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Module 5

Sustainable Water Management



Rise Up Against Climate Change!
A school-centered educational initiative
of the Inter-American Development Bank



Rise Up

Against Climate Change

A school-centered educational initiative of the Inter-American Development Bank

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- Module 3** Environmentally Friendly School Infrastructure
- Module 4** Energy Savings, Efficient Use, and Alternative Technologies
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Rise Up

Against Climate Change





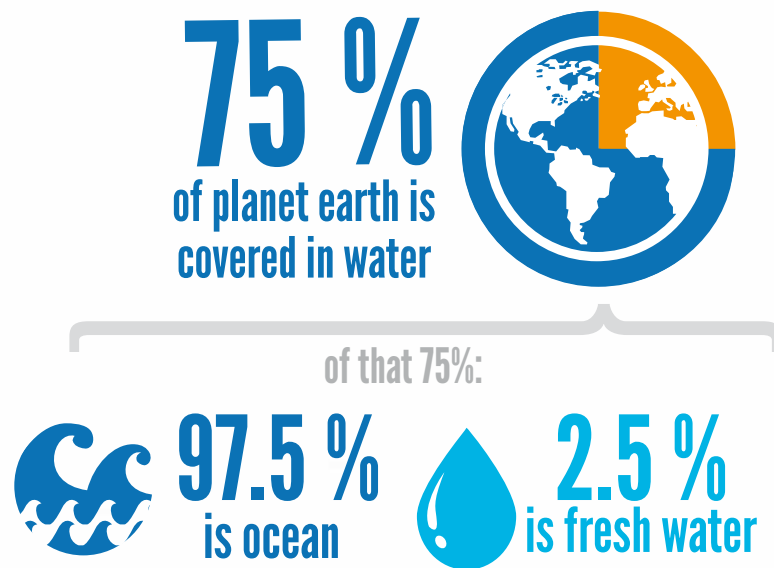
Even though there is plenty of water on earth, not all of it is suitable for consumption. One out of every five people does not have access to safe drinking water, and 40 percent of the planet's population lacks basic sanitation systems.

Identifying the problem

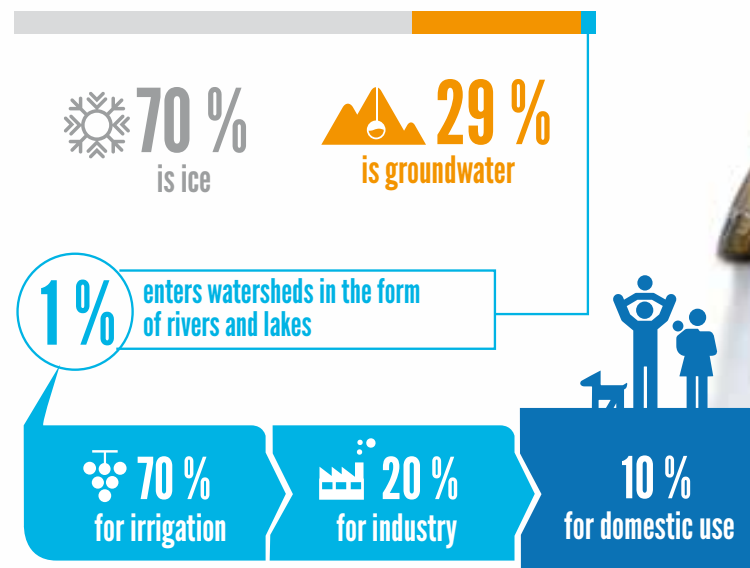
Have you ever wondered where the water you drink comes from, where it goes after you use it, or how people survive when water is not available or easily accessible?

Water is almost as old as the planet. Despite the fact that the earth looks blue-green from a distance—evidence of its abundant volumes

