

SWIM and Horizon 2020 Support Mechanism

Working for a Sustainable Mediterranean, Caring for our Future

SWIM-H2020 SM EFH-JO-2

Using NCWRs as a vehicle for applying ESD

Vicky Malotidi ESD Expert

MEdIES/MIO-ECSDE

SWIM and Horizon 2020 SM EFH-JO-2

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ESD

SESSION 4

NCWR

SUSTAINABLE DEVELOPMENT GOAL 6

Ensure availability and sustainable
management of water and sanitation for all



6A. By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies

Suggested topics for SDG6 (UNESCO 2017)

Box 1.2.6a. Suggested topics for SDG 6 “Clean Water and Sanitation”

The global water cycle and water distribution

The importance of equitable access to safe and affordable drinking water (achieving water security under climate change: e.g. coping with social and economic pressure caused by frequent waves of droughts and hence water shortages, and by floods and hence too much water)

The importance of adequate and equitable sanitation and hygiene, water quality and quantity parameters for health

The human right to water and water as a global common good

Impacts of pollution, dumping and release of hazardous chemicals and materials on water quality

Water scarcity and water use efficiency

Importance of water-related ecosystems

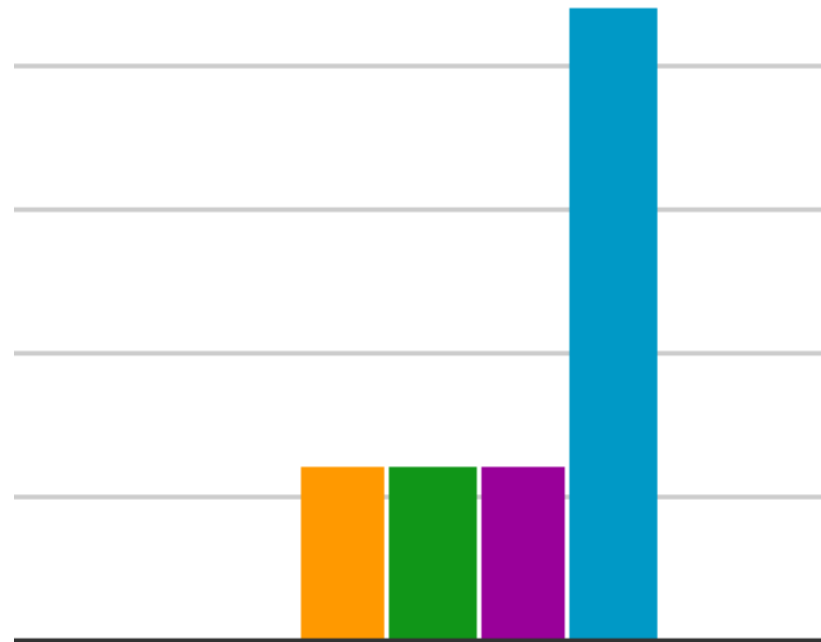
Water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies, water patents, landscaping for groundwater recharge as well as integrated water resources management

Water exports (virtual water)

Water and sustainable development (e.g. water and gender, water and inequality, water and health, water and cities, water and energy, water and food security, water and disaster risk reduction, water and climate change, water and the green economy, water and jobs)

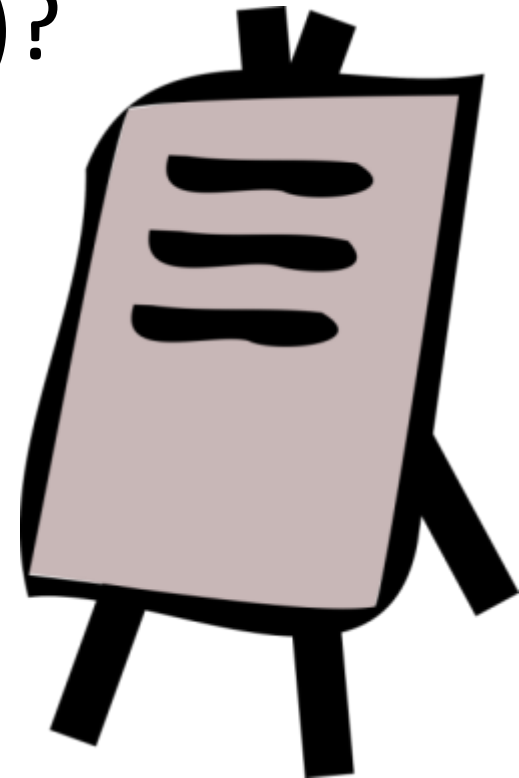
In our small survey....

Water & Non Conventional Water Resources =
Among your top-concerns as an issue for your country
& as a topic within Education for Sustainable Development



Non Conventional Water

Plenary Q1:
What is “non conventional
water resources (NCWRs)?



NCWRs: sources of water not originating from natural fresh surface water or groundwater

- **Rainwater harvesting / Storm water management**
- **Greywater recycling** water resulting from showers, baths, washing basins and laundry once properly treated can be used for flushing toilets and to irrigate the garden.
- **Wastewater recycling** , once properly treated can be used mainly for irrigation in agriculture.
- **Desalination** through the use of reverse osmosis plants, salts from saline or brackish water are removed

Other aquifer recharge, exploitation of undersea freshwater springs, cloud seeding



Rainwater
harvesting

Stormwater management





Reuse of
treated
greywater



Reuse of
treated
wastewater



Desalination
plant
(reverse
osmosis)

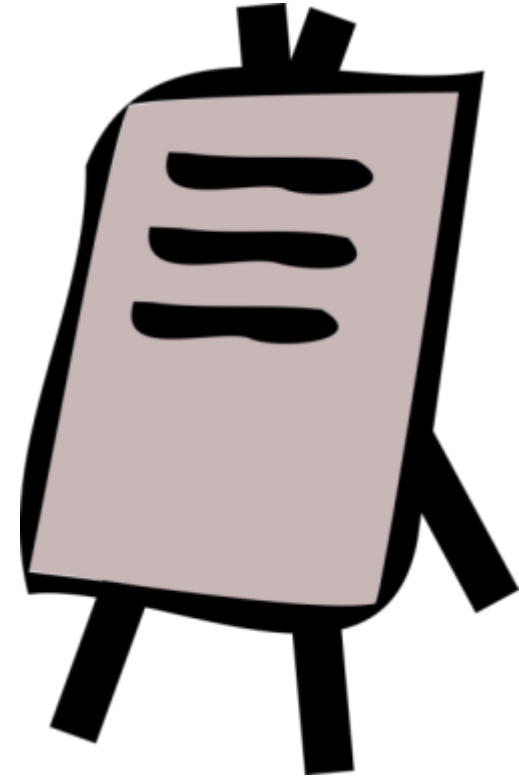


Plenary Q2.

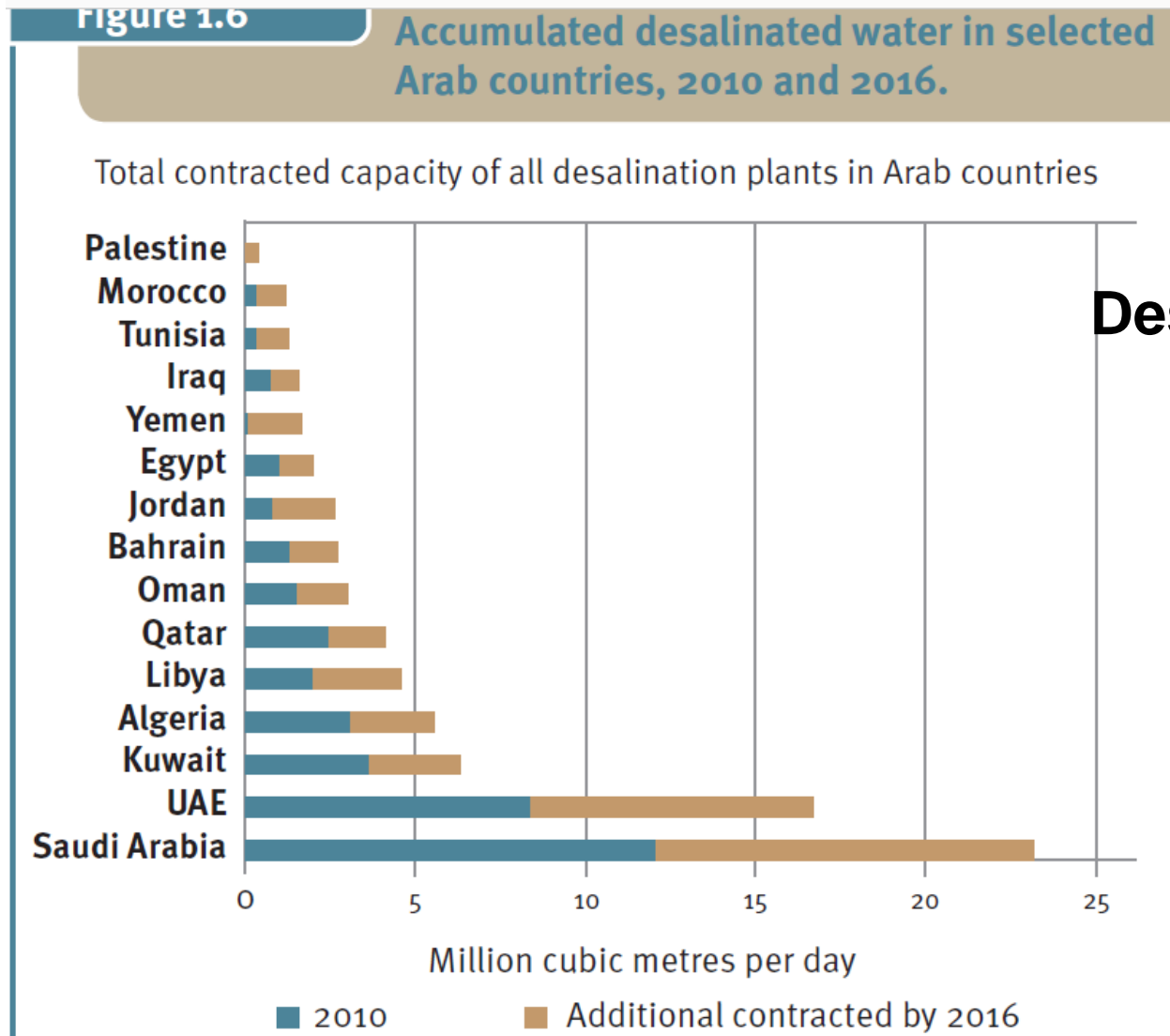
Which one do you think is:

