



Open  
Science  
School

# Water Watchers



# Citizen Science # openscience  
[www.openscienceschool.org](http://www.openscienceschool.org)  
@ossparis @criparis



By: Juanma García (@juanmagararc)  
& Sonia Agüera (@immunosoni)

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# Water Watchers: open science in schools

## Water watchers: bringing scientific tools, citizen science, and open science into high schools

“Water Watchers” is a science project in schools that aims at characterizing environmental water quality. It brings together teachers, students and scientists from 4 different European countries. The project was started in the context of an Erasmus+ exchange grant. We would like to talk about the methodology and how we achieved our different goals.

**1: Developing multilingual and reusable educational materials** for learning about water quality, treatment of water and environmental intervention.

**2: Encourage productive scientific collaboration.** All materials and equipment used are cheap and easy to buy. Teachers would



Sonia Aguera (@immunosoni) and Juanma Garcia (@juanmagararc)

More online on: [OpenScienceSchool.org](https://OpenScienceSchool.org)

## *WHAT ARE THE PLANS FOR THE DAY?*

**10:00 - 10:30:** What is water quality?

**10:30 - 11:00:** We learn how to collect the water and what else to do when do it.

**11:00 - 14:00:** We go and collect the water!

**14:00 - 15:00:** Testing water quality (back to the lab) and we document online, meanwhile.

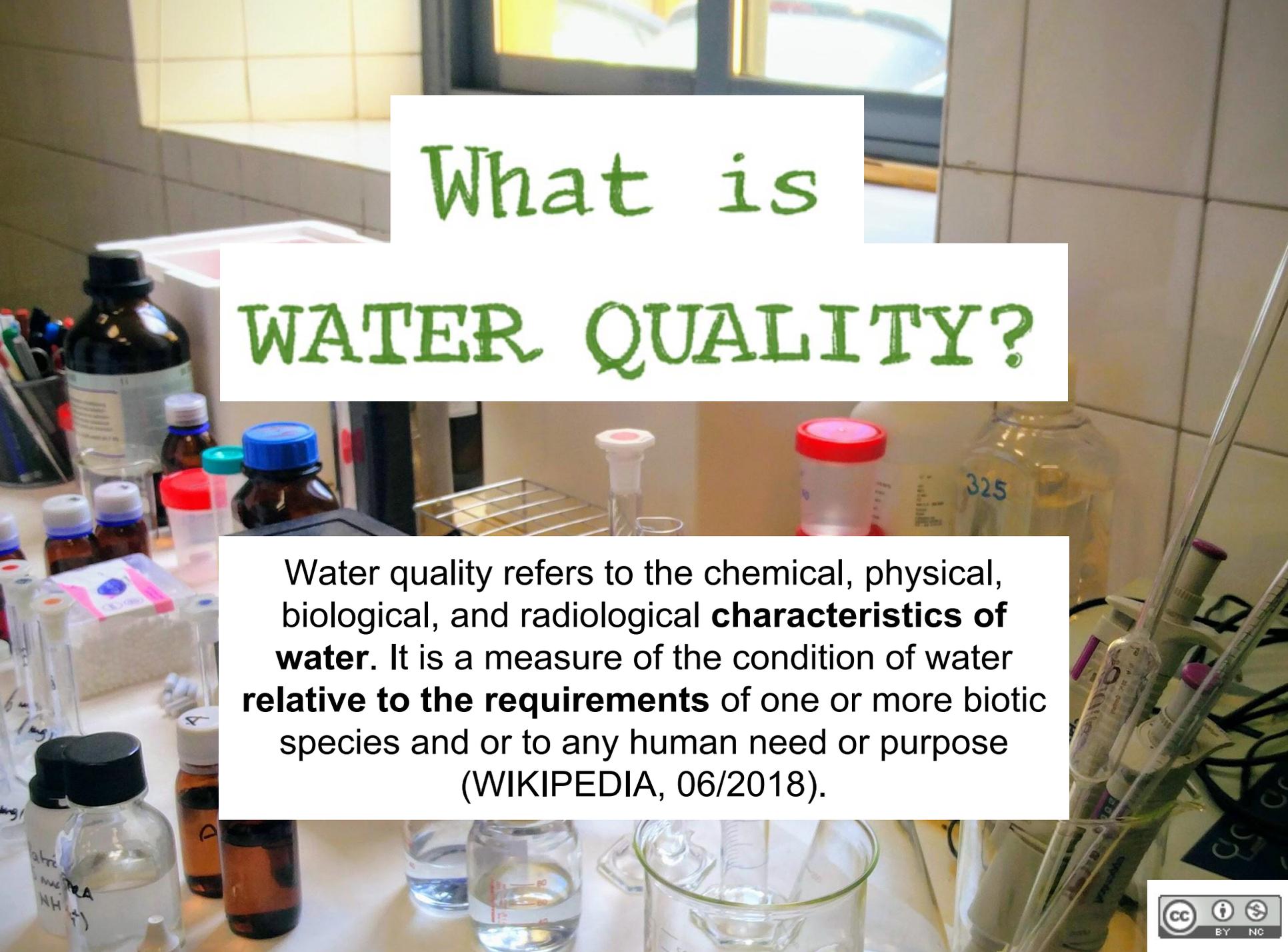
**15:00 - 16:00:** We will filter the water.

**16:00 - 17:30 approx.:** Creative exercise to simulate field work in a polluted site and open discussion.

# PART ONE: INTRODUCTION

What is

WATER QUALITY?



# What is WATER QUALITY?

Water quality refers to the chemical, physical, biological, and radiological **characteristics of water**. It is a measure of the condition of water **relative to the requirements** of one or more biotic species and or to any human need or purpose (WIKIPEDIA, 06/2018).

# WATER QUALITY relates to the way we will use it



... and also gets polluted in a different way depending on its use!