Figure 1. The world's water



Of the world's fresh water

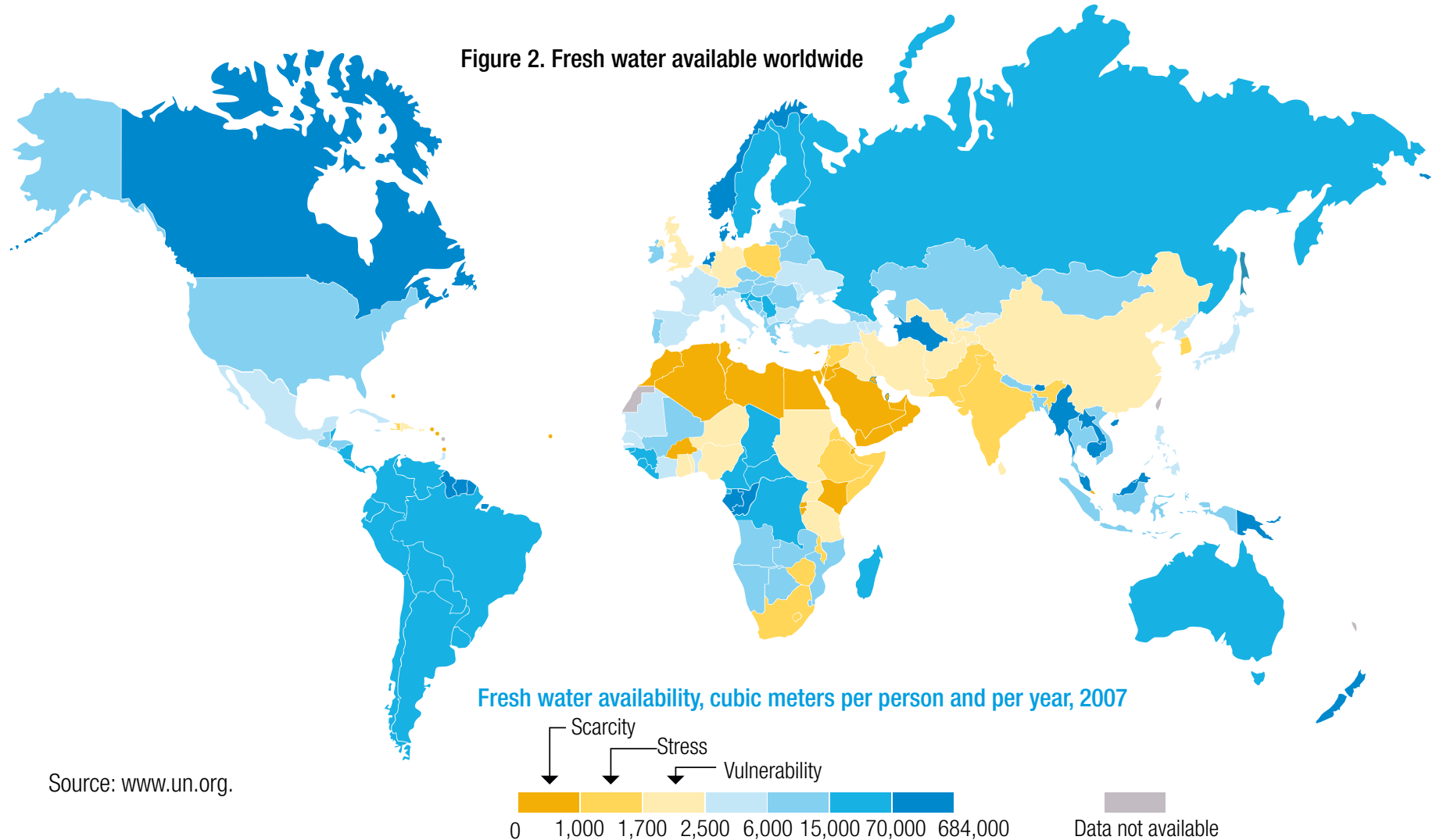


Source: www.unwater.org.

Fresh water available worldwide

Water resources are also unevenly distributed—abundant in some places and lacking in others. About 1 billion people worldwide must travel great distances daily to obtain it. In Latin America, despite considerable improvements in recent decades, almost 10 percent of the population (approximately 60 million people) still lack household access to this vital resource (Adler, Carmona, and Bojalil, 2008).

Figure 2. Fresh water available worldwide

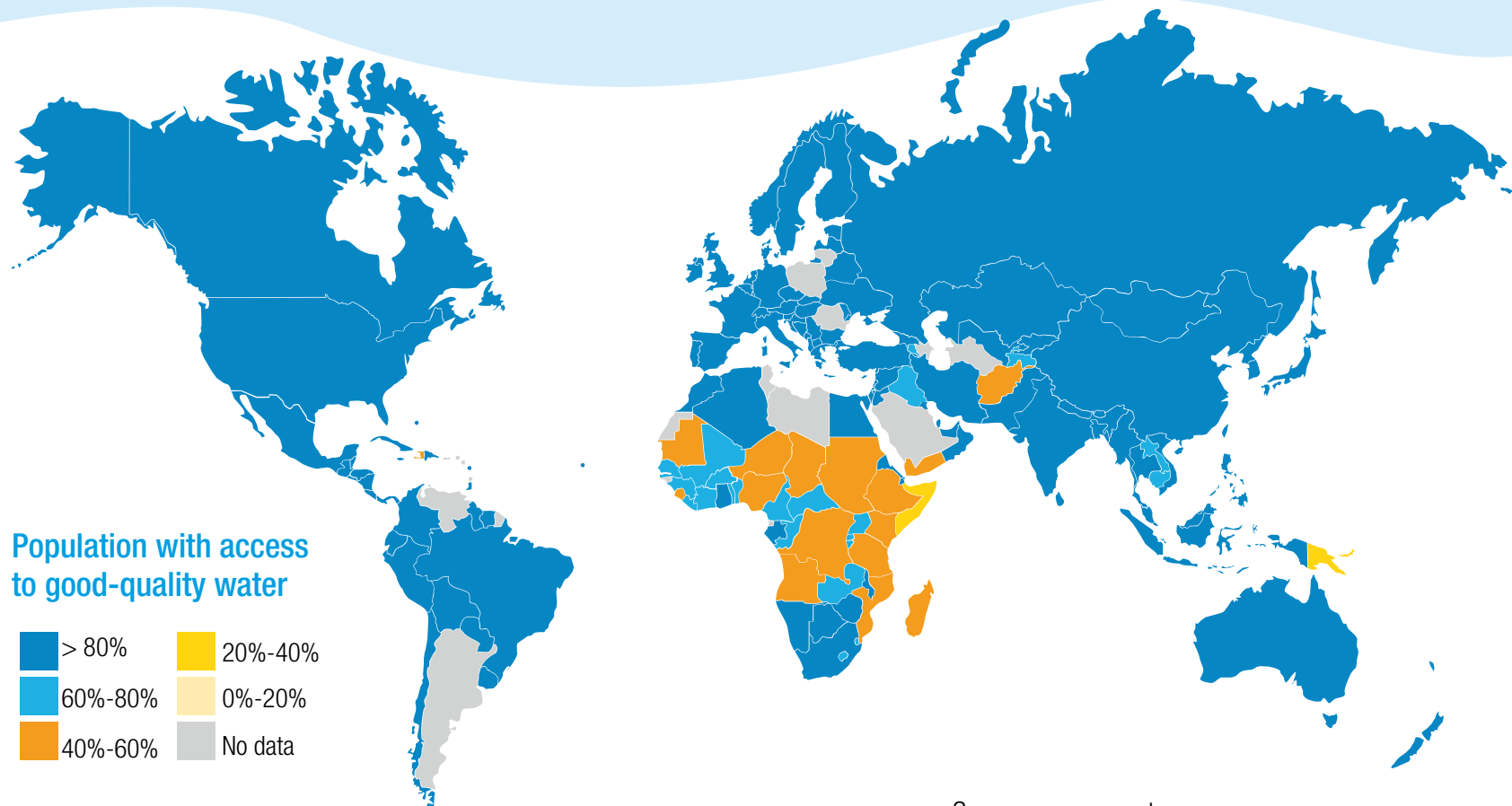


Source: www.un.org.