- a. The most **known**
- b. The most **applied**

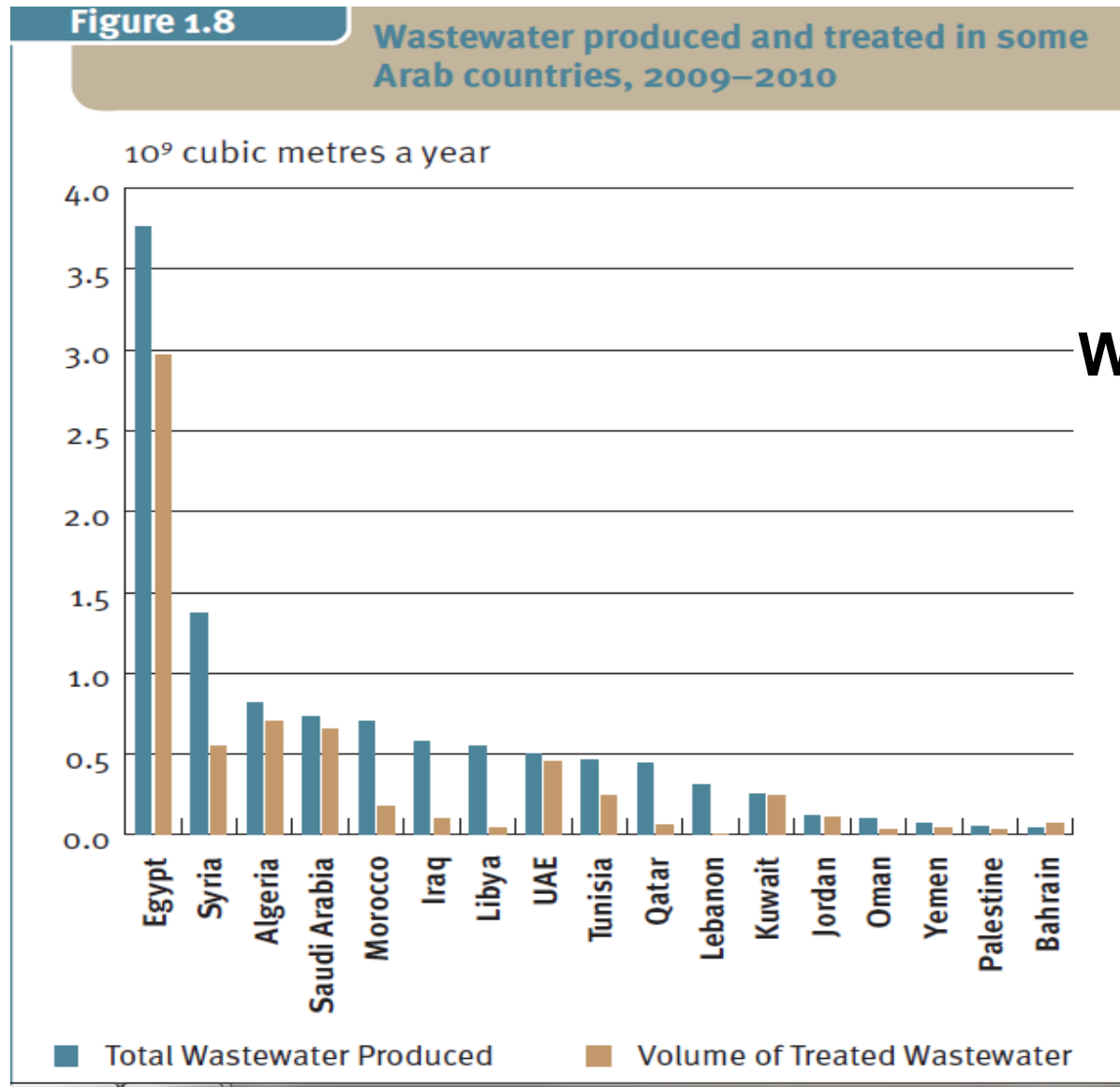
in your country?



Q2. NCWRs: an outline in the Arab countries (UNDP Report, 2014)



Q2. NCWRs: an outline in the Arab countries (UNDP Report, 2014)



Wastewater

Q2. NCWRs: an outline in the Arab countries (UNDP Report, 2014)

- *To explore **grey water** potential in the region, the Canadian International Development Research Centre has supported grey water treatment in **Jordan**, Lebanon, **State of Palestine** and Yemen, equipping more than 2,000 houses with grey water treatment systems over 1998–2008. These projects revealed not only the high regional potential for using such forms of treated wastewater but also the absence of any health risks. Annual economic saving was estimated at more than \$300 per family, but successful implementation will require government incentives, continuous quality monitoring and enforcement of local standards and regulations.*

Group question Q3 (5')

In your group, discuss & decide on **which NCWR** would you choose as a **topic** for an ESD project ?

Why? Give 2 reasons.



Group question Q4 (10')

In your group, think, discuss & decide:

- a. What would be your **Target Group**?
- b. What **type** of activity/ies would you run?
- c. Write it on a piece of paper.



