary to know how to take advantage of it and, fundamentally, to keep it.

The amount of water recovered, purified, distributed continually is enough for the global needs, despite presenting an unequal distribution. It is interesting to know if the amount of water we dispose is stable, or rather, if the Earth wins or loses water in the course of times.

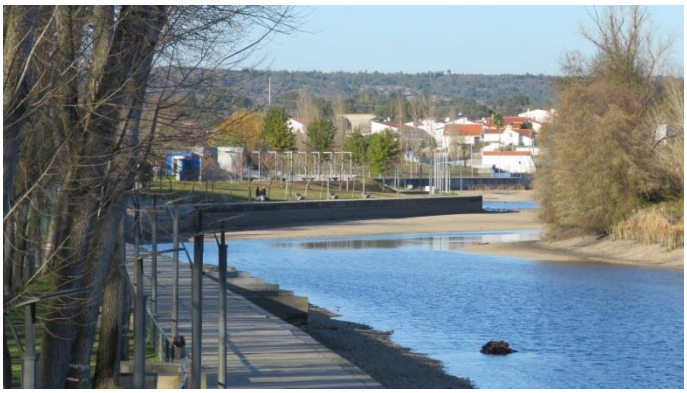
Fig. 1 River Sor

Table I - Estimation of the total volume of water on Earth

	Stock in km^3	% of total	Endurance time
Oceans	1 350 000 000	97,410	2500 years
Glaciers	27 500 000	1,984	1600 to 9700 years
Groundwater	8 200 000	0,592	1400 years
Inlands seas	105 000	0,00758	unknown
Freshwater lakes	100 000	0,00722	17 years
Humidity of soil	70 000	0,00505	1 year
Air humidity	13 000	0,00094	8 days
Rivers	**1 700**	**0,00012**	**16 days**
Water from living cells	1 100	0,00008	some hours
	1 385 990 800	1 385 990 800	100

Excerpted from World Resources

The River Sor



The River Sor is born near the village of Alagoa, near Portalegre and enters the Tagus by the left bank, downstream of the village of Benavente. In this river a curious case is observed. Leite de Vasconcelos cites this phenomenon in his book “Portuguese Ethnography”: “On the dividing line of the counties of Crato and Gavião, near the village of Sume, County of Crato, the river disappears for some hundreds of meters under cliffs of granite in a row, that replace the riverbed and on the way out takes the name, as I observed. The name is taken from the verb “*sumir”,* (to disappear), in Portuguese, in the archaic form Sume, which also applied to the village. There is in this local a bridge that makes the dividing line of those two counties and in occasions of floods the river becomes an interesting show and you can hear a deafening noise made by the waters in their passage beneath those *penedias*.

Fig. 2 River Sor

The river that flows near the city of Ponte de Sor is of great beauty until Montargil featuring charming landscapes and idyllic nooks. But the rapid development of economic activities and the growth of population have contributed to the changing characteristics of river waters. Along the banks of the River Sor there are agricultural activities that may be responsible for the contamination of water. Also, as possible contaminants are effluents from livestock and domestic effluents.

Mills in River Sor

The oldest reference to the existence of mills in the Ribeira de Sor, which bathes the county and delimits the village of Tramaga to the source, dates from the thirteenth century. In the description of the Ribeira de Sor and its tributaries made in the Parish Memories of 1758, a total of 10 mills and a watermill are mentioned, being located three of the mills in the Ribeira de Sor. They correspond possibly to the hydraulic mills of caster that we can still observe nowadays, located to the south of the city of Bridge of Sor, to Tramaga.

Fig. 3 "Pontinha" Mills

Fig. 4 "Sobreira" Mills

Analysed Parameters of River Sor's Water

Phosphates $(\mathbf{PO_4^{3-}})$ **-** The phosphates are in water in the form of suspended particles or settled in the bottom. It is used as fertilizer in agriculture and constitutes one of the nutrients of rivers. They are part of the constitution of bleaches and domestic effluents.

Ammonium $(\mathbf{NH_4^+})$ **-** Ammonium salts are found in nitrogen fertilizers.

Nitrates $(\mathbf{NO_3^-})$ **-** Most nitrates appear in drinking water as a result of soil contamination by cesspools and agricultural fertilizers. Very soluble, they pass to the water sheets and rivers if they are in excess in the soil, by storm height or at the end of the growing season.