Box 1.
Our
water needs



To live comfortably a person needs at least 20 liters of water a day; this totals 7,300 liters per person per year. Unfortunately, many do not have access to this amount because of environmental conditions, lack of infrastructure, and poor water quality (that is, unfit for human consumption)

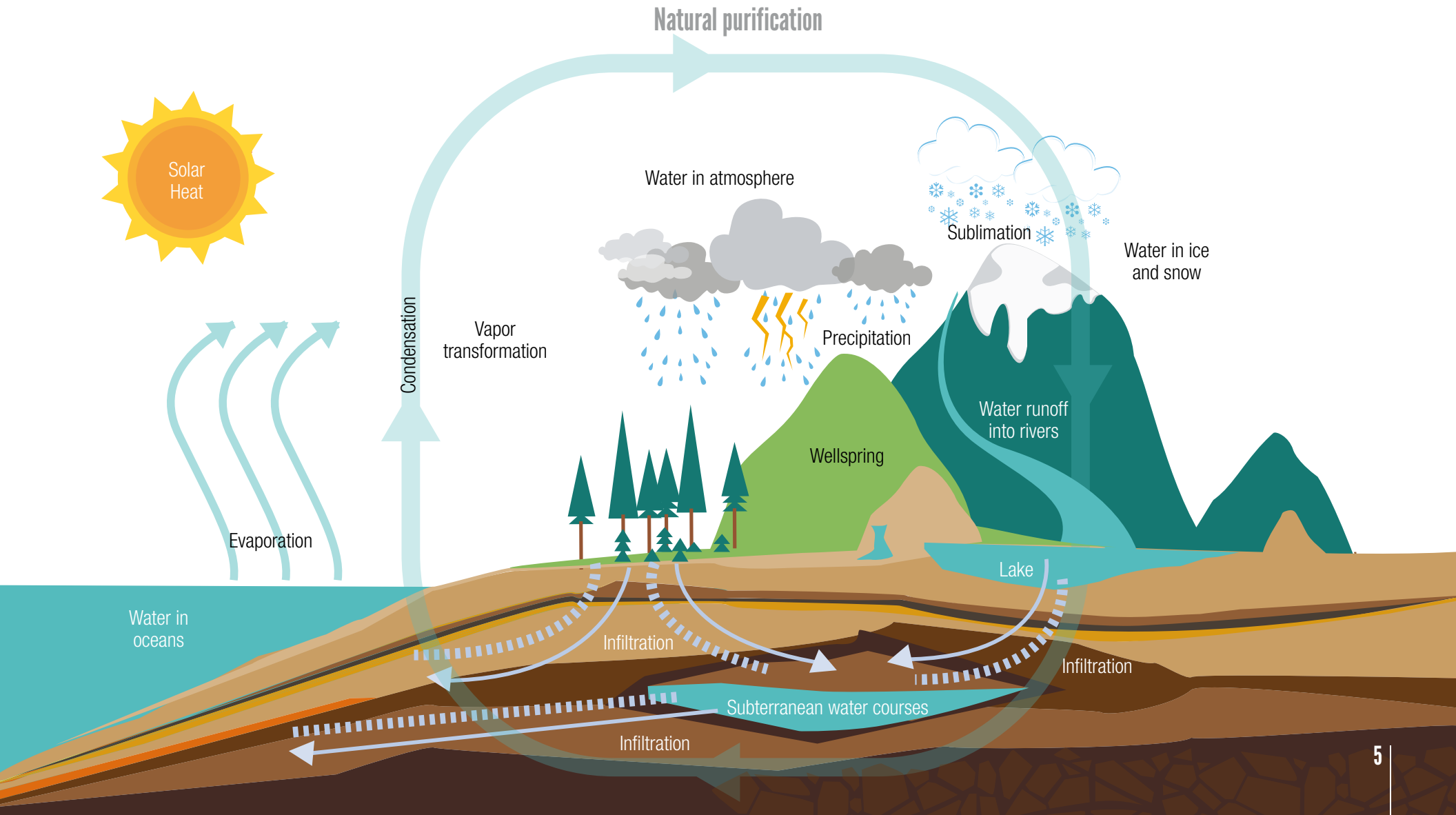


Source: www.unwater.org.

There is a strong link between ecosystems and the water cycle. High rates of deforestation and the contamination of seas, lakes, and rivers (due to inadequate sewage and industrial sanitation) leave certain regions particularly vulnerable to the scarcity and pollution of water (figure 3).

Inequality is clearly evident in global levels of access to and consumption of water. While some people barely have access to 20 liters per day (the minimum needed for basic needs), others consume over 400 liters. Should we consider this a result of ignorance, or apathy—or a combination of both?