NCWRM in the Mediterranean Programme

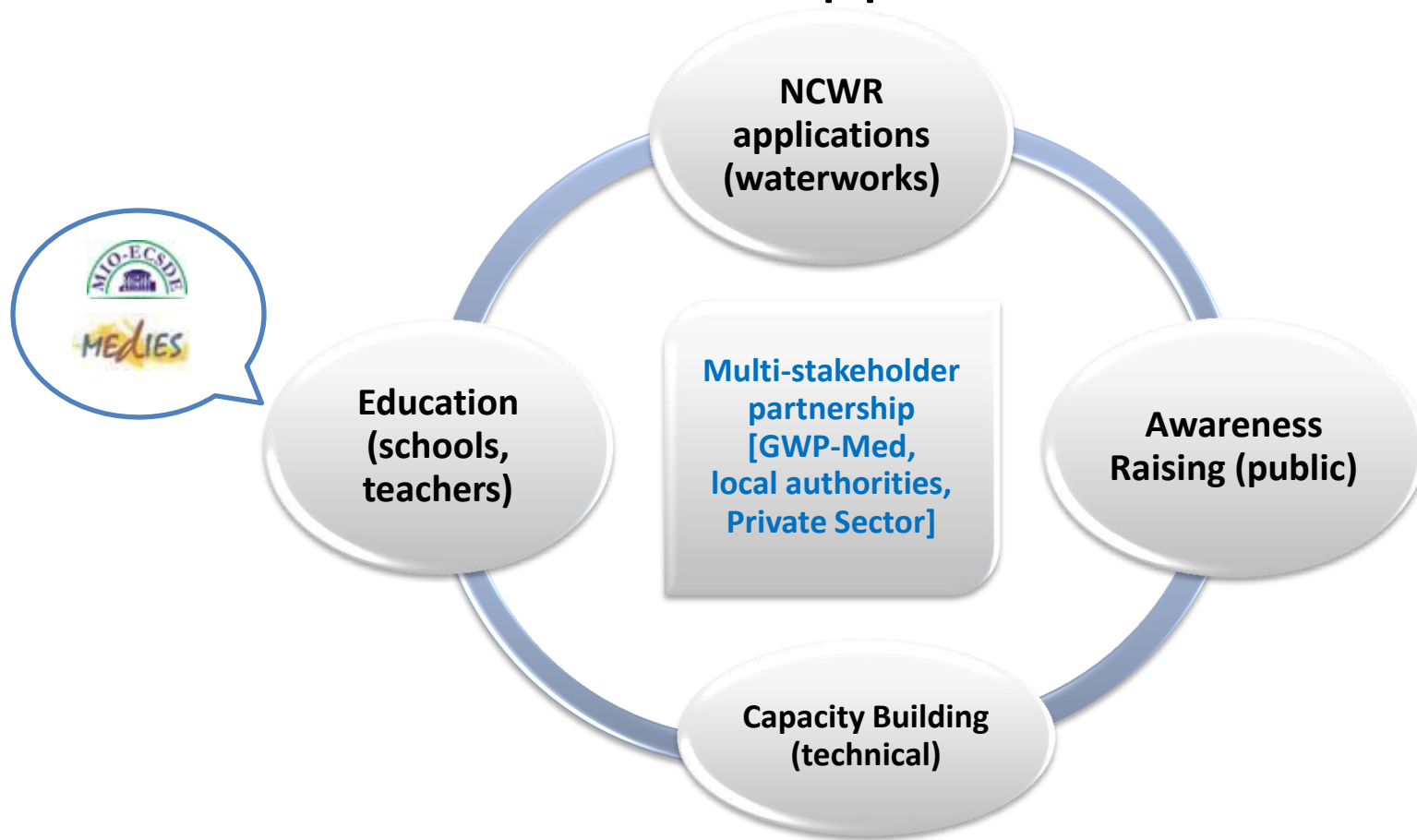
Greece , Malta , Cyprus , Italy

- **Aims** at advancing the use of NCWR, mainly **rainwater harvesting** and **greywater reuse** in water scarce communities in the Mediterranean islands, as a cost-effective method to locally increase water availability and to adapt to climate change.
- The Program's **objectives** are:
 - To **demonstrate** smart, innovative & cost-effective NCWR solutions
 - To **educate** students, teachers and the public on NCWRs.
 - To enhance local **technical expertise** on modern NCWR systems.

While

- Promoting **multi-stakeholder** partnerships
- Providing a best practice for further **replication**

NCWRM in the Mediterranean Programme - The approach



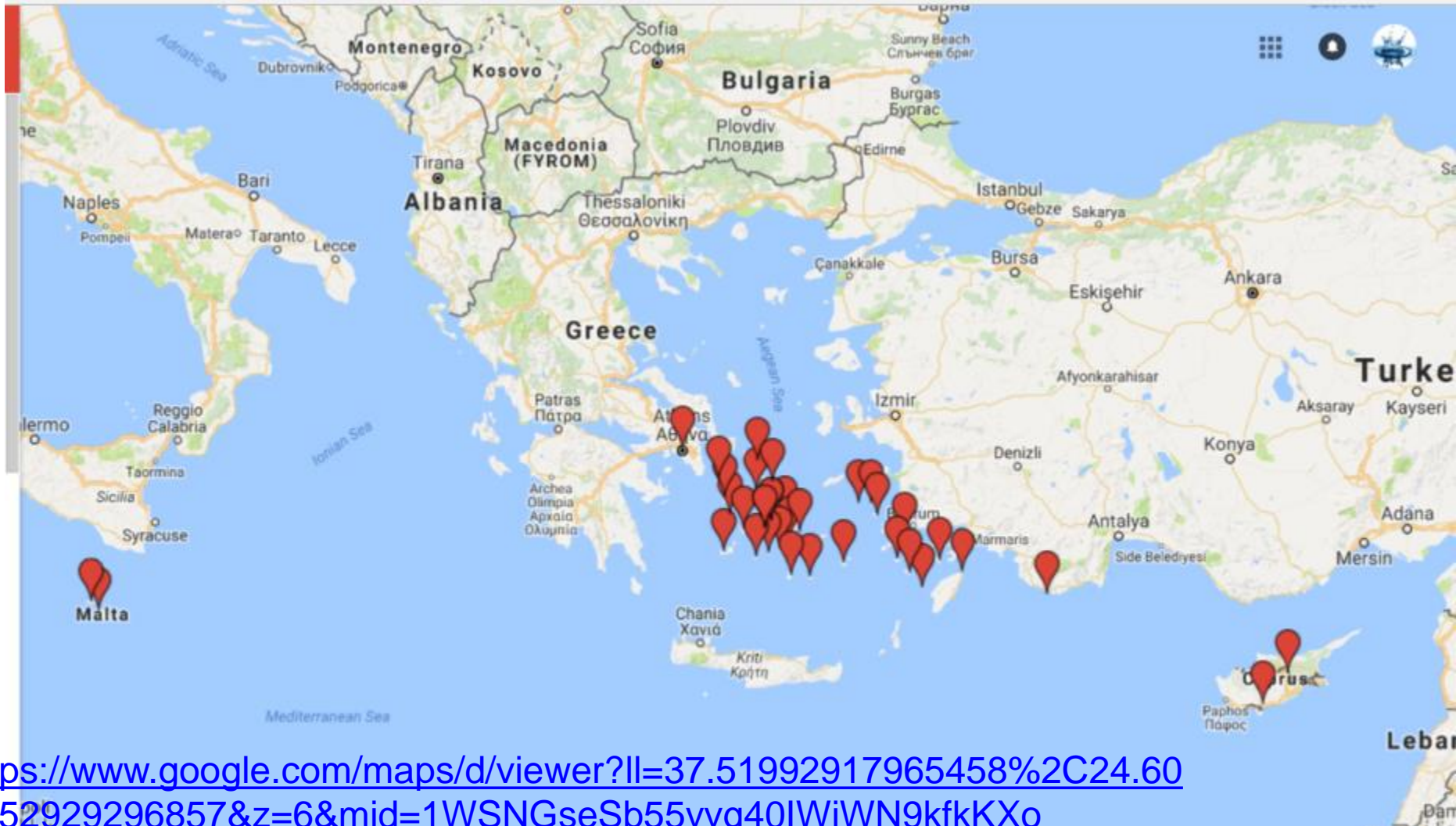
GWP-Mediterranean is the Coordinator
Duration: 2008 - 2018
primarily Coca-Cola Foundation Grants

Overall NCWR Outcomes & Results in the Mediterranean, 2008-2016

- **33 islands** (29 Greek Islands, 2 Maltese islands, Cyprus, Sardinia)
- More than **95 NCWR systems** have been installed or reinstated
- **Annual water yield ~ 280 million L /yr**
- More than **22,000 students**, and **3,500 teachers**
- More than **110,000 beneficiaries**

What students know about the NCWRs?

ESD Programme: Hands-on activities in schools, Teachers' trainings, a School contest (Greece)



<https://www.google.com/maps/d/viewer?ll=37.51992917965458%2C24.600252929296857&z=6&mid=1WSNGseSb55vvg40lWiWN9kfkKXo>

Students & the NCWRs

The application of the project with school students so far outlines the following:

- ✓ Students show great **interest** in the topic and enjoy very much the activities;
- ✓ They declare that they gained **knowledge** on water cycle, rainwater harvesting, runoff, cisterns, greywater, etc.
- ✓ **Younger pupils** show preference on the general topic of the «water cycle»
- ✓ **Older students** seem to be more interested in and “impressed” by technologies of rainwater harvesting and greywater systems
- ✓ Some of them are aware of the rainwater harvesting; however very few one knows about “grey water” and “black water” & how they can be recycled.
- ✓ The majority **commits** that will be in favor of the NCWRs and water saving; they propose practical ideas of reusing the water in everyday life (after washing the vegetables or dishes, or after washing their bicycles,
- ✓ **General comment**: Students in urban areas are not familiarized with the older systems (cisterns) for harvesting rainwater in contrast with the pupils in rural areas, coastal/islands.

Students & the NCWRs: some quotes

Ερ. 1: Μπορώ να «προστατεύσω» το νερό με το να ...

βα το να το βάζω σε δεξαμενή
όταν βρέχει

κάναμε σήμερα, το πιο ενδιαφέρον για εμένα ήταν

ο τρόπος με τον οποίο λειτουργεί το
νερό χρήσιμο

Ερ. 1: Μπορώ να «προστατεύσω» το νερό με το να ...

αποθηκεύω
βρόχνο νερό με το βρόχιμα ή
να χρησιμοποιώ το βρόχιμα του
Μαυρού και του Γκρι νερό

Ερ. 2: Από όσα κάναμε σήμερα, το πιο ενδιαφέρον για εμένα ήταν

με το σύστημα αερίων
νερού

Ερ. 2: Από όσα κάναμε σήμερα, το πιο ενδιαφέρον για εμένα ήταν

αι δεξαμενές που 500 χρόνια
πες οποιες είχαν στα καστρά

MEdIES approach on learning about the NCWRS

- Grab attention ...
- Raise ideas and initial knowledge
- Connect with everyday life, experiences, choices, hobbies/activities, ...
- Hands-on activities: games, experiments, discussions ...
- Feedback: Check initial ideas and knowledge
- What about our behaviours related to.. ? Stay the same ? Need to adapt ? Discuss
- Commit to ...