Nitrites $(\mathbf{NO_2^-})$ **-** They come from the reduction of nitrates by our organism. They are extremely dangerous since they oxidize the haemoglobin thus making it difficult to transport oxygen and can lead to death due to lack of oxygen.

pH - Acid / Base - The pH gives us the indication if the water is acidic or alkaline. Usually the pH of the water varies between 6 and 8. The pH decreases as the presence of CO_2 increases. One of the problems related to pH is the phenomenon of corrosion of pipes and equipment.

Fig. 5. Sorensen scale

Hardness - When water contains significant amounts of Ca^{2+} ions and Mg^{2+} ions (from limestone and dolomite) is called hard water. The presence of these ions makes water unsuitable for some domestic and industrial uses.

Water collection

On the 13th December we made the collection of water samples to analyse in the laboratory.




Fig. 6 Water collection

Fig. 7 Group of students

The material we used for analysis

These parameters were studied using:

- A water analysis kit Aquanal-Ökotest Riedel-deHaën
- pH meter

Fig. 8 Kit Aquanal-Ökotest Riedel-deHaën




Fig. 9. Students in the laboratory

Results obtained by students in river water analysis

DATE	PARAMETERS				
	Phosphates (mg/L)	Ammonium (mg/L)	Nitrates (mg/L)	Nitrites (mg/L)	pH
08/02/2019	3,0	3,0	20	0,03	7
15/02/2019	1,2	1,0	10	≤0,02	7
22/02/2019	0,5	≤0,05	10	≤0,03	6,5
01/03/2019	0,5	0,2	10	≤0,02	7
08/03/2019	0,5	≤0,05	10	≤0,03	7
	0,5	0,2	0	0,1	7

Analysis of the results obtained

The fresh waters (rivers, lakes, etc.) of the planet in conditions of use are less and less, because of their diminishing quality, from day to day, due to pollution. The problem of altering fresh water by contamination has been known for a long time.

The values obtained are among the recommended values. It should be noted, however, that the concentration of nitrites and ammonium undergoes a slight change. The presence of phosphates e ammonium can be justified by the fertilization because the fertilization have occurred during this period, since it is a region where agricultural activities are carried out.

On March 8th, there is a significant increase in the nitrite concentration, reaching a higher value than the recommended one, while the nitrate concentration is zero. These results may be due to the influence of factors that are unrelated to us and which may have influenced the balance.

Contamination of water

Causes of water pollution

The main causes are: pollution, contamination by pollutants and sewage, and contamination by corpse residues

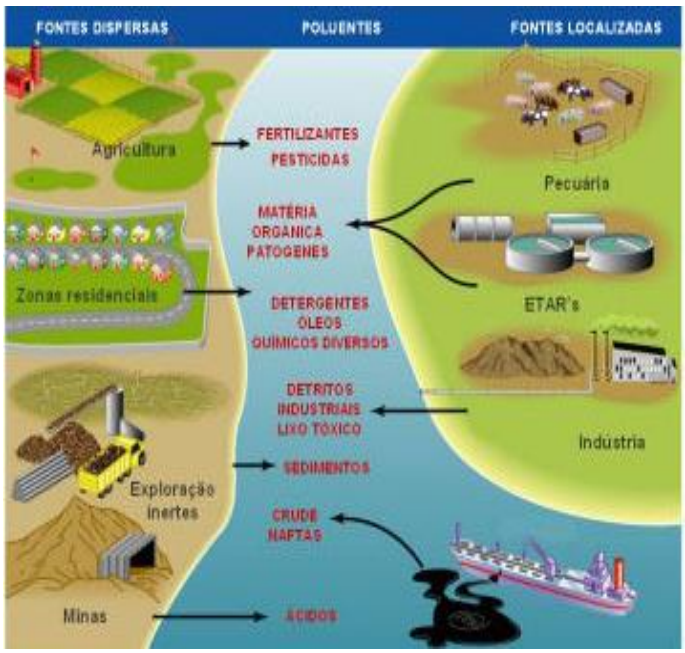


Fig. 10 Causes of water pollution

Organisms that identify water quality

To identify the quality of the water we have to see what kind of species live in these places.