Figure 3. The water cycle



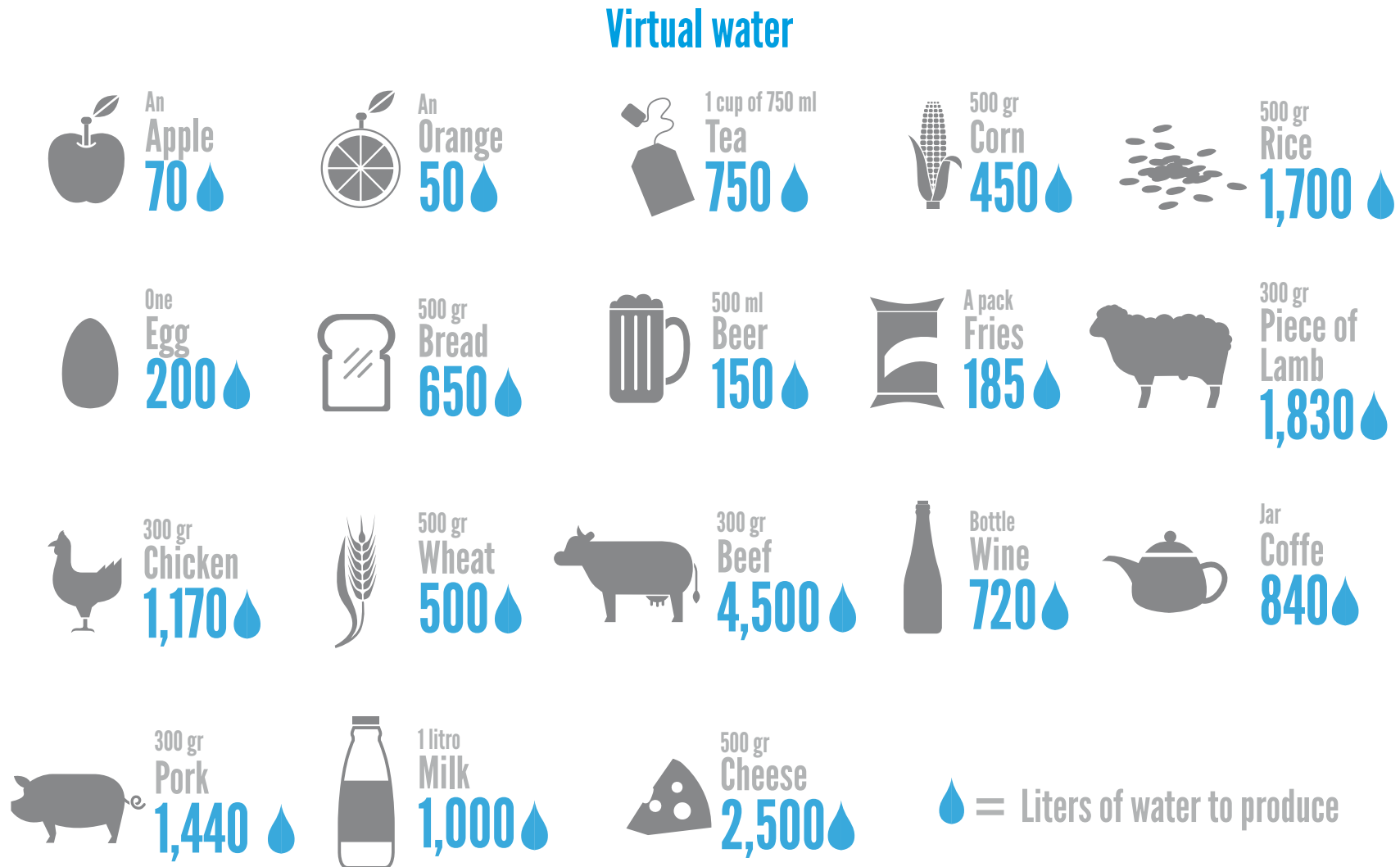
Many people waste large volumes of water while washing their cars or sidewalks or while showering. This misuse probably results from having misunderstood the water cycle and assuming water to be a renewable and unlimited natural resource. Although safe water is available to these people at present—even as other people suffer scarcity—it will not necessarily always be so.

Population growth, human apathy, the widely held belief that water is an unrestricted renewable resource, increased costs of supply (since we have to go continually farther and deeper to get it), pollution problems, lack of sanitation systems and technologies, and the intensification of droughts and floods (caused by climate change) have all further exacerbated the problem of water scarcity.

This problem is enormous; although your school cannot solve it alone, your intervention can make a big difference. First, you can change the perception that water is an unlimited resource and emphasize that supplying water involves using energy for drilling wells, transporting the water, and purifying it. Second, your school can serve as an example of a responsible user. Solutions are available to any group willing to work together to adopt alternative forms of retrieving water, allow it to infiltrate the subsoil, and handle it more effectively.



Figure 4. How much water does it take to manufacture a product?



Source: Virtual Water 2007 (<http://virtualwater.eu/>).

Note: Poster based on Hoekstra and Chapagain, 2007. Designed by Timm Kekeritz.

Making a change in your school

If a school is using water as if it were an unlimited resource, it must change that mindset. This can be accomplished by making necessary adjustments to the curriculum and by teacher (and student) example. Smart use of water is vital to transforming the traditional school into an environmentally friendly space.

Transforming and improving water utilization in schools is not as difficult as you may imagine. Once a group makes up its mind, much can be accomplished through consistent action. The first step in establishing a water management program is to identify and analyze existing conditions, including the water habits and perceptions of the school community and the state of the school's water supply and sanitation infrastructure.

Next, steps can be taken to reduce water consumption, either through adoption of new habits and customs by the school population or the incorporation of small changes and new technologies that improve water use and allow its infiltration to underground aquifers.

Diagnosis

Preparing a general diagnosis of water conditions in the school involves at least three steps:

- Outline the route that water follows in the school: consider where it comes from, the path it takes, and where it goes when it leaves.
- Identify how water is used and regarded by the school community.
- Evaluate the school's current hydraulic facilities.

The water cycle in the school

Understanding how the school obtains, uses, and disposes of water are the first tasks of the diagnostic exercise. In most schools, water distribution systems will either be hidden beneath building foundations or hard for the inexperienced eye to observe. Take advantage of your students' and teachers' interest and resources, your communities' water services offices, and the senior school staff responsible for the schoolyards, restrooms, and gardens. Tour the school facilities together to determine the path of water at the school.

By addressing these considerations, you will be able to ascertain whether the school is actively generating problems for the ecosystem, either in how it accesses water resources or how it disposes of water.

As part of this first exercise, it may be useful to draw a sketch or map of your school in addition to listing information in a format similar to the example provided in table 1.