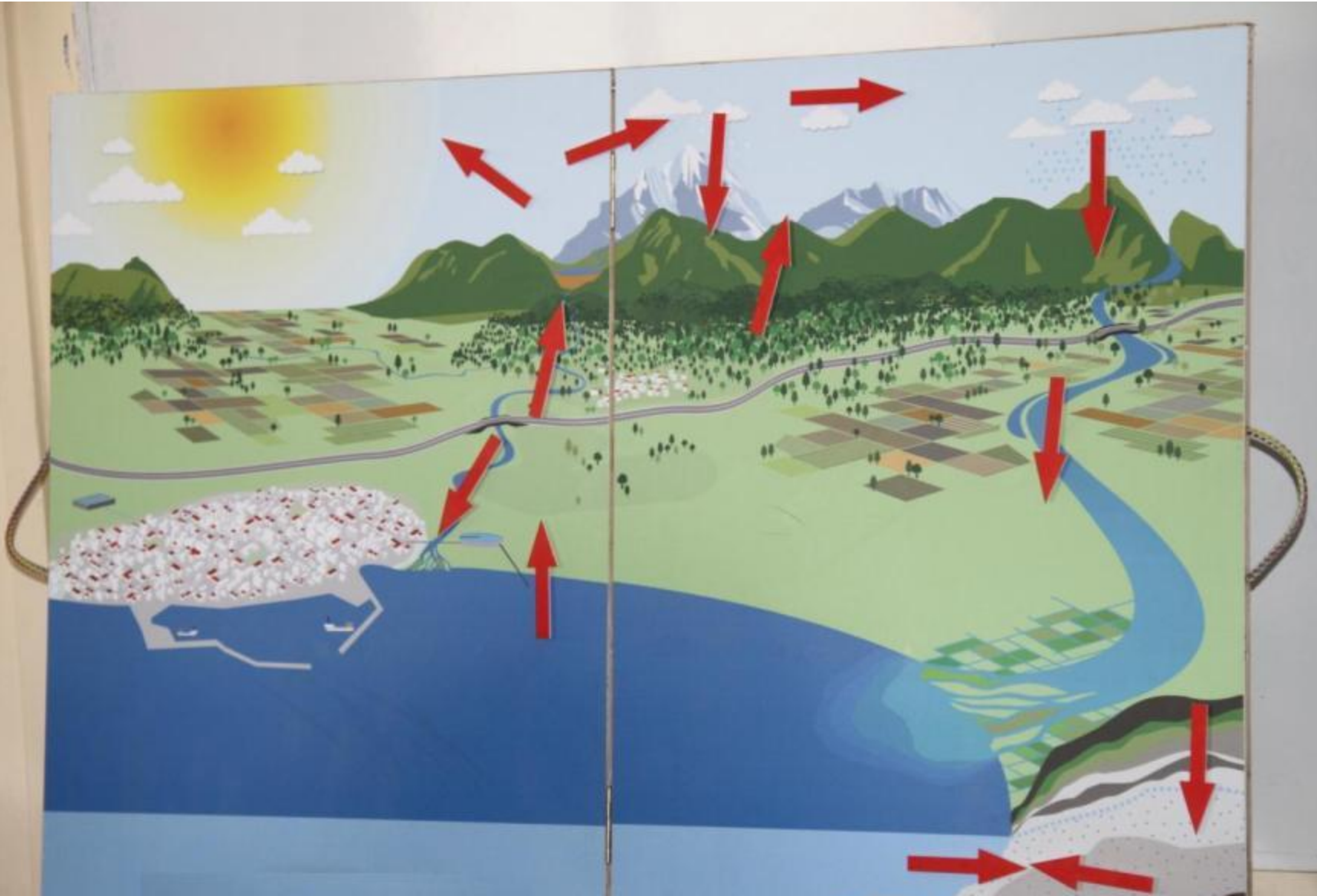
MEdIES hands-on activities in schools about NCWRs

1. Water cycle / Urban water cycle
2. Rainwater harvesting system
3. Desalination
4. What is greywater?
5. Greywater system
6. Set of experiments
7. Connecting past water wisdom with the present technologies (i) the old cisterns (ii) HYDRIA web-tool
8. **Reflection exercise:** Why discuss about these issues? Why is water important? What about our behaviour; Do we need to change something towards water sustainable use? What? Are we committed to do so?

Group activity Q5 (15')

- In your groups you will work on one characteristic hand on activity about NCWR!
- Then, you will share your results with the rest!

Activity 1. The (urban) water cycle

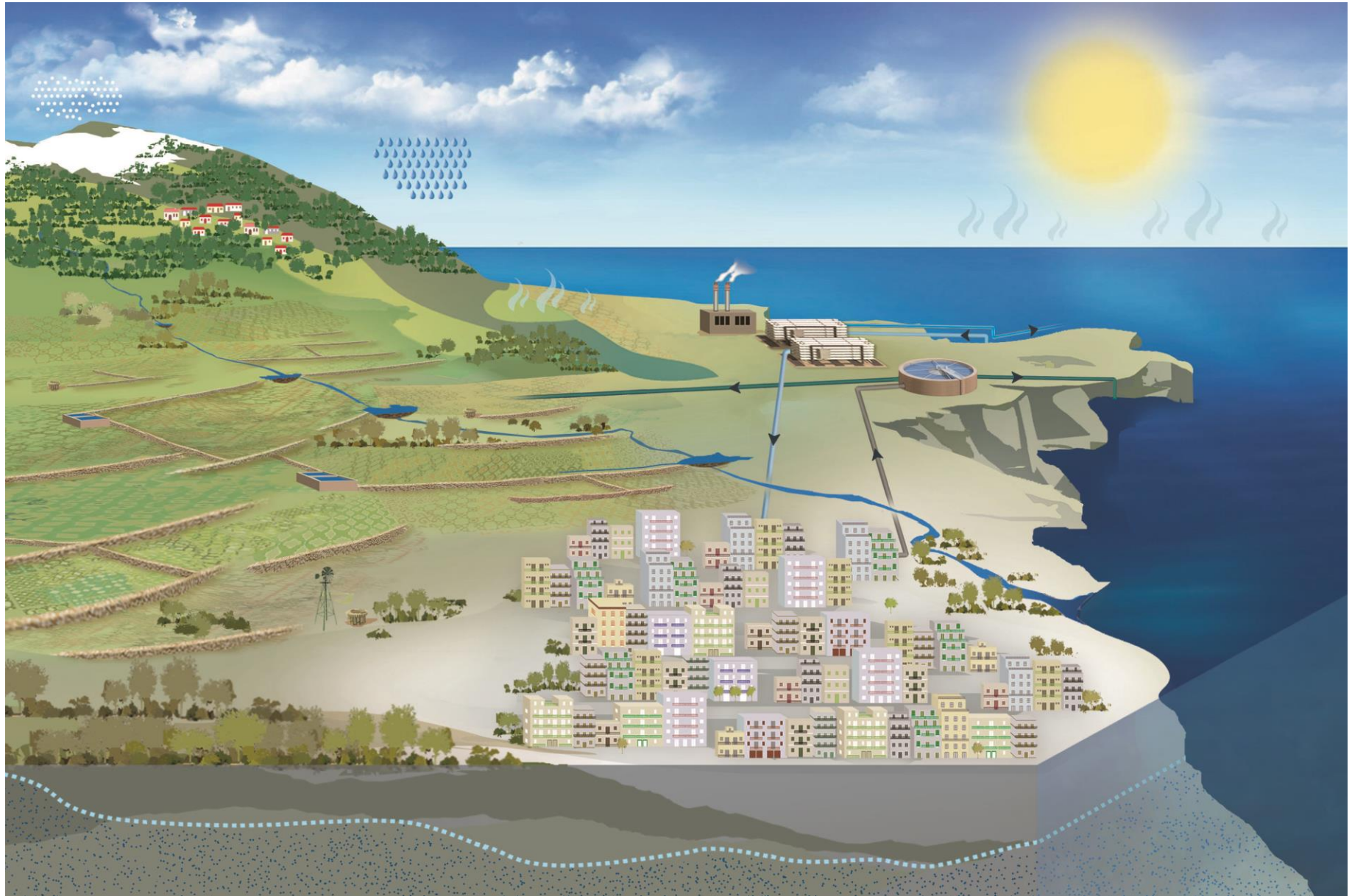


Activity 1. The (urban) water cycle

We discuss . . .

- Evaporation & transpiration
- Condensation
- Precipitation (rain, hail, snow)
- Surface run-off
- Percolation & groundwater
- **Human activities & their impact** on the water cycle: Groundwater exploitation (seawater intrusion); Agricultural runoff (pollution by nitrates, etc.) ; Fires & deforestation (soil degradation/erosion, floods. etc.) ; Urbanization and population growth (reduction of soil permeability and floods risks, etc) ; Overconsumption of water (decrease in the amount of the available freshwater of good quality)

