

## Teaching and learning materials on Clean water and sanitation (IREN)

### SUMMARY

The document includes a description of the activities and the related teaching and learning materials on Clean Water and Sanitation. These were designed by the Italian multiutility company Iren, through its educational division Eduiren, in cooperation with the Applied Sciences upper secondary school Blaise Pascal in Reggio Emilia.

### INTRODUCTION TO THE TOPIC

Water management is crucial to sustainable development, because clean freshwater and sanitation services are essential to human health and well-being. (UN, 2015; UN, 2023; WHO, 2022). While substantial progress has been made to achieve the integrated management of water resources, billions of people still lack access to safe drinking water and sanitation. Furthermore, water scarcity is one of the major challenges of our times and threatens to get worse in the next few years due to climate change and population growth.

Considering water drinking habits, Italians consume the most bottled water per person in Europe. There are over 600 domestic Italian bottled water brands, which means that about 600 different bottled water brands are sourced in Italy. An Italian's average amount of water is nearly half a liter, and over half of the population prefers bottled water to tap water. This implies a high environmental impact in terms of production of waste and pollutants. Many beliefs are related to preconceived ideas rather than to actual experiences or product characteristics: tap water is controlled every day, is safe to drink and has usually a good taste.

Regarding sewage management, "Not In My Back Yard" is an usual battle cry of residents from areas that are being considered for a new sewage treatment plant. Securing social acceptance is important, as wastewater treatment plant play a significant role in reducing environmental pollution caused by direct discharge of sewage in water bodies. Furthermore, inaction in meeting wastewater targets and complying with the legal requirements set by the European directives is coming at a high price and implies court action and/or fines for administrations.

### PRESENTATION OF THE MATERIALS

#### Overview

The present materials, addressed to upper secondary school students (17-18 years old) were co-designed in collaboration with teachers from different disciplines (chemistry and science lab, biology, Italian, history, art history) and with the utility company experts (e.g.: technicians at the water analytical laboratory, managers of drinking and waste water treatment plants). A modular approach was followed, so that the Teaching and Learning Sequence (TLS) about clean water and sanitation consists of 5 sets of activities. Teachers can choose the ones to implement. However, some of them are highly recommended to allow students to acquire knowledge on water management and consumption and to develop critical thinking and inquiry skills. As part of the TLS, students are involved in the process of expressing, evaluating and revising their own ideas about this topic and to learn how drinking water and wastewater are managed in their area and appreciate how technological developments changed lifestyles and improved sanitary and health conditions. They are actively encouraged in proposing solutions and organizing initiatives to inform and raise awareness addressed to the community.

Information

Age	17-18 year old
Topic	Clean Water & Sanitation
Country	Italy
Duration (select those which apply):	<input type="checkbox"/> Less than 1 hour
	<input type="checkbox"/> Between 1-2 hours
	<input type="checkbox"/> Between 2-5 hours
	<input type="checkbox"/> Between 5-10 hours
	<input checked="" type="checkbox"/> More than 10 hours
Stakeholders involved in the implementation (select those which apply)	<input checked="" type="checkbox"/> Teachers
	<input checked="" type="checkbox"/> Families
	<input type="checkbox"/> Researchers
	<input checked="" type="checkbox"/> Experts form industry
	<input checked="" type="checkbox"/> Informal and non-formal education professionals
	<input type="checkbox"/> Professionals from the Media
	<input type="checkbox"/> Policy Makers
<input type="checkbox"/> Other (civil society)	
Open Schooling Scaffolings (select those which apply):	<input checked="" type="checkbox"/> Reflection activities
	<input checked="" type="checkbox"/> Jigsaw groups / debates
	<input checked="" type="checkbox"/> Meet with the experts
	<input checked="" type="checkbox"/> Learn in the lab
	<input checked="" type="checkbox"/> Going outside
	<input type="checkbox"/> Other (add all Open Schooling Keywords you consider relevant for your activity/TLS): ___ Historical research_____
Other Tags	<input checked="" type="checkbox"/> Modelling
	<input checked="" type="checkbox"/> Inquiry
	<input checked="" type="checkbox"/> Argumentation
	<input type="checkbox"/> Social Justice
	<input type="checkbox"/> Gender
	<input type="checkbox"/> CLIL (Content and Language Integrated Learning)
	<input checked="" type="checkbox"/> Problem-based learning
	<input checked="" type="checkbox"/> Project-based learning
	<input type="checkbox"/> Formative Evaluation
	<input checked="" type="checkbox"/> Flipped Classroom
	<input checked="" type="checkbox"/> Contextualization
	<input checked="" type="checkbox"/> Design Thinking
	<input checked="" type="checkbox"/> Case study
	<input type="checkbox"/> Gamification
	<input type="checkbox"/> Making
	<input checked="" type="checkbox"/> STEAM perspective
	<input checked="" type="checkbox"/> Technological process
	<input type="checkbox"/> ICT
	<input type="checkbox"/> Tinkering
	<input checked="" type="checkbox"/> Evaluation Rubric
<input checked="" type="checkbox"/> Cooperative work	
<input type="checkbox"/> Add all keywords that you consider relevant to describe your activity/TLS	
Technical Resources	Laboratory glassware, chemical reactants, Titration equipment, Spectrophotometer, Indicators, pHmeter