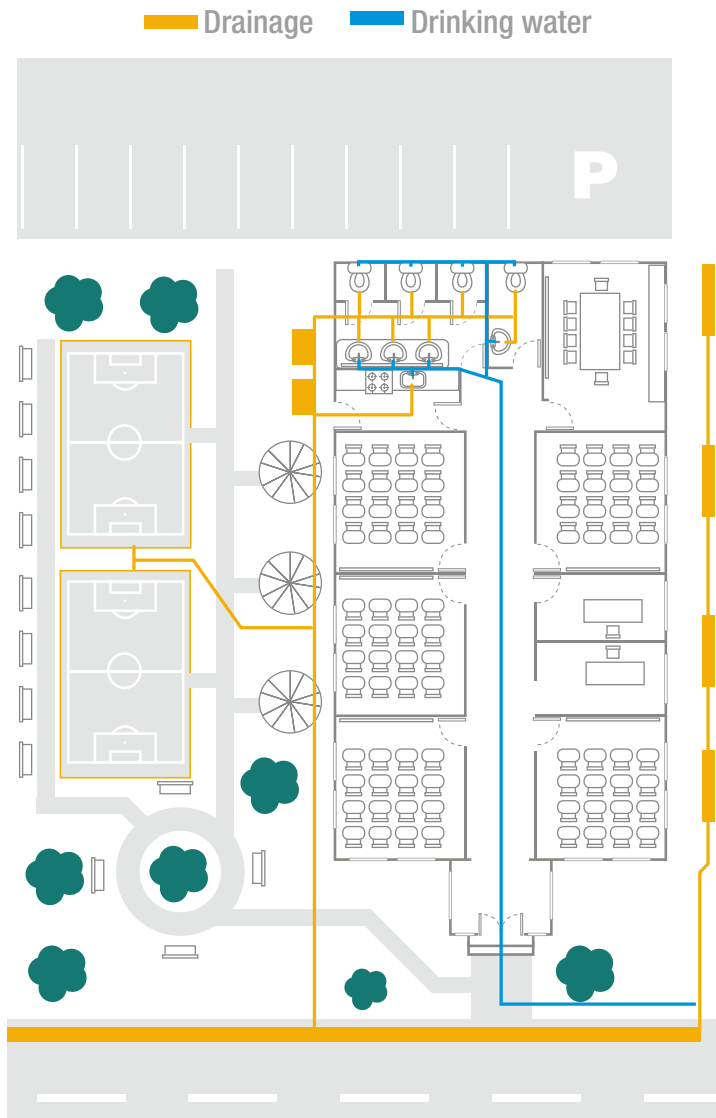
Table 1. Analyzing where the school's water comes from and where it ends up

Topic or question	Answer	Comments
Origin of the water supply	The Lerma-Cutzamala Basin and Magdalena Contreras River	Both the basin and the river are heavily overused. In fact, deeper wells are being built each year. The basin system is very far from town, so water transportation costs are very high. Each year, the communities adjacent to the basin hold demonstrations asking officials to stop supplying the town with water because they themselves experience serious scarcity problems.
Costs incurred by the town to provide the water supply	More people are without access to water each year. Many communities hold meetings and protest marches demanding increased supply.	
Cost of water to the community per cubic meter or per liter		
Water supply problems in the school		
School's drinking water supply and drainage and runoff systems	A complex network supplies water to restrooms, the kitchen, laboratories, sports facilities, and other areas. (The water comes from the town's water supply.) It is supplied by tankers and trucks that bring water in containers to fill the school tanks. The school has its own water well.	It can be useful to find out how old the school's water systems are, as well as the frequency of their breakdown and regular maintenance. If toilets use drinking water, consider making the small adjustments necessary to use gray water(water from sinks or showers).

Table 1. Analyzing where the school's water comes from and where it ends up, continued

Water consumption at the school (over a given period of time)		In cubic meters or liters	
		Economic cost	
School population total (students, teachers, and other employees)			
Uses of drinking water at the school (may be estimated in percentages or in liters, if you are able to calculate it)	Drinking		
	Restroom cleaning		
	General school cleaning		
	Garden irrigation		
	Washing backyards and sidewalks		
	Washing cars		
	Washing tools		
	Washing kitchen and dining room utensils		
Bodies of water close to the school (lagoon, lake, wetland, river, dam, ocean, others)			
Where is the water used at the school disposed of?	At a drainage system in town, a river or stream nearby, a local treatment plant, a treatment plant of the school, and so on.		
Where does the water used at school finally end up?	Once it goes down the drain, it is treated and dumped on a nearby beach. (Without any treatment it ends up in a lagoon, from which the area gets its water supply.)		It is important to keep in mind that, as in all natural systems, water is part of a cycle. Every- thing we do to this cycle (good or bad) will later affect us.

Figure 5. Water's journey



School water use: community habits and perceptions

The most significant legacy your school leaves is the education it offers to students and the rest of the community. Educating people in intelligent, sustainable water use is of paramount importance.

As you examine current water use and envision future improvements, members of the school community may be invited to share their ideas and viewpoints. This exchange could be conducted in a classroom. Teachers and students should be encouraged to include an activity of this kind in their curricular or extracurricular activities. You may also carry out a small survey or interview to collect answers, discuss them with the group, and share them with the school community.

You may choose to conduct both a written survey and classroom discussions. In tables 2 and 3, we offer guides for both exercises. Once they are completed, you can collect all the information, illustrate it in a way that makes it easy to understand, and share it with the school community. The next step will be to motivate community members to participate in the initiative.

(Note: The exchange of ideas can take place over a one-hour session; if more time is needed, several short sessions are more effective than one single long one. Moreover, if the community you are bringing together does not see plans taking shape over the short term, they may become discouraged. Take initial steps before preparing a comprehensive plan.)