Activity 1. The (urban) water cycle

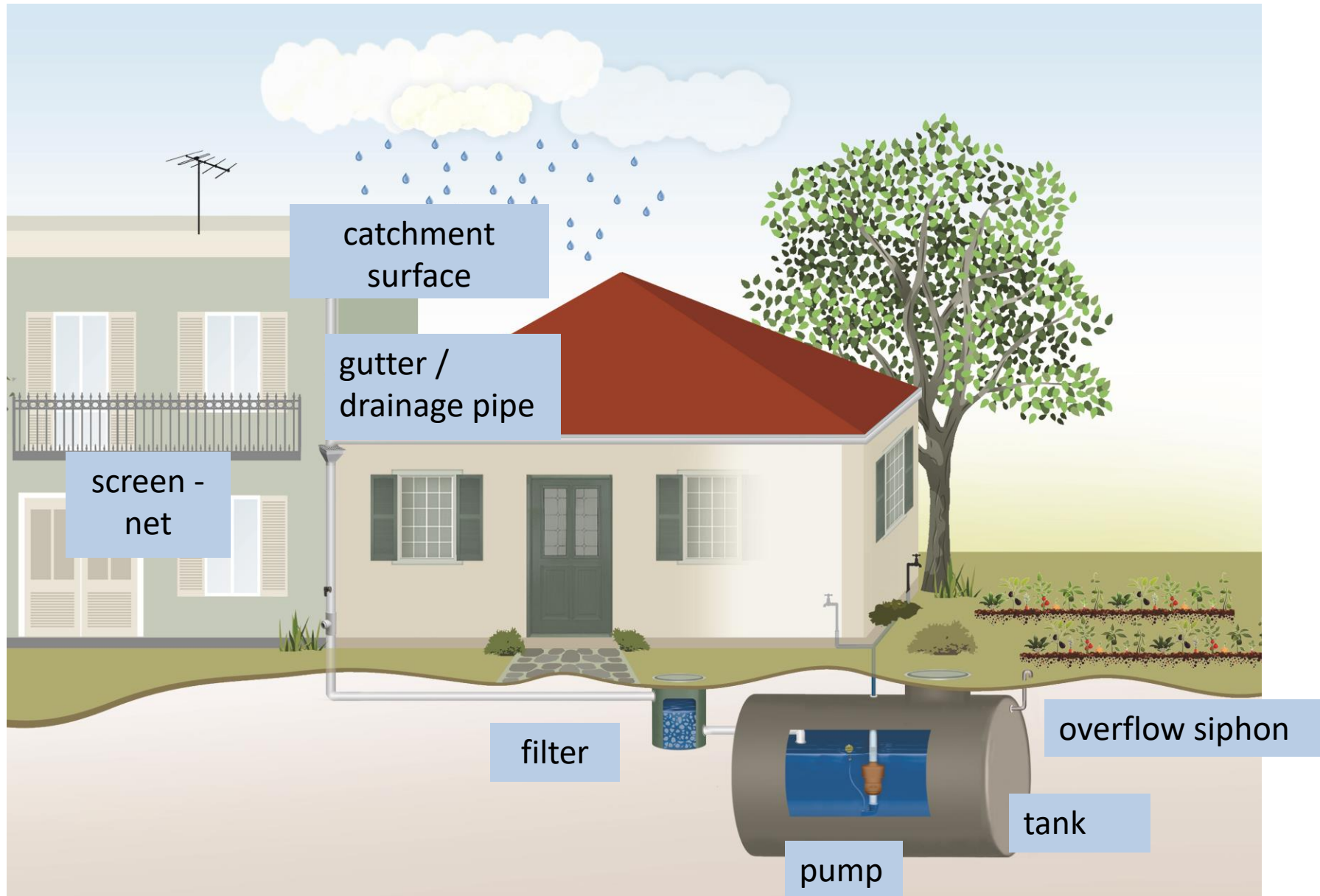


Activity 2. The RWH system

- We hand out the concepts of a basic RWH system (in groups of 3 students)
- Each group should discuss and trace where its concept should be placed on the floor mat
- Group by group we need to place all elements correctly
- We end with plenary discussion on maintenance of such a system



Activity 2. The RWH system



Activity 3. Getting to know grey water

- Share in small groups targeted photos
- Learners discuss and decide whether the photo depicts a “grey water” resources
- They reply with YES or NO
- We make clear what greywater is

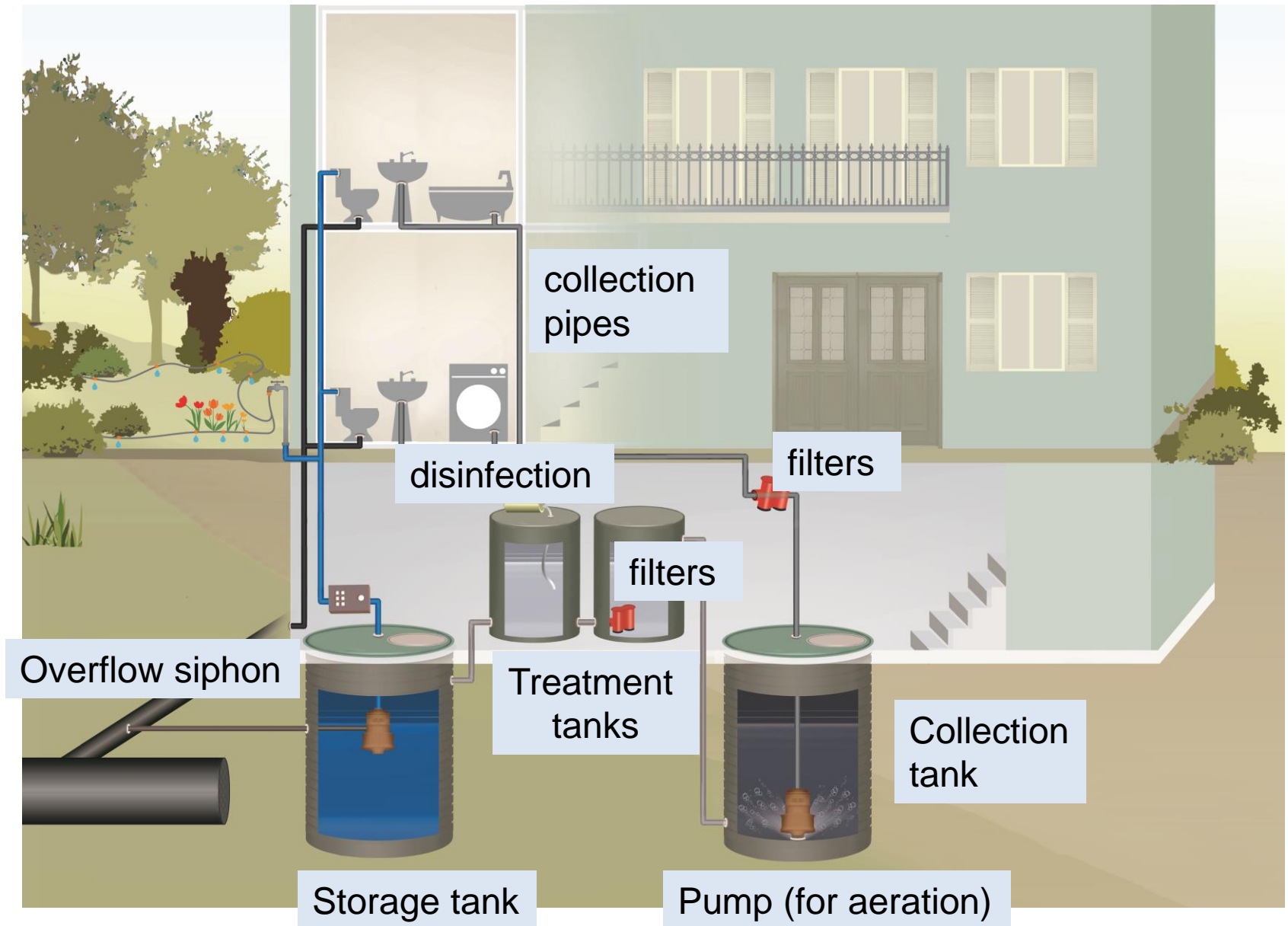


Activity 4. Greywater system

- We hand out the concepts of a basic greywater system (in groups of 3 students)
- Each group should discuss and trace where its concept should be placed on the floor mat
- Group by group we need to place all elements correctly
- We end with plenary discussion on maintenance of such a system