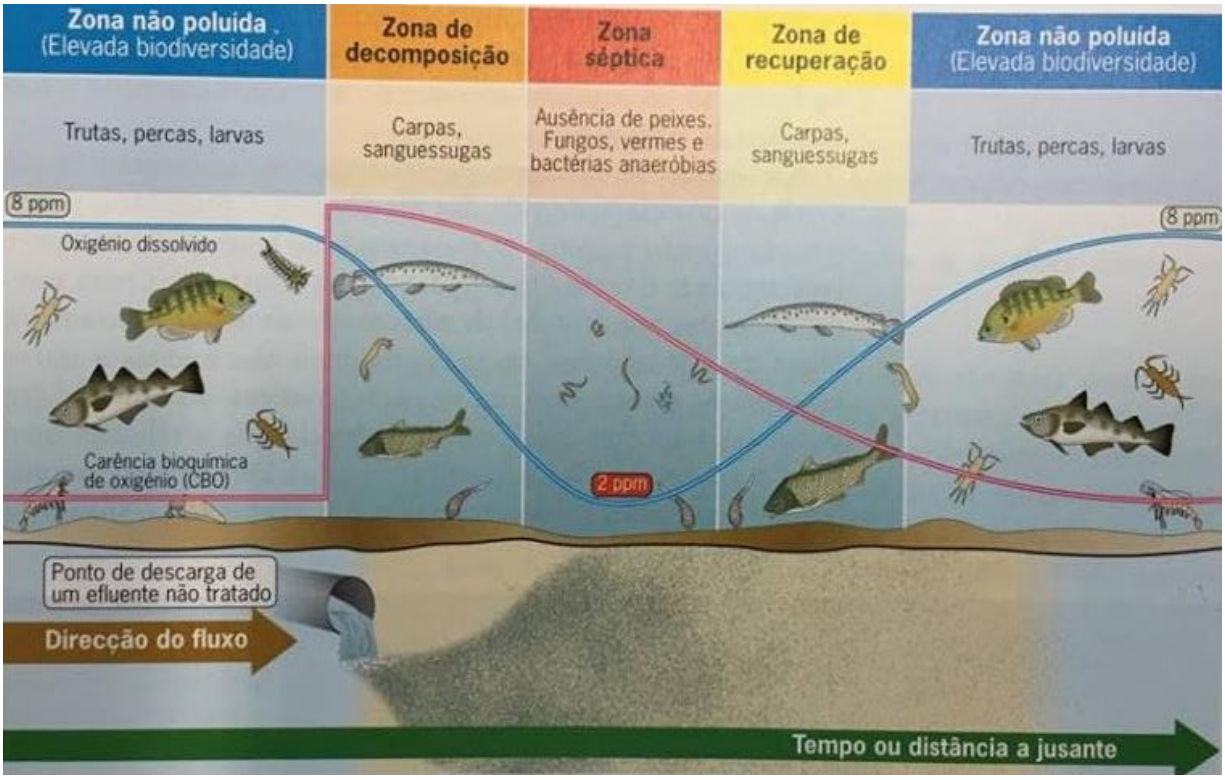


Fig. 11 Variation of the biochemical oxygen demand during discharge of a wastewater effluent

Organisms which identify water quality

To identify the quality of the water we have to see the macroinvertebrates that inhabit these places.

Biotic Index	Water Quality Rating		Degree of Organic Pollution
0.00 - 3.75	Excellent		Organic Pollution unlikely
3.76 - 4.25	Very Good		Slight Organic Pollution possible
4.26 - 5.00	Good		Some Organic Pollution probable
5.01 - 5.75	Fair		Fairly Substantial Pollution likely
5.76 - 6.50	Fairly Poor		Substantial Pollution likely
6.51 - 7.25	Poor		Very Substantial Pollution likely
7.26 - 10.0	Very Poor		Severe Organic Pollution likely

Fig. 12 Quality table

Species	Score
Heptageniidae 	10
Philopotamidae 	8
Ephemerellidae 	7
Ancylidae 	6
Elmidae (larva e adulto) 	5
Baetidae 	4
Gerridae 	3
Chironomidae 	2
Oligochaeta 	1

Fig. 13 Scoring table

Bio indicators

Biotic components of an ecosystem that respond to changes in systems in a predictable way. The most commonly used are macro invertebrates, since they are easy to show and observe and have very varied tolerances.

Fig. 14 Macro invertebrates

Why use bio indicators?

- It is a simple, fast and inexpensive method;
- Provide quick signals on environmental problems;
- They allow the identification of causes and effects between triggering agents and biological responses;
- Provide an overview of the integrated response of organisms and environmental modifications;
- They allow to evaluate the effectiveness of the actions taken to mitigate the problems created by man.

Procedure:

- A submerged sediment sample is collected.
- It is taken to the lab (laboratory) where the sample is washed and the macro invertebrates are collected.
- Transfer to individual jars and observed with the help of a magnifying glass.
- Families are identified and the corresponding points are added.