<p>Webpage materials</p>	<p>- English version: <a href="#">English version - OneDrive (sharepoint.com)</a>          - Italian version (original): <a href="#">Italian version - OneDrive (sharepoint.com)</a></p>
--------------------------	--

**TEACHING AND LEARNING MATERIALS**

**VISUAL ABSTRACT**



Figure 1. On-site visit of the Mancasale WWTP



Figure 2. Water blind tasting and polls



Figure 3. Debate "Bottled Water vs Tap Water"



Figure 4. Group activity "Your home water"



Figure 5. History research: discovering the old water system

**ACTIVITIES**

With MULTIPLIERS, schools and communities are engaged to increase their scientific understanding of water management and sustainable use and to debunk common myths and fake news, encouraging good habits to protect water resources and safeguard the environment.

To appreciate water value, it is vital to make clear that water doesn't flow out of the tap by magic and sewage must be collected and treated: this implies long and complex processes, involving pipes and plants, state-of-the-art technologies, continuous quality control, machines, materials and energy. There is a common lack of awareness on the link between technological advancement applied to management of water resources and health and hygiene conditions in our countries.

It is also important to increase knowledge and trust on distributed drinking water, submitted to continuous quality controls, to contrast overconsumption of plastic bottled water.

The Italian experience aimed at working out students' views around the topic and influence changes in water consumption and perception.

The TLS included the following set of activities:

- **A1** Presentation of local water management: quality, processes and facilities
- **A2** Debate “Tap Water vs Bottled Water”
- **A3** Authentic learning task “Your home/school water”
- **A4** Water Blind Tasting
- **A5** History research on local water systems and uses

It is recommended to perform the activities A1, A2, A3 and A4 in the presented order. A5 may be organized as an independent activity.

### **Activity 1. Presentation of integrated water management: quality, processes, and facilities**

The aim of this activity is to provide an introduction to integrated water management and water quality, with a particular focus on the situation in the Reggio Emilia area. This included:

- an Introduction to the topic of water quality, with an analysis of hardness in samples of water distributed in the Reggio Emilia province, to make students aware of the characteristics of local drinking water supply.
- an introduction to the topic of water management, in cooperation with the utility company experts, with particular focus on technologies and issues to face with, such as prevention of water losses, water scarcity, climate change, drought and desertification, regulations and best practices.
- a visit of the water supply system reservoir.
- a presentation on sewage networks and treatment systems, with focus on recovery and reuse of discharge water and sludge and a technical visit of the local sewage treatment plant. This was followed by a visit of the water and wastewater lab, where technicians assisted the students in analysing nitrogenous compounds in wastewater samples, using spectrophotometric methods.

**Key concepts of the activity:** *Contextualisation, Meet with the experts, case study, technological process*

#### Students' resources

Smartphones or cameras to take pictures of the facilities.

#### Teachers' resources

Ppt presentation on integrated management of water and wastewater systems; evaluation test:

- English version: [A1 eng - OneDrive \(sharepoint.com\)](#)
- Italian version (original): [A1 - OneDrive \(sharepoint.com\)](#)

#### Additional resources

- Text book: “Chimica Più” T: Fiorani, V. Posca, Zanichelli editore
- Analytical methods for measurement of hardness, nitrites and nitrates in water
- Lab equipment: Laboratory glassware, chemical reactants, Titration equipment, Spectrophotometer, Indicators, pHmeter

### **Activity 2. Debate “Tap Water vs Bottled Water”**

The aim of this activity is to make students aware on the environmental impact of their water consumption habits and to contrast preconceived ideas and distrust on tap water, evaluating evidence and supporting claims, developing argumentative skills and formulating creative solutions to the SSI. Two debates (between two groups of about ten students for each group) took place in the classroom

## MUL+IPLIERS

and was coordinated by the teachers in cooperation with Eduiren experts, including discussion and brainstorming on the quality aspects of different types of water and on the environmental impact of our consumption habits. The students' argumentative skills were evaluated using a specific rubric.