# *Example 1: Doñana wetlands, Spain*

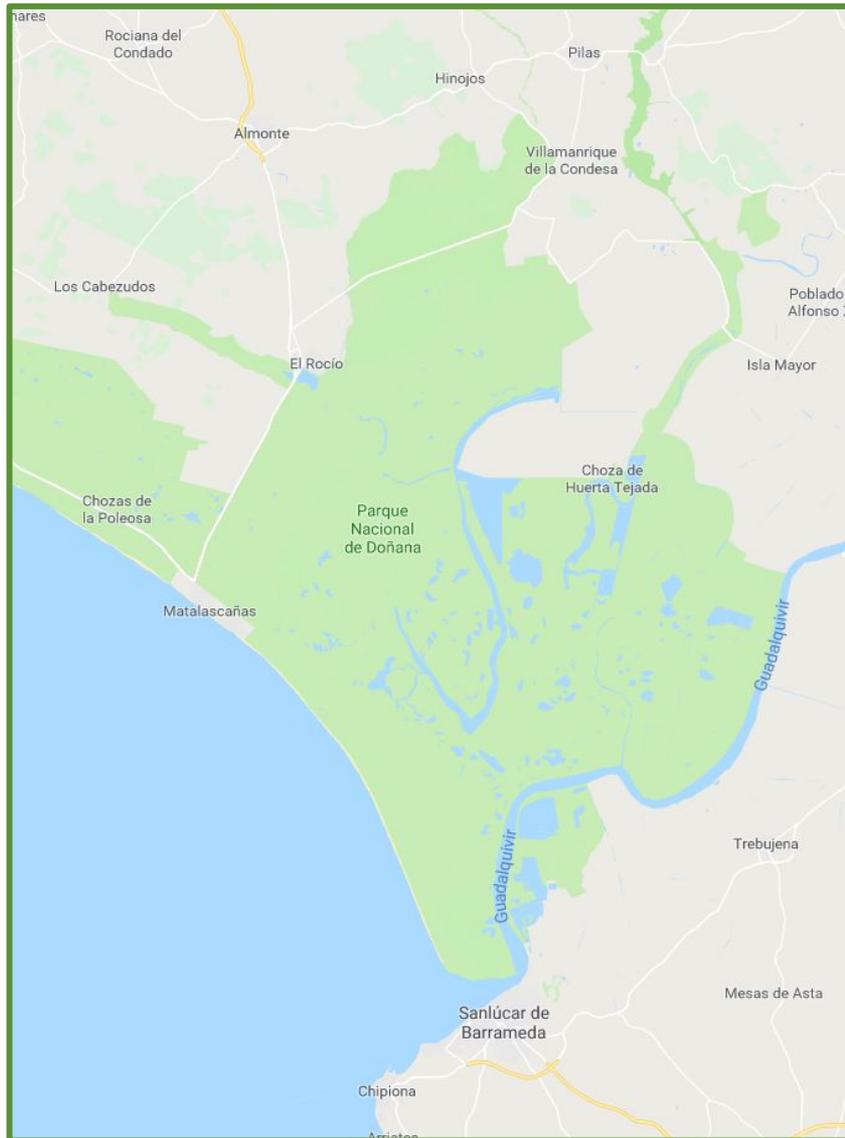
**SALINIZATION**



CC4.0-SA-BY Wikipedia User Ultratomio



# Doñana wetlands, Spain



# On the news...

EL MUNDO España Opinión Economía Internacional Deportes Papel Más  [Suscríbete](#)

< [Ciencia y Salud](#) | **Ciencia**

MEDIO AMBIENTE - La Unesco amenaza con retirarle el título de Patrimonio de la Humanidad

## Más de 800 pozos ilegales secan Doñana con la permisividad de las autoridades

CECILIO GALDÓN  YULY JARA  JUAN MANUEL LERALTA  ADELA VIVED  Madrid / Huelva 23 SEP. 2017



- Las ayudas concedidas durante años por la Junta de Andalucía han incentivado prácticas agrícolas irregulares en suelo forestal
- La sobreexplotación del acuífero compromete la salud de los ecosistemas del Parque Nacional y Natural, según el último informe oficial
- El 90% de los fondos FEDER para Doñana acaba en el Palacio de Las Marismillas

 85



POLICY FORUM | WATER

## Saving freshwater from salts

M. Cañedo-Argüelles<sup>1,2\*</sup>, C. P. Hawkins<sup>3</sup>, B. J. Kefford<sup>4</sup>, R. B. Schäfer<sup>5</sup>, B. J. Dyack<sup>4</sup>, S. Brucet<sup>6,1</sup>, D. Buchwalter<sup>7</sup>, J. Dunlop...  
[+ See all authors and affiliations](#)

Science 26 Feb 2016:  
Vol. 351, Issue 6276, pp. 914-916  
DOI: 10.1126/science.aad3488