There are several organisms that allow us to identify the quality of water, such as carps, leeches, worms, fungi, anaerobic bacteria, which tell us if the area where they live is polluted or unpolluted.

We also have the macroinvertebrates, which indicate, according to a scoring table and the number of individuals of a family that inhabit a certain place, if the water of this place is very good or extremely polluted. In this type of tables we also have the colours corresponding to each zone. of very good water. If the colour is blue we have very good water; if the colour is red we have extremely polluted water.

There are certain parameters that can be used to evaluate water quality, one of which is the biochemical oxygen deficiency, which refers to the amount of O_2 dissolved in water and which allows the decomposition of the organic matter that exists there.

An example of an experimental protocol applied in Biology classes at our school

Experimental Protocol

How does acidification of the oceans occur?

Framework:

The oceans absorb about 25% of the carbon dioxide (CO_2) from human activities, which is released into the atmosphere. This greatly mitigates the climate impact of this greenhouse gas. However, the dissolution of the carbon dioxide in the water causes the formation of carbonic acid which acidifies the water. CO_2 emissions into the atmosphere have increased significantly since the Industrial Revolution, and in particular in the last decades. As a result, the increase in acidification of the oceans is notorious. This increase in acidity has consequences for marine organisms. It significantly reduces the rate of calcification of organisms with shells. It may also alter the physiology and reproduction of some organisms. These changes have both ecological repercussions, affecting the food and biodiversity chains as well as economic ones, causing serious damage to the fisheries sector.

Goals:

This activity introduces the notion of greenhouse effect and demonstrates experimentally the acidification of the oceans caused by the increase of atmospheric carbon dioxide. To understand the adverse effects of this acidification on marine communities, it is proposed to verify the erosion of calcium carbonate present in the exoskeleton of marine animals and shells, through the reaction of this with an acidic aqueous solution.

Adapted from: www.ciimar.up.pt/oCIIMARnaEscola/

Material:

- Purple Cabbage Extract
- Color Colorimetric pH scale
- Sodium bicarbonate
- Vinegar
- Distilled water
- Shells of marine animals
- 30 cL plastic bottles
- 50 cL plastic bottle
- Straw or other flexible tube
- Clay
- Glass cups
- Straw

Procedure

A. Water-induced acidification by CO_2 dissolution

Experience 1

1. Perfuge the bottle caps and pass the straw through the holes made, thus joining the bottles. Use plasticine to seal the holes (bottles should be well sealed allowing only gas exchange through the tube) (Figure 15).
2. Put in the smaller bottle 30 mL of purple cabbage extract and 60 mL of distilled water.
3. Place in the other bottle 100 ml of vinegar and one teaspoon of baking soda. The acetic acid from vinegar reacts chemically with sodium bicarbonate releasing CO_2 (according to the reaction $CH_3COOH(aq) + NaHCO_3\ (aq) \rightarrow CH_3COONa\ (aq) + H_2O\ (l) + CO_2\ (g)$). The CO_2 will diffuse through the tube into the smaller bottle lowering the pH of the water solution and indicator.
4. Observe the color changes that occur in the bottle containing the water solution and pH indicator; if necessary, shake the bottle with water. Compare the colors obtained with the colorimetric pH scale. Note the observed changes and the pH determined on the experiment record sheet**.**

Fig. 15 Exemplification of experience

Experience 2

1. Place equal volumes of purple cabbage extract solution (15 mL of cooking water + 30 mL of distilled water) in two glass cups. One of the cups will serve as the control and the other of the test vessel.
2. Squeeze into the test container liquid, making the solution bubble. Compare the color changes observed with the control solution and with the colorimetric pH scale. Record the observed changes and the pH value determined.

B. Effect of ocean acidification on shells of marine animals

1. Put 15 mL of purple cabbage extract and 30 mL of lemon juice in a glass. Note: the solution should be very red (pH <3).
2. Place another 15 mL of purple kale extract and 30 mL of tap water in another glass.
3. Place a shell in each beaker and observe the release of CO_2.

How does acidification of the oceans occur?

Experience Log

1) Formulate and indicate the hypotheses to be tested in these experiments.
2) Indicate what changes you observed in CO_2 acidification experiments. What pH did you get in experiment 1 and experiment 2?
3) What is the origin of CO_2 that caused water acidification in the experiment?
4) In which glass did you observe greater release of CO_2 in the study experience of the effects of acidification on limestone structures of marine animals?
5) Indicates three human activities that cause the intense release of carbon dioxide into the atmosphere contributing to the acidification of the oceans.