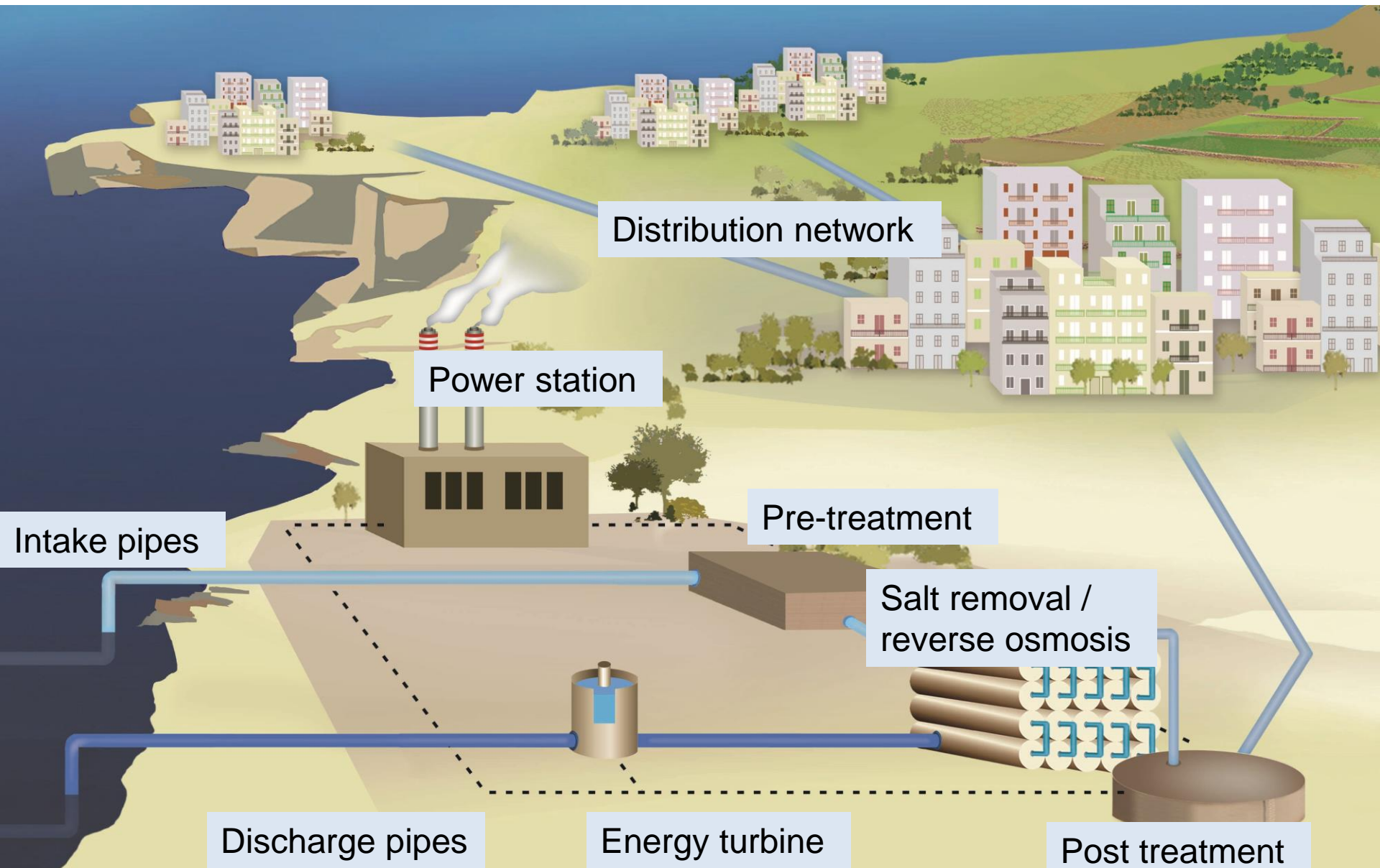
Activity 4. Greywater system



Activity 5. Desalination

- The teacher/educator hands out the cards to small groups of students (e.g. 3) standing around the mat.
- The teacher/educator asks the students to discuss the meaning of the term they are given and then, try to identify where this process is located on the mat.
- In plenary, each group describes their term and places it in the correct place on the mat. All unknown terms, disagreements and doubts are discussed and clarified.
- We pay attention to the following points:
 - * *Pre-treatment of salt water mainly includes filtration to remove debris, solids and floating particles.*
 - * *Post treatment of desalinated water includes disinfection to avoid bacterial infection and/or taste improvement (i.e. by passing it through carbonate rock).*
 - * *The output volume of the desalinated water is approximately half the incoming volume.*
 - * *The remaining half volume of water including the high salinity brine is used in the operation of the plant (energy producing turbine). Then, it is discharged back to the sea.*

Activity 5. Desalination



6. Simple experiments

- a) Creating a model of the water cycle
- b) Building a water tank - Testing water permeability
- c) Setting up a rainwater “meter”
- d) Filtering grey water

6A. Creating a model of the water cycle

- Students construct **a model of the water cycle** and interpret its functions and capacities: evaporation, condensation and precipitation.
- Impact of human activities (e.g. pollution) is also discussed. .



6B. Testing water permeability

- Using a pipette students add some drops of water on materials to check if they are water proof.
- Their task is to advise YES/NO to someone that wishes to build a cistern today using:
- Cement, ceramic, porcelain, aluminum, plastic, geo-fabric, etc.



6c. Setting up a rainwater “meter”

1. Set up the apparatus according to the sketch. Make sure that the funnel and the bottle have the same diameter.
2. Place the rain-gauge in an open area. Fix it to a pot filled with sand, so that it cannot be overturned by wind or heavy rain.
3. Measure the height of the water in the bottle immediately after a rainfall.

Record your data in a table. Calculate the monthly average rainfall.

4. Compare your monthly data to those published by the meteorological office. Are there any variations? Try to explain why.
5. Compare your monthly or annual estimates with published data of average rainfall of previous months/years. Try to explain any differences

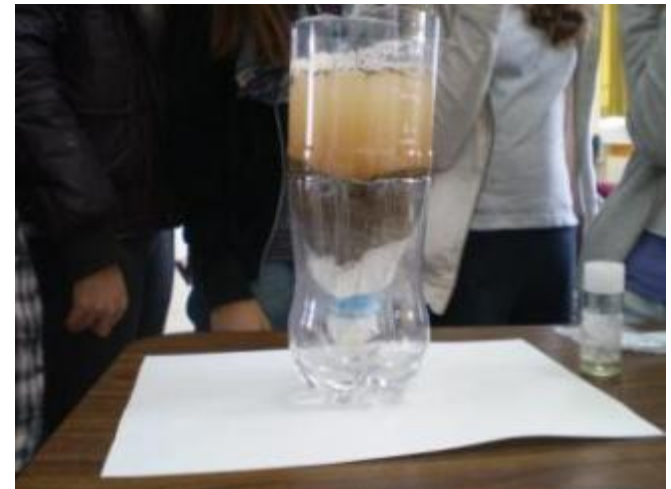
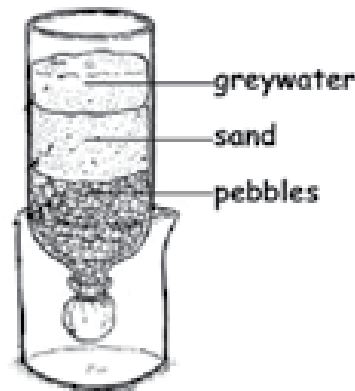


6d. Filtering greywater

Construct a filter using a plastic bottle with its bottom cut off as presented in the sketch:

Clean the filter by slowly pouring 3 litres of clean drinking water.

- Allow your hands to become very dirty by rubbing soil, mud, etc. Wash your hands using a lot of soap and collect the water in a bucket. Wait for 30 minutes. Then stir the dirty water (greywater) using the stick.
- Pour the greywater through the filter and collect the filtrate in a beaker. What do you notice? Stir the content of the beaker. What do you notice now? Compare the filtrate with the greywater you collected . *What can you use the filtrate for?*



7. Linking the present with the past

Unveiling cisterns, aqueducts, reservoirs...

- A. The 3D model of an old cistern (discussion on the shape, process of building and maintenance, uses of water, materials)
- B. How old is this cistern? (analysis of photos, group work)

7A. The old cisterns (a) the model

Who has seen a cistern ?

- Is it above or below ground? Why?
- How does it fill? How big is it?
- Do you know how it was built?
- How did people know the proper spot to build it? (e.g. impermeable rock with natural cavity)
- What Building material did they use ?(Rocks and binding material)
- How was it made impermeable (Use of glazing material)
- How did they check that water was clear (e.g. eels, lime, etc)
- How did they use their water (to drink, wash to water, irrigate, etc.)



Group activity 7B. The old cisterns/photos

- What is it?
- What material is it built with?
- What are the main parts i.e. pipes, reservoir, basin/s, taps, openings, etc.
- Shape and architecture. Are there any decorations?
- Can you guess Where & When was it built?
- Where does the water come from? Where does it go?
- Why do you think was it built? Which purpose to serve? Did it serve one or more houses?
- Is it still in use? For what?