Table 2. Ideas for a classroom exchange on water use

Meeting objective: Find out the views of the school community (students, parents, teachers, and so on) on the water problem. Develop ideas to improve the school community's water utilization performance.				Meeting location and date
Schedule	Discussion questions and subjects	Initial presenter or pre-senter in charge	Required materials and general ideas	Comments
8:00 AM to 8:05 AM	Present meeting objective and agenda	Initiative leader	Meeting objectives and agenda should be typed, presented on a board or blackboard in front of the classroom, or projected digitally.	Appoint one or two rapporteurs for the process, who will record what is said and agreed on.
8:05 AM to 8:45 AM	<p>Do you believe the school adds to the community's or the world's water problems? Why?</p> <p>Do you believe that the school has a water-related problem (supply, quality, cost, and so on)? What are the school's main water problems?</p>			<p>Invite a guest speaker to offer an overview of the topic in the community or the world, then open up the discussion.</p> <p>Start with a round of open sharing and close with a brief talk given by a guest.</p>
8:45 AM to 9:00 AM	What can the school community do to improve the school's water utilization performance?		Provide examples of what other schools, local or international, have done.	Record agreements and a list of volunteers who want to take part in initiating specific proposals.

Table 3. Sample survey: the school community's views on the water problem

Name:	School role:	Parent	Associated school grade
		Teacher	
		Student	
		Staff	
		Other	
What river, ecosystem, or basin supplies the school's water?	Name?	Don't know	
What is the town's main water-related problem?	Shortage		
	Poor quality		
	Pollution		
	Wastefulness		
	Other (specify)		
Do you think the school handles its water in an environmentally harmful way? What harm is caused?	None		
	Contamination—sewage or other		
	Waste from consumption		
	Waste due to poor facilities and leaks		
Do you think the school can make adjustments to improve its management of water?	YES	NO	
If yes, continue to the next questions. If no, ask why and go to the last question.			

Table 3. Sample survey: the school community’s views on the water problem, continued

What are they?	Agree on new ways to decrease consumption		
	Fix leaks		
	Use rain water collectors		
	Reuse gray and sewage water		
	Create a means to treat gray and sewage water		
	Others		
Would you be willing to participate in initiatives or actions like these?		YES	NO
If yes, continue with the following questions. If no, go to the last question.			
In what way?	Exercise care in my consumption		
	Detect and fix leaks		
	Seek advice on using a collector, biofilter, or other alternative technology		
	Get support from educational or governmental institutions		
	Gather materials		
	Convince other colleagues to participate in a project like this		
	Others		
If no, answer the following question.			
What might encourage you to participate in actions such as these?			

Condition of the school's hydraulic facilities

The first step is to identify the school's hydraulic facilities (restrooms, swimming pool, showers, drinking water dispensers, dishwashers, washbasins, and so on), and the location and distribution of drinking water networks, drainage, and wastewater.

To determine whether facilities are working properly, it is essential to audit leaks. You can do this through a class activity with students. With a map and record sheet, inspect all hydraulic facilities. Initially, only surface leaks (such as dripping faucets and showers) or those that

have formed large areas of moisture (because of their location deep within walls or floors) will be evident. Others will be more difficult to identify, including small leaks in toilets or very slow seepage from underground piping. Such leaks may be few but steady.

Before consulting a specialist, conduct your own audit. Recommendations on how to proceed and how to record, systematize, and solve the problems discovered are as follows.

Figure 6. Storing and using rainwater

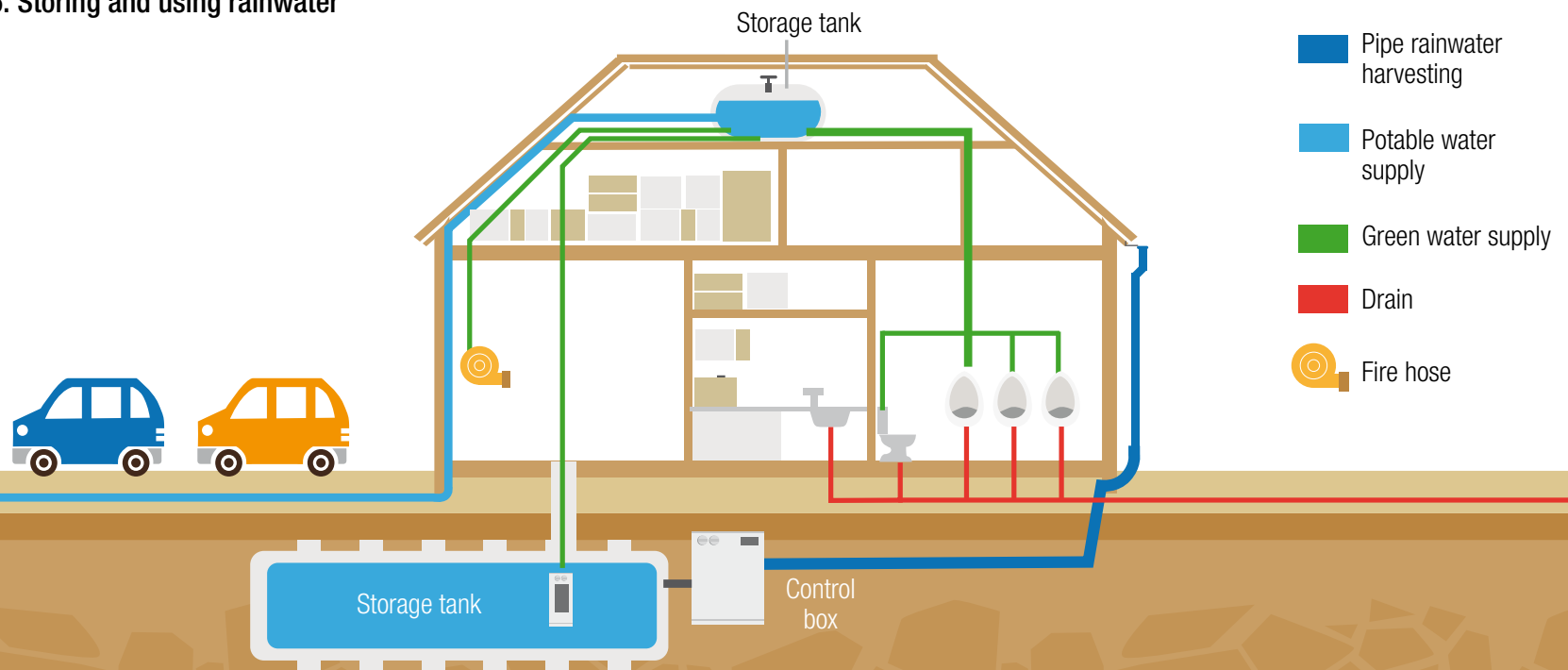
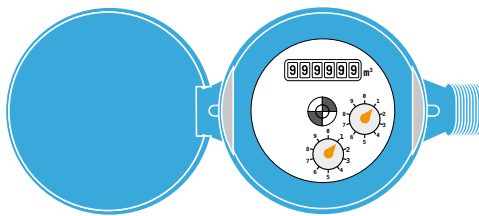
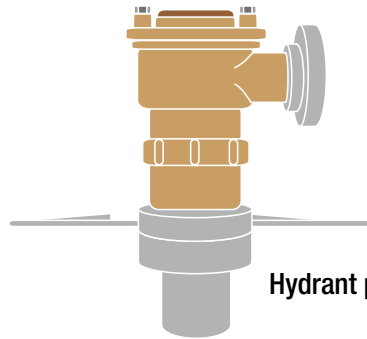