Article

Info & Metrics

eLetters

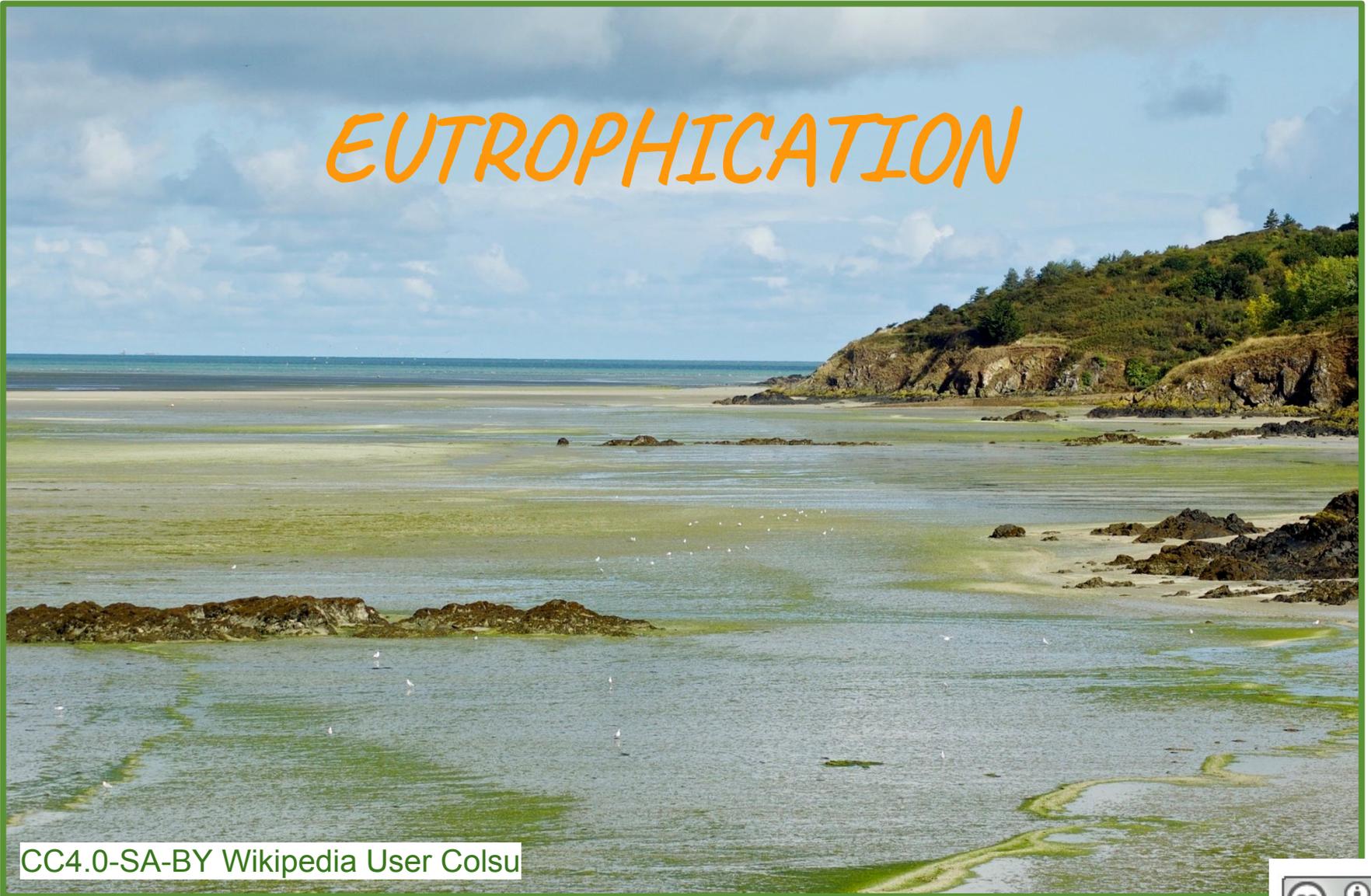
 PDF

Many human activities—like agriculture and resource extraction—are increasing the total concentration of dissolved inorganic salts (i.e., salinity) in freshwaters. Increasing salinity can have adverse effects on human health (1); increase the costs of water treatment for human consumption; and damage infrastructure [e.g., amounting to \$700 million per year in the Border Rivers catchment, Australia (2)]. It can also reduce freshwater biodiversity (3); alter ecosystem functions (4); and affect economic well-being by altering ecosystem goods and services (e.g., fisheries collapse). Yet water-quality legislation and regulations that target salinity typically focus on drinking water and irrigation water, which does not automatically protect biodiversity. For example, specific electrical conductivities (a proxy for salinity) of 2 mS/cm can be acceptable for drinking and irrigation but could extirpate many freshwater insect species (3). We argue that salinity standards for specific ions and ion mixtures, not just for total salinity, should be developed and legally enforced to protect freshwater life and ecosystem services. We identify barriers to setting such standards and recommend management guidelines.

Attempts to regulate salinization on the basis of ecological criteria can be found in the United States and Australia, where total salinity recommendations have been made (5, 6). Even these criteria are insufficient to protect freshwater life, because waters with the same total amount of salts but different ionic composition can have markedly different effects on freshwater fauna (7).

## *Example 2: Saint-Brieuc bay, France*

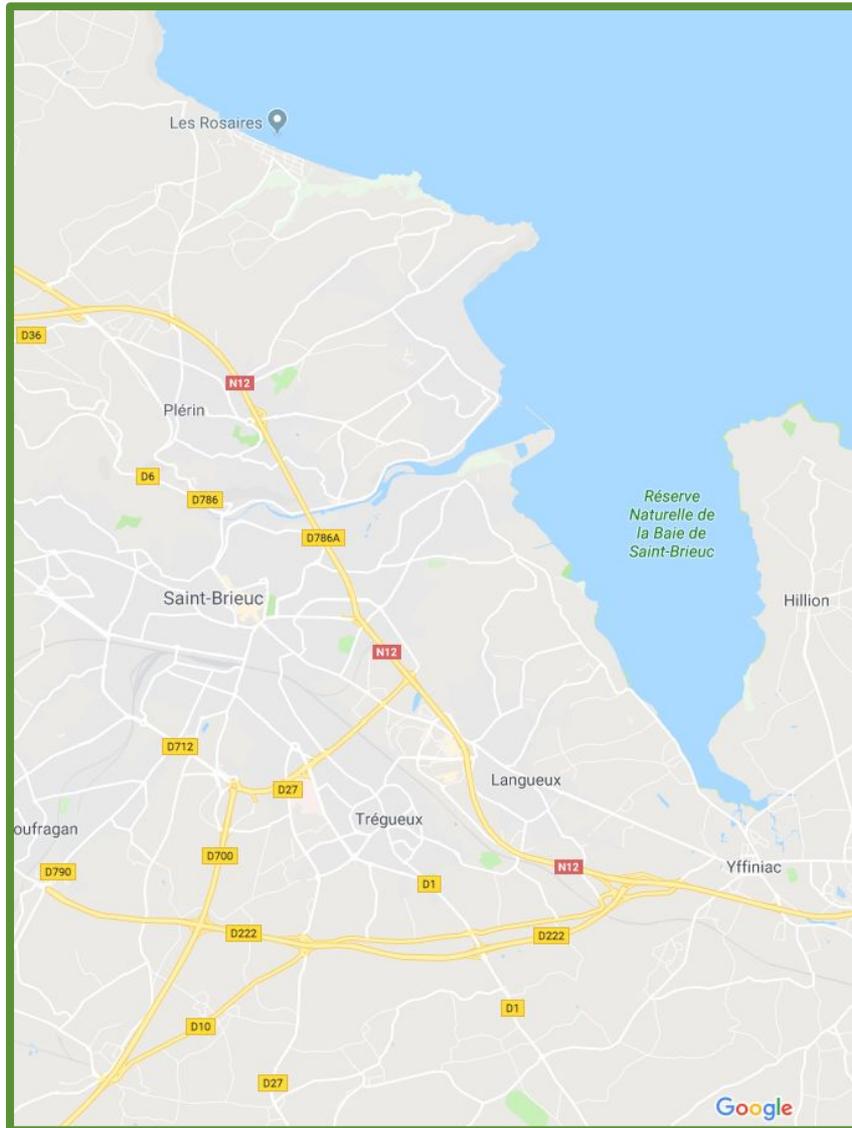
**EUTROPHICATION**



CC4.0-SA-BY Wikipedia User Colsu



# Saint Briec, France



# On the news...

**VSD** ACTUALITÉ LES INDISCRETS DIAPORAMAS ADRÉNALINE LOISIRS

VSD / Actualité

Publié le jeudi 24 août 2017 à 08:00 par Patrick TALHOUARN

## BRETAGNE ALERTE, LES ALGUES VERTES TUENT LES PLAGES



*Crédit photo : Pixabay*

Le phénomène, qui frappe les baies bretonnes depuis une trentaine d'années, regagne du terrain cet été. Les associations écologistes accusent les éleveurs et les agriculteurs industriels. Ceux-ci contre-attaquent.

## Invasion d'algues vertes en Bretagne : l'État condamné à verser 500 000 euros à Saint-Brieuc

Ma Terre / Environnement | Le Parisien avec AFP | 15 février 2018, 18h56 | f t 3



Plusieurs plages en Bretagne connaissent le même fléau depuis plusieurs années. (Illustration) LP/Alain Auboironx



Cette somme vise à dédommager Saint-Brieuc Armor Agglomération pour les opérations de ramassage, de transport et de traitement des algues vertes qui ont envahi les plages bretonnes ces dernières années.