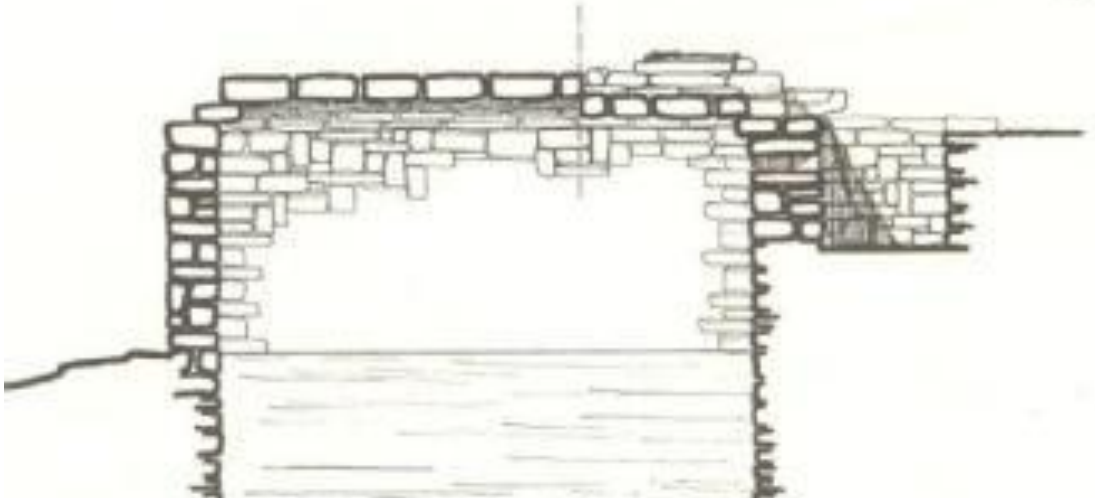
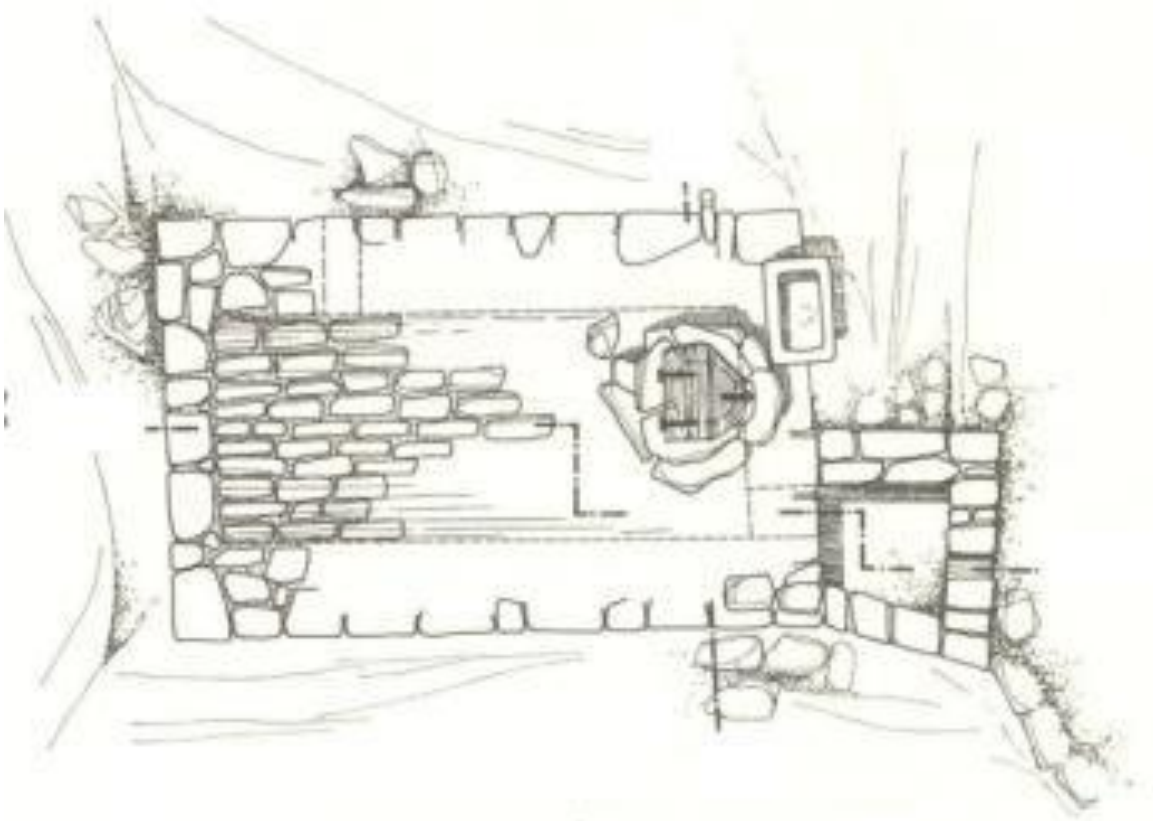
Basilika cistern, Istanbul (Turkey)

- 6th century AD by the Emperor Justinian.
- Large scale underground cistern; One protected access point and very few other openings, keeping light, rubbish, and rodents out. The cistern, measures $141 \times 66,5$ metres with a total capacity of 78,000 cubic metres.
- Impressive vaulted structure with a forest of 336 columns (9 metres high).
- Fed by a water reservoir 20 km away, the cistern provided the precious resource especially during draughts or sieges.
- The capitals of the columns are mainly of Ionic and Corinthian styles. Built with the ruins of older constructions. Some of these components are unique, such as the two carved Medusa heads (coming from a *nymphaeum*, a sort of Roman monumental fountain), which support two of its pillars. *It is said that the Medusa heads, one of which is placed upside down and the other one sideways, were placed in the cistern to ward off evil spirits.*
- Nowadays: Unique touristic attraction.



“Sarnitsi”: traditional cistern in rural areas of Crete (Greece)

- Typical traditional cistern built in the rural areas of Crete for the last centuries - near slightly inclined areas, it collects the rainwater that it is led to the cistern through a small channel.
- Underground cistern with vaulted structure; usually hewn in the rock at 4m depth. Built with stone. It includes a smaller cistern, an *antechamber*, where the solids included in the water settle, and the cleaned water is then collected in the main cistern. Usually it had a small window for aeration.
- “Gourna”, a small basin to water the animals.
- The collected amounts used for irrigating the nearby fields and for watering the animals.
- Nowadays: Most of them are still in use.





Cisterna dei carcerati, Italy

- The cistern "of convicts" was built in 1st – 2nd century BC the small island of Ventotene in Italy (in Pontine archipelago between Rome and Naples).
- As there weren't fresh water natural springs on the island human settlement has always depended on collecting rainwater. Huge reservoir carved directly into the tuff about 10 meters below ground level. It includes an open air space for harvesting rainwater, underneath which there are two vaulted tunnels communicating with each other, used for storage.
- The area near the cisterns was slowly inclined to convey most rainwater towards the collecting basin called "impluvium" and to the containers (~ 700-800 m³).
- The name of this cistern *dei carcerati* (= of convicts) comes from the fact that its rooms were used during the Bourbon period as a place to house labourers forced to do construction work on the island (jail).
- Still shows evidence of the use of the cistern in the centuries that followed, by its *wall paintings and drawings*, etc.

Collection, Storage & Distribution of Water in Antiquity
Linking Ancient Wisdom to Modern Needs

HYDRIA Project

- HYDRIA (www.hydriaproject.info) is a knowledge management tool.
- It is a trilingual (EN-AR-GR) website showcasing 39 distinctive examples of water management wisdom of the distant and more recent past.
- The project aims to demonstrate the wisdom of our ancestors, and their respect and adaptability to water availability and geo-climatic peculiarities.
- Further to promoting our cultural heritage, the research aims to unlock the possibilities of combining the past wisdom in the area of water collection, storage and transfer with modern technological innovations towards addressing today's needs in harmony with the environment.

<http://www.hydriaproject.info/>

Discover the wealth of the Mediterranean water management heritage. Browse case studies by:



Latest case studies



Water & Culture

07/05/2014

Iranian qanats reo

14/04/2014

Study on the Qari

22/03/2014

Waiting for Climate Change

20/03/2014

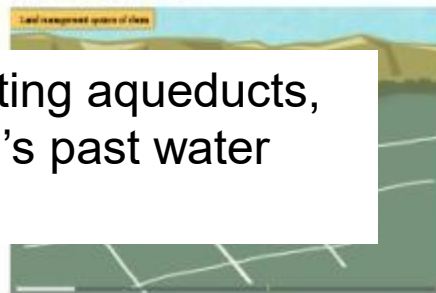
Hydria project promoted in article of GWP-med Executive Secretary

04/01/2014

Solomon's Pools and relating aqueducts,
the heart of Jerusalem's past water
supply

Animated waterworks

Land management & water supply in the Ancient
Greek colony of Pharos



The water drainage system (qanat) of Hortiatia,
Greece

HYDRIA features:

- Engaging experience to the user including maps, animations, timelines and extensive photographic material.
- Targets young people and the formal and non formal educational community (teachers, NGOs, museums staff, etc) especially in the Mediterranean.
- Active since 2008.
- So far, the project has been funded by UNESCO, ALF, GWP-Med and MIO-ECSDE.

More ideas for NCWRs within ESD

Box 1.2.6b. Examples of learning approaches and methods for SDG 6 “Clean Water and Sanitation”

Calculate one’s own water footprint (WF)⁴

Develop a concept for local sustainable water use and supply based on success stories

Develop school partnerships between schools in regions with abundance or scarcity of water

Organize excursions and field trips to local water infrastructures, and monitor water quality at school and home

Plan and run an awareness campaign or youth action project on water and its importance

Develop a project work on the invisible water, e.g. how much water in a litre of beer, a kilo of beef, a teeshirt, etc.

Develop an enquiry-based project: “What human activity can happen without water?”

More ideas for NCWRs within ESD

the diagram of WATER CYCLE

the WATER CYCLE in your island: key words:

- Mark on the picture the following terms that relate to the water cycle: *precipitation, aquifer, aquifer recharge, saltwater intrusion, collection surface, water supply network, wastewater treatment plant.*
- Can you indicate these phenomena? *evaporation, condensation, transpiration*
- Discuss with your classmates and teacher if you have difficulties.

WATER SAVING tips

Saving water at home

- Turn the tap off when washing hands, brushing teeth, doing the dishes, etc.
- Wash fruits and vegetables in a full glass dish instead of letting the tap water run.
- Opt for a short shower instead of a bath.
- Use the washing machine and dishwasher only when full.
- Use a bucket instead of a hose when watering a car or terrace.
- Check for leaking taps in the house and garden: if the running water is constant when all taps are turned off, you probably have a leak somewhere.
- Check for a noisy toilet by adding a few drops of ink in the flushing tank: if the toilet is working, coloured water will appear in the toilet bowl after a few minutes.
- When possible, install water saving devices, i.e. aerators, low flow taps, dual flush toilets, "water sippers", etc.

Did you know that...?