**Key concepts of the activity:** *debates, argumentation, evaluation rubric*

### Students' resources

Set of arguments and counter-arguments:

- Italian version (original): [A2 - OneDrive \(sharepoint.com\)](#)

### Teachers' resources

Evaluation rubric and debate rules:

- English version: [A2 eng - OneDrive \(sharepoint.com\)](#)
- Italian version (original): [A2 - OneDrive \(sharepoint.com\)](#)

### Additional resources

A set of articles on: water prices, safety of bottled water, water consumption habits, health aspects, environmental impact of bottled water

## Activity 3. Authentic learning task "Your home water"

The aim of this activity was to engage students in an analysis of distributed water, encouraging collaboration to build and evaluate knowledge. The group authentic learning task "Your home/school water", involved them in the the definition of analytical certificates, with assessment and critical considerations on the characteristics of specific tap waters. An online presentation was held on the task results, with the assistance of experts from the Iren analytical laboratory.

**Key concepts of the activity:** *Case study, evaluation rubric, cooperative work*

### Students' resources

Ppt presentations on the origin and properties of the water distributed in their respective area:

- Italian version (original): [A3 - OneDrive \(sharepoint.com\)](#)

### Teachers' resources

To-do list: including a checklist of assignments, an example of certificate of analysis, a list of some analytical parameters to be evaluated from a sanitary point of view; evaluation rubric:

- English version: [A3 eng - OneDrive \(sharepoint.com\)](#)
- Italian version (original): [A3 - OneDrive \(sharepoint.com\)](#)

### Additional resources

Utility company lab certificate of analysis, maps of raw water sources and drinking water networks.

## Activity 4. Water Blind Tasting

The aim of the activity was to work out students' views on water quality and discuss drinking habits: The water blind tasting session included data collection and evaluation and addressed to students and families. Perceptions at the tasting experience were compared to the results of analytical tests on several types of drinking water, allowing participants to debunk myths and fake news regarding water quality and taste

**Key concepts of the activity:** *inquiry, case study, statistical survey*

### Students' resources

Pie charts showing the tasting preferences and questionnaire result:

- Italian version (original): [A4 - OneDrive \(sharepoint.com\)](#)

### Teachers' resources

Google module, questionnaire on water taste:

- English version: [A4 eng - OneDrive \(sharepoint.com\)](#)
- Italian version (original): [A4 - OneDrive \(sharepoint.com\)](#)

### Additional resources

3 glass bottles filled with three different types of water: tap water and two types of low residue bottled water available on the market at different prices (one of them heavily advertised)

## Activity 5. History research on local water systems and uses

The aim of this activity is to raise awareness on the impact of technological progress on everyday life and on health and hygiene improvements brought by the advent of drinking and wastewater treatment processes. This included:

- a presentation by Italian and art history teachers on the history of water management
- the following assignment performed by different groups of students:
  - analysis of ancient maps of the old water system and collection of information on the channels path, on the water uses and on the place names
  - exploration of the local area, taking pictures of statues, historical artifacts and sections of the channel
  - comparison of ancient charts with maps of the modern distribution and sewage networks.
  - visit of the State Archives to complete the study and collect documentation on the "Botte Meravigliosa", a barrel-vault section of the Secchia Channel.
  - On-site visit of the "Botte Meravigliosa"

The project results are shown in panels, designed by the different groups of students in cooperation with the art history and history and Eduiren and are the object of an exhibition open to the general community.

**Key concepts of the activity:** *going outside, inquiry, historical research*

### Students' resources

Presentations and panels on the history of the Reggio Emilia water system and uses:

- Italian version (original): [A5 - OneDrive \(sharepoint.com\)](#)

**Teachers' resources**

Presentation on water and sanitation history – Presentation of local water history:

- Italian version (original): [A5 - OneDrive \(sharepoint.com\)](#)

**Additional resources**

- History books – Previous studies on this topic

**REFERENCES**

- UN (2015) UN Sustainable Development Goals – Goal 6: Clean Water & Sanitation. <https://www.un.org/sustainabledevelopment/water-and-sanitation/>
- UN (2023) UN Water Conference 2023.
- <https://www.un.org/sustainabledevelopment/blog/2023/02/2023-un-water-conference/>
- WHO (2022) Water Sanitation and Hygiene. [https://www.who.int/health-topics/water-sanitation-and-hygiene-wash#tab=tab\\_1](https://www.who.int/health-topics/water-sanitation-and-hygiene-wash#tab=tab_1)