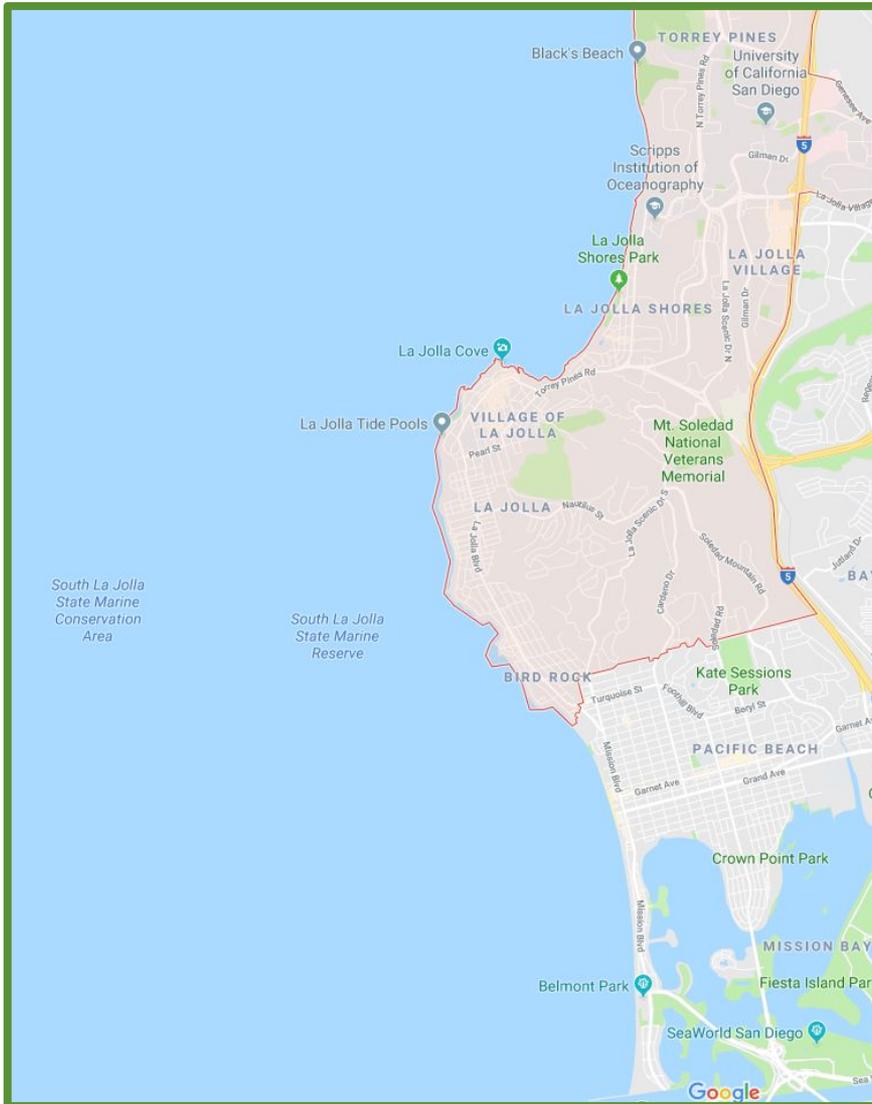
Elles sont le [cauchemar des saisonniers et des habitants du coin](#). Depuis plusieurs années, [ces algues vertes - toxiques lorsqu'elles se décomposent](#) - envahissent plusieurs plages de Bretagne [obligeant](#)

## *Example 3: La Jolla bay, San Diego, USA*



Public domain

# La Jolla Bay, San Diego, USA



# On the news...



## The Ocean Is Losing Its Breath

In broadest view yet of world's low oxygen, scientists reveal dangers and solutions

Jan 04, 2018

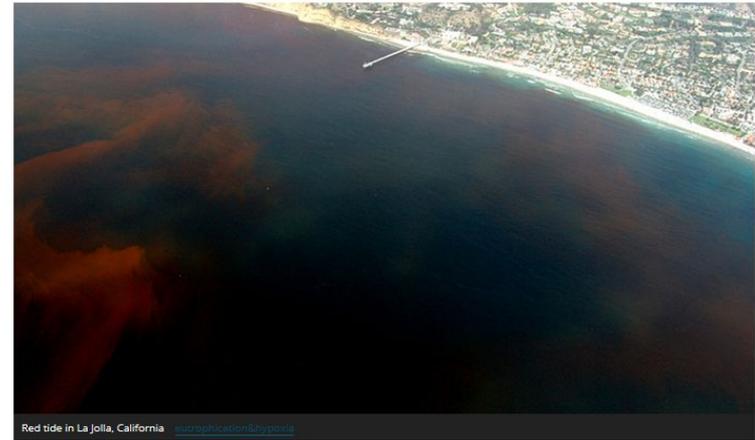
**Media Contact:** Robert Monroe | Phone: 858-534-3624 | Email: [scrippsnews@ucsd.edu](mailto:scrippsnews@ucsd.edu)



Low oxygen caused the death of corals and crabs in Bocas del Toro, Panama. Photo: Arcadio Castillo/Smithsonian



GRIST 50 VIDEO SECTIONS NEWSLETTERS DONATE MORE Q



Red tide in La Jolla, California [www.scripps.edu/oceanography](http://www.scripps.edu/oceanography)

SPOILER ALERT!

## A huge, toxic algae bloom is basically eating the West Coast alive

By [Amelia Urry](#) on Aug 7, 2015

[Tweet](#)

[Share](#)

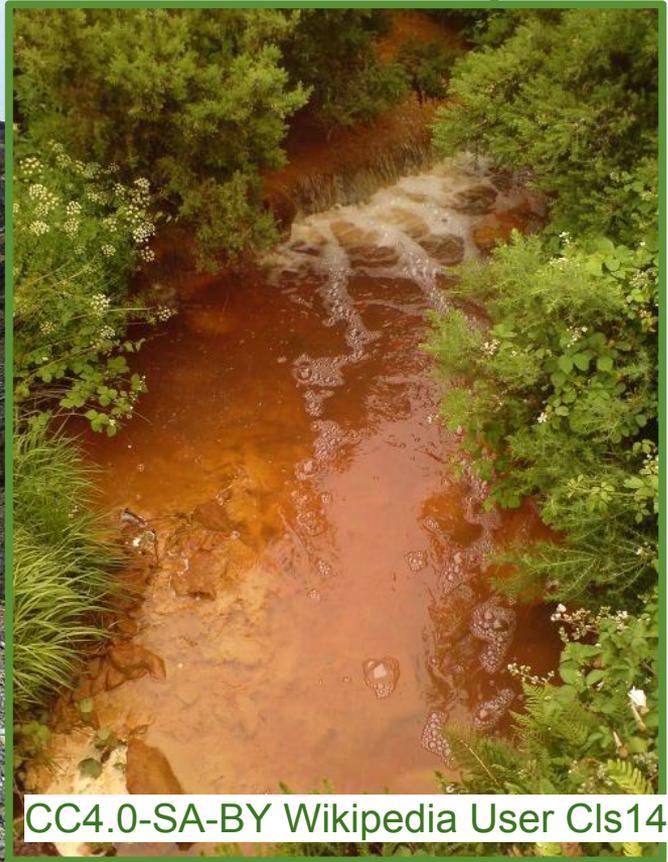
Remember that [big algae bloom](#) that was sweeping the West Coast a few weeks ago? Here's an update: It's still there, and it's bigger, denser, and more toxic than anyone suspected. You know what this means, don't you? [Welcome back to Spoiler Alerts](#), where we bring the worst news from our changing climate, straight to you.