- The toilet flush consumes most of the water used at home. Followed by shower and bath.
- A leaking toilet tank can waste thousands of

Saving water in the garden

- Plant indigenous plants that don't need a lot of water in your home and school grounds.
- Water your plants early in the morning or in the evening.
- If you only have a few flowerpots outside using the hose. Use a watering can instead.
- Consider soil around each plant so that water is retained and directed to its roots.
- If you have a drip irrigation system make sure it is correctly aligned with the plant roots, doesn't over-drip and is not blocked.
- Persuade your parents and neighbours to avoid using the garden hose to clean balconies, steps and sidewalks: they should use a bucket instead.

Did you know that...?

- Indigenous plants of a region are accustomed to local weather conditions (e.g. water scarcity).
- A genuine watering can or a hose used in better than a daily trickle which does not allow the soil to dry up in between.

Harvesting rainwater in a classroom

- Collect the rainwater and use it for the toilet, in the garden, for watering the plants, etc.
- Before the first autumn rains, clean the roof, the gutters, the flows, etc. also remove any remaining dirt in the channels.
- Every time it rains, let the first downpour wash out the roof and then start filling the tank.
- Ask your grandparents about the way they collected and used water in the past. Visit www.culture.gouv.fr to explore past techniques for water collection and management in various Mediterranean countries.

Did you know that...?

- Once, today some people keep casks in their chimneys to use the rain off the roofs and keep the water transparent (through sedimentation).
- In the past, cleaning a cistern was a task for small child men or children (that could go through the opening).
- Drinking rain water without any treatment with disinfectants entails health risks, as it may contain microorganisms, bacteria and viruses.

Recycling greywater

- Collect wastewater when washing hands or taking a shower and reuse it in the toilet, the garden, etc.
- If you have a greywater system installed maintain it properly by keeping pipes, flows and the tank clean.
- If you switch to plastic-based, phosphate-free cleaners, in the household you don't have to worry about chemicals in the greywater filtering and pipes.

Did you know that...?

- around half of the water we use at home does not have to be potable. Water treated at a high cost is inappropriate to use for flush toilets, wash floors and for gardening.
- Computer is wastewater resulting from "hot" chemicals used such as boiling, showering, cleaning toilets, etc.
- Installed greywater is suitable for garden irrigation and the flushing of WCs.
- Using greywater in toilets can decrease daily consumption in a household's 10%.
- For the average household it takes the amount of greywater generated from shower and bath.

Saving water at school

- Don't leave taps running in the yard and in the toilet restrooms.
- Maximize the school water system: taps, toilets, pipes, showers, etc. Check for leaks and damages, and inform the school management for any repairs needed.
- Try to recycle any unused potable water.
- If there is a cistern at school keep the collection surface (roof, pipes) clean and use a rainwater gauge to estimate the amount of water collected per year.
- Try and involve all the students in the school's water saving efforts.

alter aqua

Educational Material on Non Conventional Water Resources
an application of Education for Sustainable Development (ESD)

Alter Aqua - Educational Material on Non Conventional Water Resources

NCWR

NON CONVENTIONAL WATER RESOURCES
FOCUSING ON THE SUSTAINABLE

HARVEST RAINWATER!

WorldWaterDay

NCWR

NON CONVENTIONAL WATER RESOURCES
FOCUSING ON THE SUSTAINABLE

RECYCLE GREYWATER!

WorldWaterDay

More ideas for NCWRs/ESD at: www.medies.net

The screenshot displays the MEDIES website, which is dedicated to the Mediterranean Education Initiative for Environment & Sustainability. The website features a navigation menu with links to About, Background, The Partners, Become involved, Staff, and Contact. A large banner image shows a group of people at a training session, with the caption "MEDIES Teacher Training in Andros, 2012". Below the banner, there are sections for "MEDIES Resources" (Publications, In the class, E-bulletins, ESD Library) and "MEDIES Events" (Trainings & Conferences, Representations, Members' events). A red circle highlights the "Current Projects" section, which includes "Rain water harvesting/NCWRs" and "Water for the City". The website also has a search bar and a "beta version" label.

MEDIES MEDITERRANEAN EDUCATION INITIATIVE FOR ENVIROMENT & SUSTAINILITY **beta version**

A long standing Initiative of

Sign in | Register

el **RSS** **SITEMAP**

Search: Go

About Background The Partners Become involved Staff Contact

MEDIES Teacher Training in Andros, 2012

MEDIES Resources

Publications

In the class

E-bulletins

ESD Library

MEDIES Events

Trainings & Conferences

Representations

Members' events

Welcome to MEDIES Education net!

Find here useful material for all those involved with **Environmental Education (EE)** or **Education for Sustainable Development (ESD)**. The website serves as an interactive point for sharing relevant documents, projects, websites, etc. for all interested individuals from the Mediterranean and beyond.

All MEDIES projects, current and past are presented herewith. The site serves as an online resource for educational material in many languages (Publications), offers a list of reference texts of EE and ESD (Library), and proposes ideas for projects to educators (Lesson Plans).

All members of MEDIES e-network are welcome to comment on the educational material and enrich the site with their own educational activities and news at local, national or regional level, so as to help us maintain an accurate resource.

the MEDIES Secretariat

ESD News

Wednesday, 23 August 2017
12 Questions to ask students on the 1st day of school (useful for train-the-trainer events too)

In Focus

Thursday, 16 February 2017
2017 UNESCO MAB YOUTH FORUM

Greek Corner

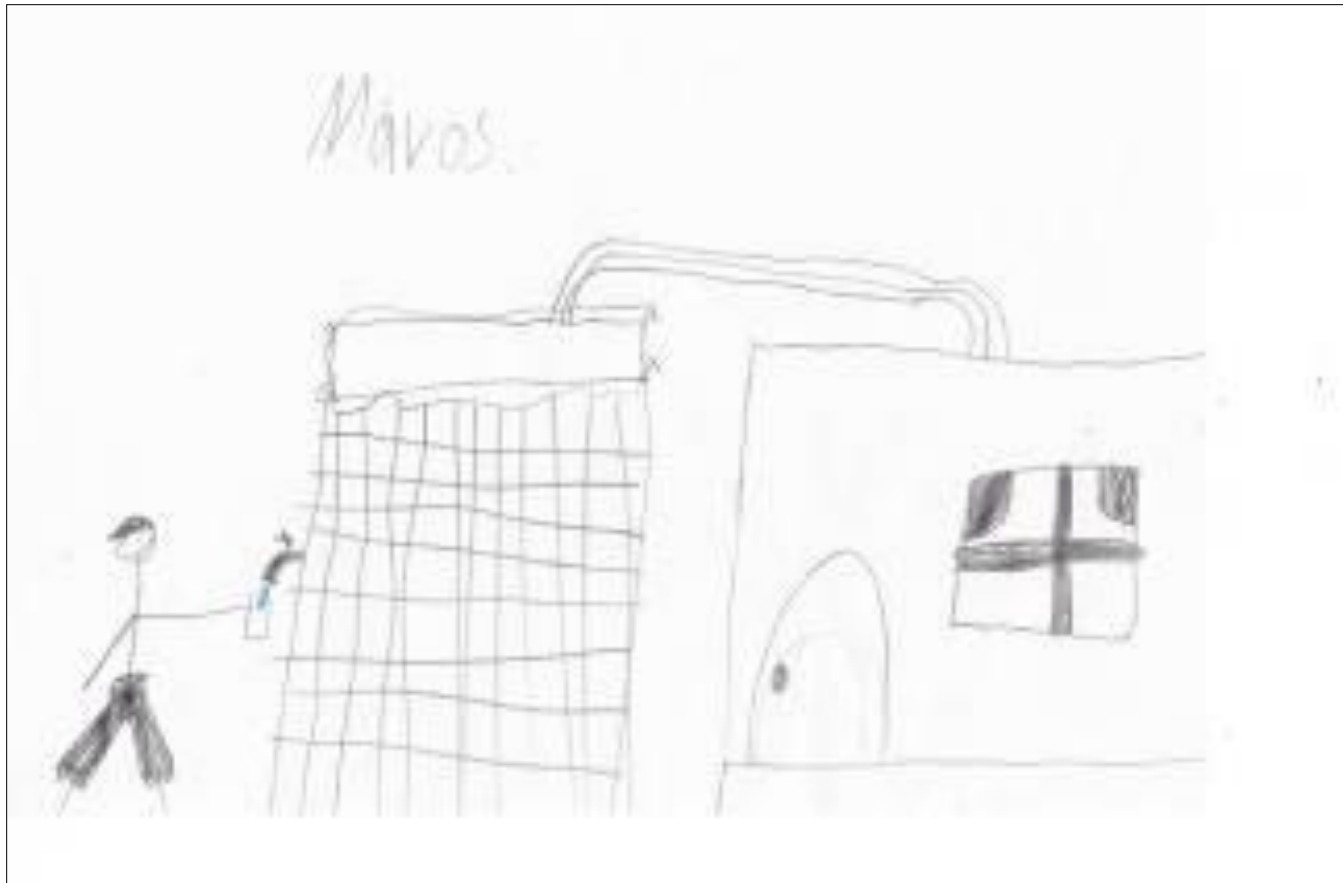
Current Projects

Rain water harvesting/NCWRs

Water for the City

WATER FOR

“Establishing a rainwater harvesting system in my home” Manos, 8yrs old student



SWIM and Horizon 2020 Support Mechanism

Working for a Sustainable Mediterranean, Caring for our Future

What ABOUT YOU?

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Thank you for your attention.

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