Figure 7. Examples of various types of water meters

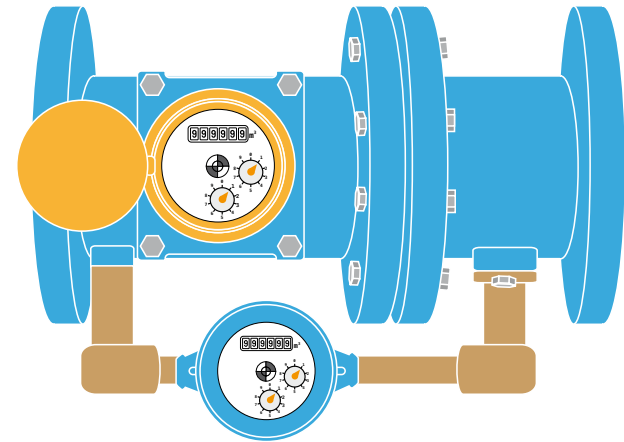
Water meters



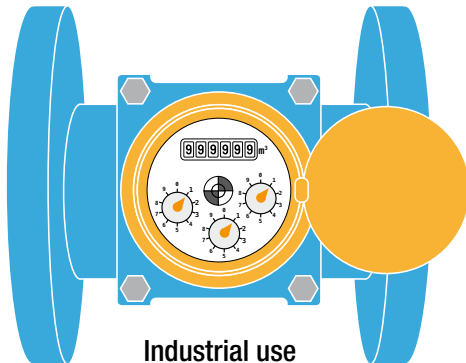
Home use



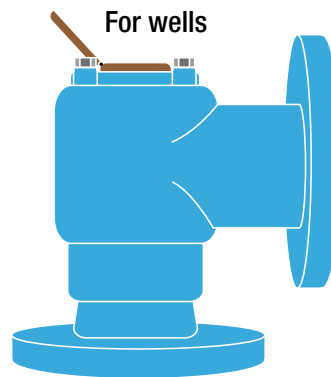
Hydrant pits



Compound pressure valve



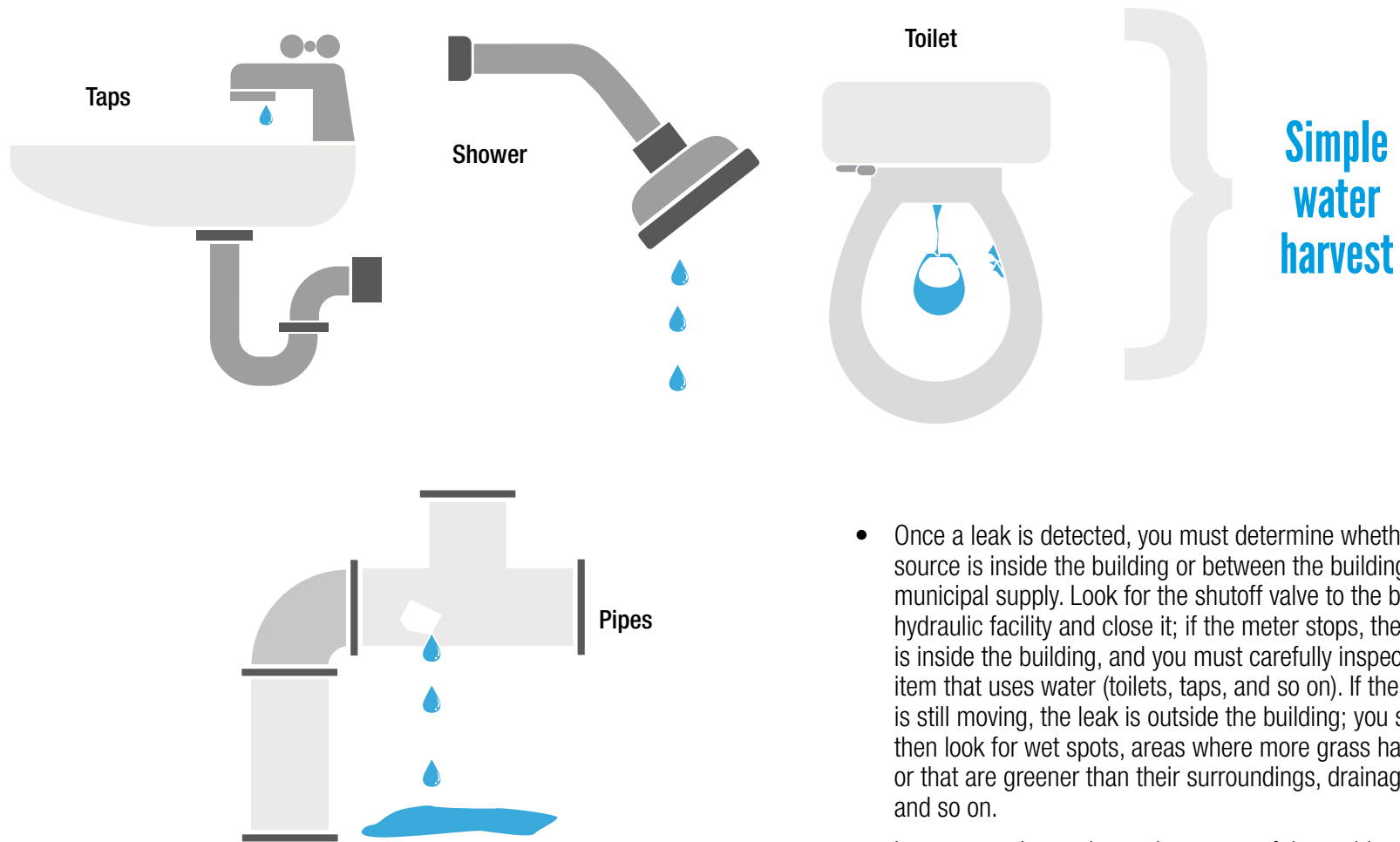
Industrial use



For wells

- Once you locate the water meter, locate the flow indicator. Usually this is a red triangular pointer or narrow needle—like that on a watch dial. When water is flowing, the indicator moves visibly.
- Close all the stopcocks in the school's water system, including those in tanks and cisterns, and observe the flow indicator. If it continues to move, you have leaks. You can gauge their size by how fast the needle is moving.

Figure 8. Sources of water waste



- Once a leak is detected, you must determine whether its source is inside the building or between the building and municipal supply. Look for the shutoff valve to the building's hydraulic facility and close it; if the meter stops, the leak is inside the building, and you must carefully inspect each item that uses water (toilets, taps, and so on). If the meter is still moving, the leak is outside the building; you should then look for wet spots, areas where more grass has grown or that are greener than their surroundings, drainage runoff, and so on.
- In case you do not detect the source of the problem, call a specialist or consult the local water authority in your community.

Recommendations

A diagnosis of your school's water resources and usage patterns can be used to:

- Learn about and raise awareness of the availability and quality of the water in your town and school.