This kind of toxic algae bloom — sometimes called a “red tide” — is not uncommon. But scientists have never known one to be this bad before, [according to Reuters](#):



## Example 4: Parys Mountain, Wales, UK

**COPPER and ARSENIC!**



CC4.0-SA-BY Wikipedia User Cls14

CC4.0-SA-BY Wikipedia User Marc.murphy

# Parys Mountain, Wales, UK



# On the news...

**BBC NEWS** [Watch](#) One-Minute World News

Last Updated: Monday, 11 October, 2004, 16:13 GMT 17:13 UK

[E-mail this to a friend](#) [Printable version](#)

## Fears over 'red river' pollution

Calls have been made for a river running through a play area on Anglesey to be fenced off over pollution fears.



Tests have been carried out on acid levels in the river, Afon Goch, or "red river".

Amlwch town councillor Robin James said there were worries about a risk to children's health.

The Environment Agency agreed the pollution level was not satisfactory and work could involve an application for European money.

The agency has already pumped away millions of gallons of acidic water from old copper mine workings on Parys Mountain.

The river was already polluted before the removal of an old crumbling dam, but is now more acidic and the agency has been working towards getting the discharges treated.

But work could depend on an application for money under the

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## Contaminated soil tests for 112 homes in Amlwch, Anglesey

14 October 2017

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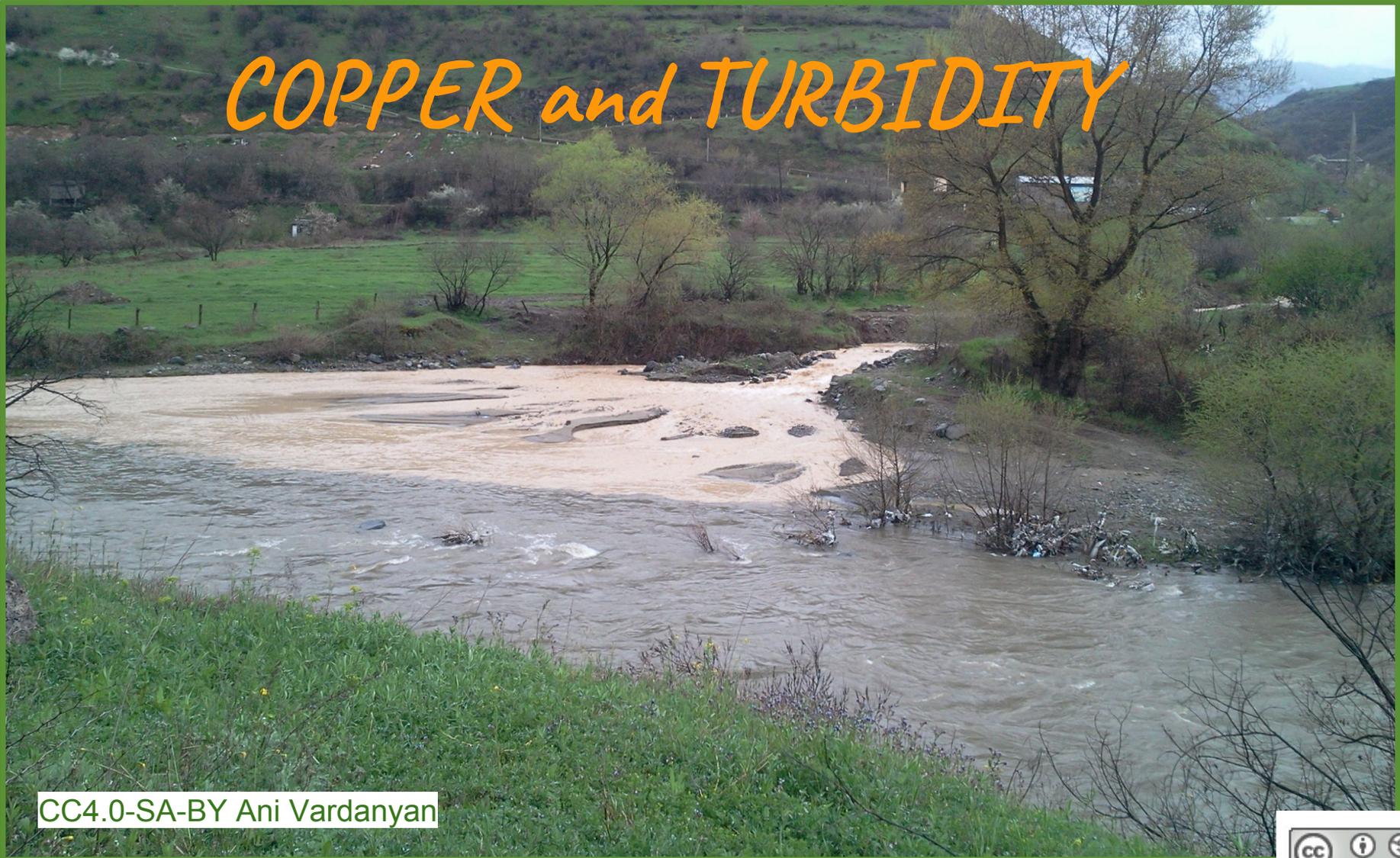


The gardens of 112 homes are to be tested to see if they have been contaminated by a smelting copper works in the area more than 200 years ago.

Soil samples will be taken from the Craig-y-Don estate in Amlwch on Anglesey.

# Example 5: Shnogh River, Armenia

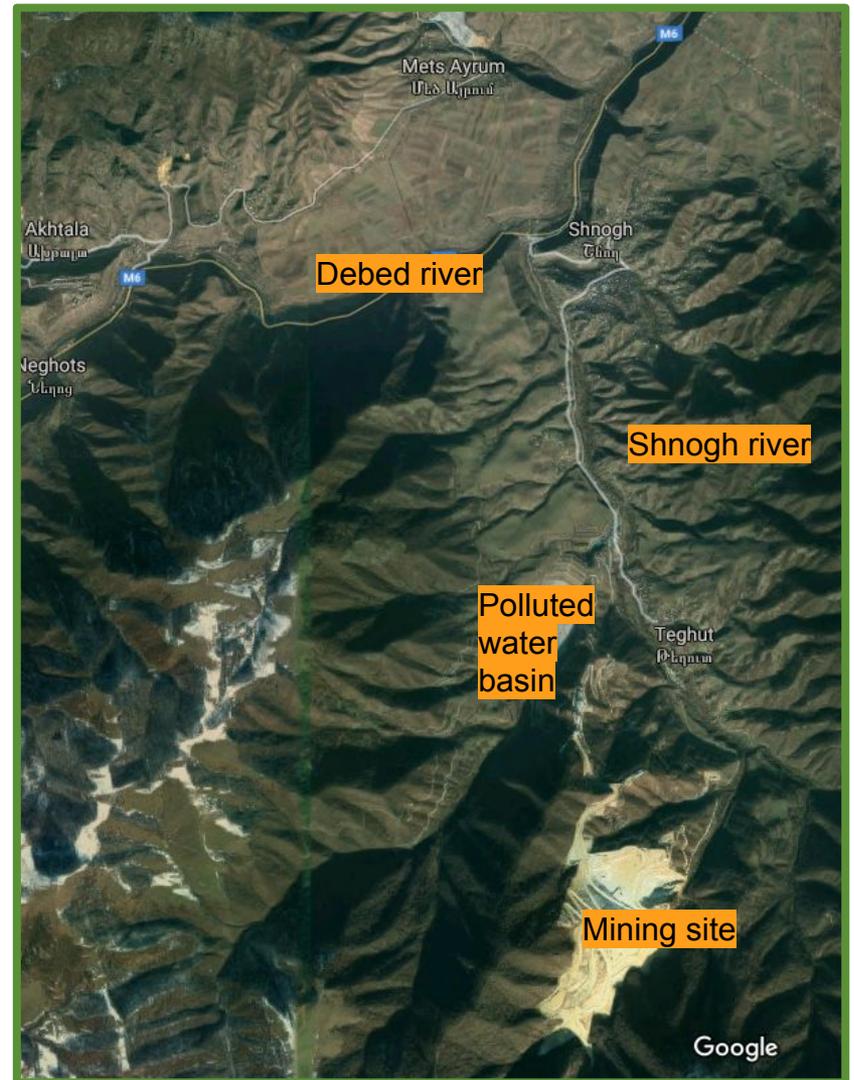
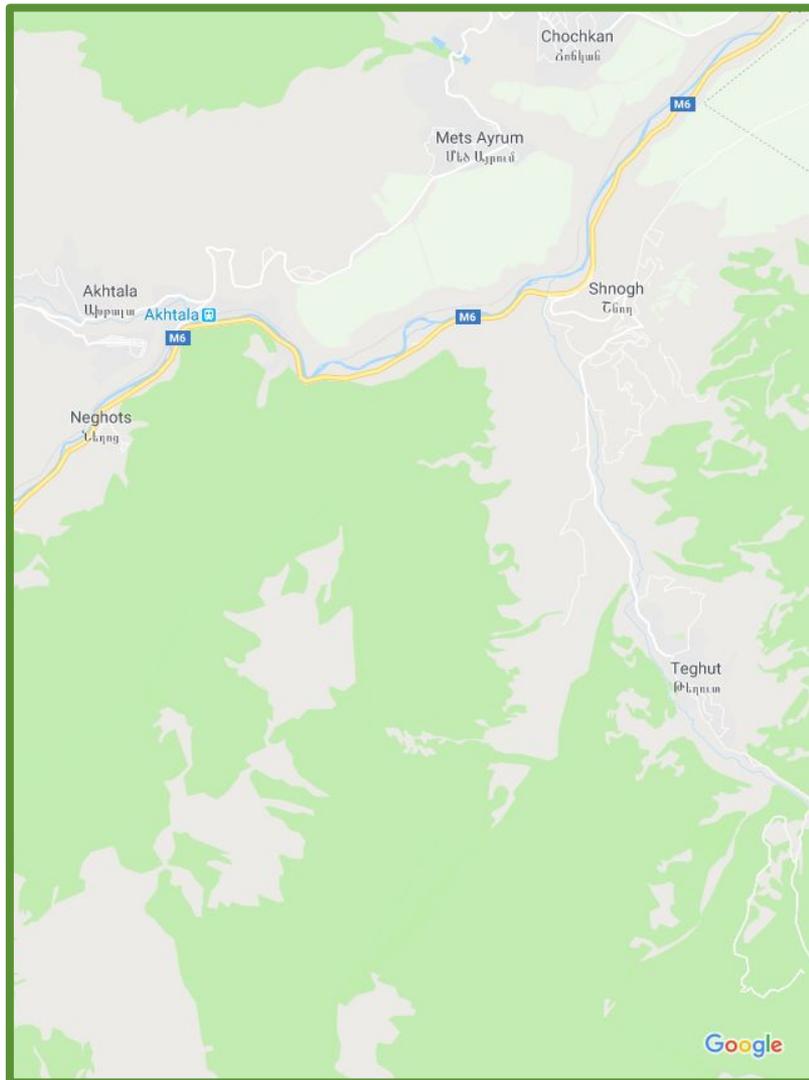
**COPPER and TURBIDITY**



CC4.0-SA-BY Ani Vardanyan



# Shnogh River, Armenia



# On the news...

monday, 11 june



Society Rights Economy Politics Culture Diaspora more

Ecology

## The Environmental Disaster in Teghut No Longer Possible to Cover Up: Denmark Pulls Out From the mine



16:57, October 18, 2017

***Yet one more positive outcome of the consistent efforts of active citizens and investigative journalists***

On October 16, 2017 Denmark's Export Credit (EKF) agency, a state body in charge of promoting Danish exports, published an [official statement](#) on their website stating that EKF, together with the private pension fund PensionDanmark, withdraws its 62 million USD worth

## Armenia: before the goldrush

PETER LIAKHOV [31 January 2017](#)

A British mining company has struck gold in southern Armenia. What's in it for the locals? *Updated 3 February with reply.* [Русский](#)



*The small village of Gndevaz in Armenia's Vayots Dzor province will soon be home to Lydian International's Amulsar gold mine. The reception is mixed. Photo by Peter Liakhov.*

Read Lydian International's response to this article [here](#).

"Is this what we fought a war for?" Victoria exclaims, exasperated, jabbing the table with her finger.

**PART TWO:  
WATCH YOUR WATER!**

Water  
Watchers



## First of all:

1. Make teams of 3-5 people
2. Find an interesting area for your water survey
3. Decide exactly the spot for your sampling

## Collect your water!

1. Take pictures, videos, of the site, maybe type of nature
2. Write down the day and sampling hour
3. Explore what is around the area, map the surroundings
4. Describe the type of waterbody and its main water source
5. Possibly interview people regarding problems

## Back to the lab:

1. Analyze the pollutants in the water (colorimetric tests and turbidity and pH)
2. Summarize and document your findings
3. Compare with other results

**Create your own subfolder here:**



<https://goo.gl/qaEJRt>

# Colorimetric tests

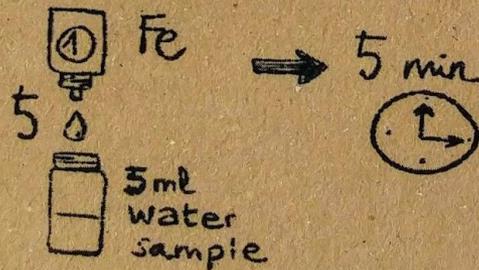
Define the concentration of a compound with the aid of a **COLOR**.

Most chemicals are invisible in water: we add something that makes the color **ONLY** when the chemical is present.



The more color we will see the **MORE** chemical will be

**Fe**  
iron



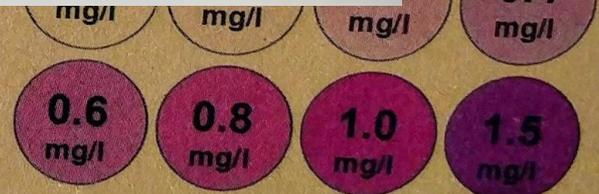
# Colorimetric tests

The concentration of the chemical is linearly **PROPORTIONAL** to the color **INTENSITY**



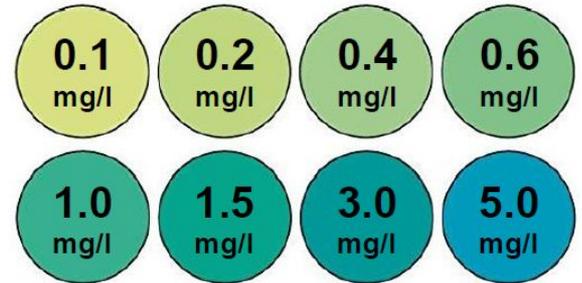
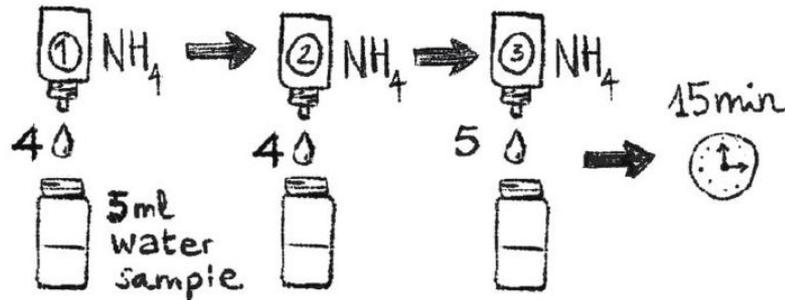
Fe  
iron

5  
5ml  
water  
sample

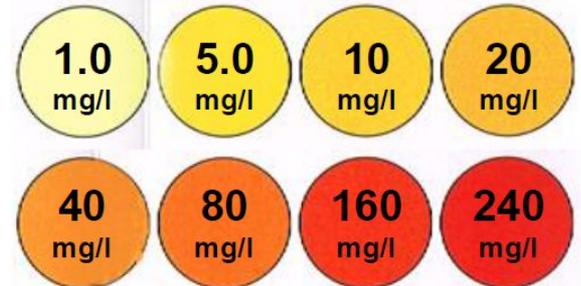
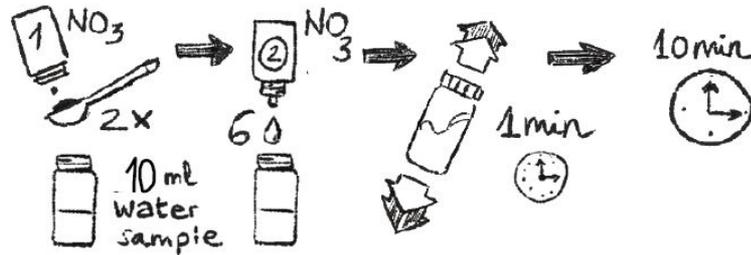


# Colorimetric tests

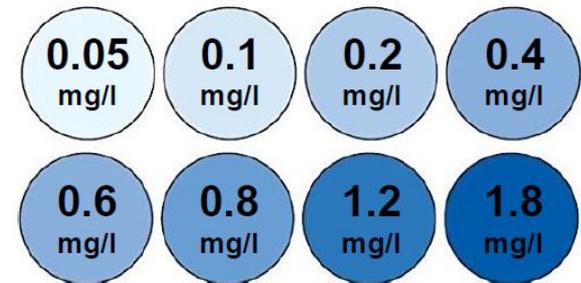
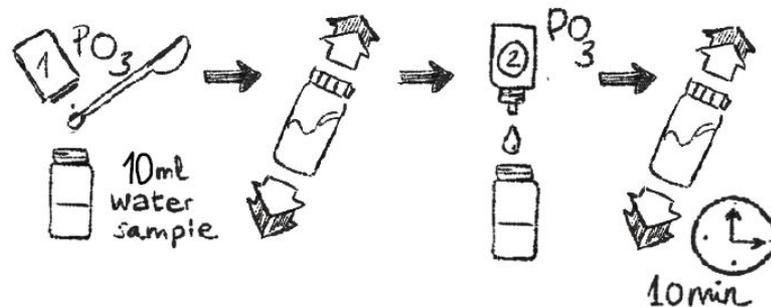
## NH<sub>4</sub> ammonia



## NO<sub>3</sub> nitrates

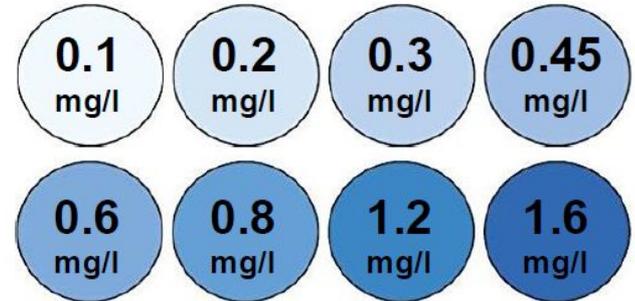
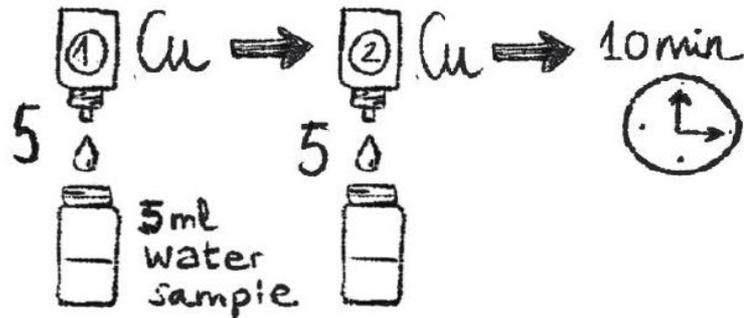


## PO<sub>4</sub> phosphates

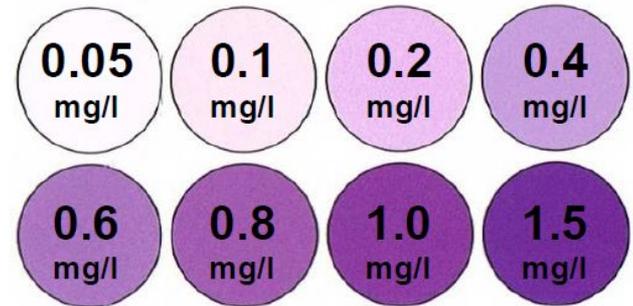
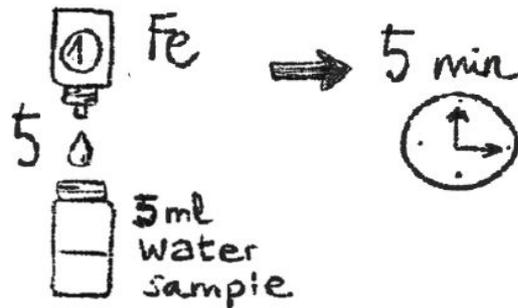


# Colorimetric tests

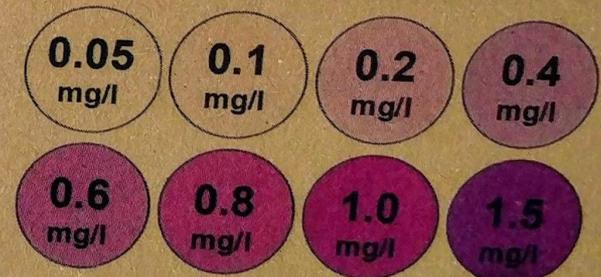
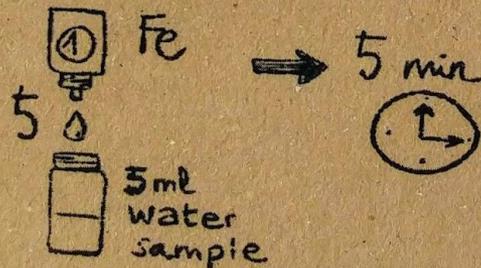
**Cu**  
copper



**Fe**  
iron



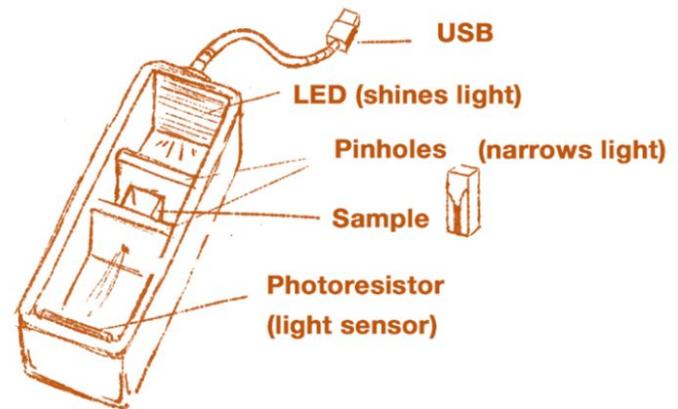
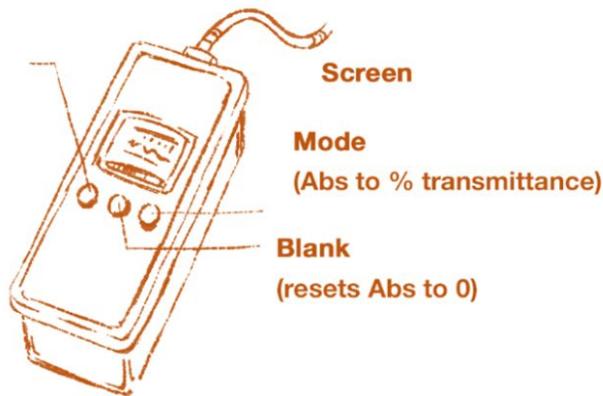
**Fe**  
iron



# 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

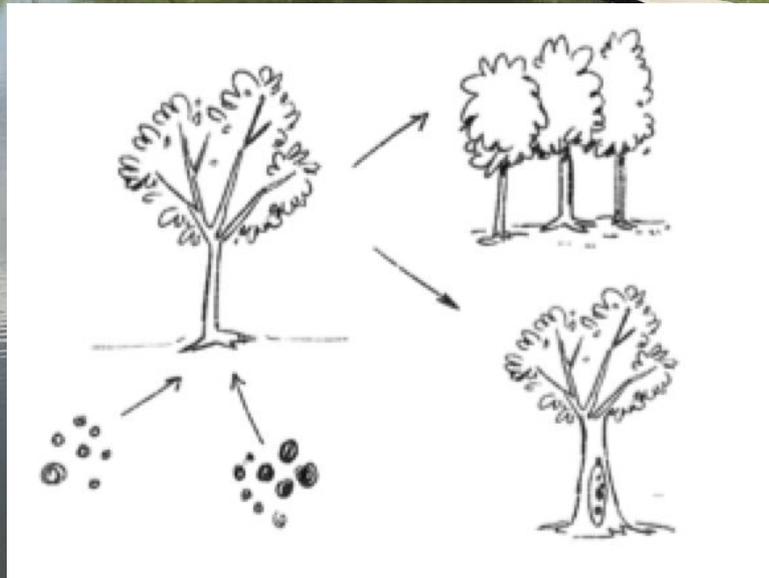


*PART THREE:  
TREATMENT OF WATER*



# Treatment of WATER

**BIOREMEDIATION:** using life to treat water.  
Fertilizers can be used by plants and other organisms.  
Other plants can absorb heavy metals: accumulate them or use them to grow.



# Treatment of WATER

**ACTIVATED CHARCOAL:** a SUPERFILTER: due to its tiny holes inside. This surface is “sticky” to pollutants.



# Treatment of WATER



# 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?**

## Before

1. Summarize your results of colorimetric tests.
2. Decide what materials to use for your specific problem.
3. Wash the materials with clean water first.

## Filtering the water

1. Add filter paper at the bottom of a cut bottle.
2. Make sure you pack well the components and that you have no leaks.
3. Equilibrate your filter before testing the water
4. Take water samples before and after

## After filtering

1. Perform colorimetric tests in filtered water.
2. Compare with initial results. Did it clean the water?



# PART FOUR: DISCUSSION



# 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 water bodies 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.

Open discussion points:

**1/ What was the problem in your water sample?**

**2/ How to treat the water?**

# Environmental Intervention

3/ Where your water was taken..How his water could be polluted?

© From EHGO.FR



# Environmental Intervention

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

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