- Plan and design, along with school authorities, a gradual change of the school's water-management technologies.
- Design a comprehensive water-saving and environmentally sound water-management program for the school community.

Many of the recommended actions depend on the school's spatial, economic, and human resources. While some actions require specialized help and costly technologies, others are very easy to implement at low cost. Yet, much of the work to improve the way we use water has to emerge from our own efforts, intent, and desire to succeed.

Developing a savings plan depends on the aspirations and resources of each group and school. Following a format like the one proposed in table 4 can help; other ideas may emerge at your group meetings to enrich, modify, or supplement it.

A plan usually has better results when made in a group. Convene a planning session with members of the school community—include parents, students, teachers, administrative and maintenance staff, and others. Begin by presenting an overview of their insights into the problem, and discuss how their suggestions could improve the school's environmental performance and student learning.



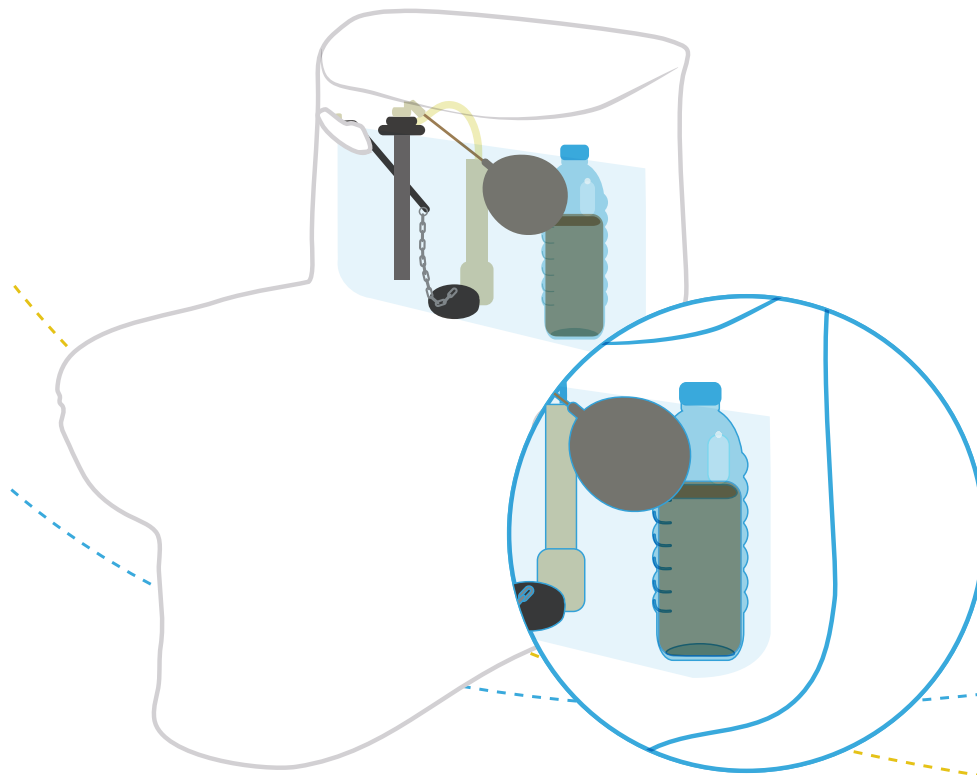
Table 4. Preparing a plan to save water and improve water management at the school

Problem	Potential causes	Solution	Actions required to implement solution	Results expected	Those responsible for carrying out or coordinating the plan
Water leaks in the restrooms.	Equipment is old or in poor condition.	Comprehensive diagnosis of leaks. Change faucets and washers.	Make a schoolwide schedule to fix leaks. Request support from a plumber to guide the work. Purchase materials.	Reduction of leakage and consumption.	Coordinated by the gym teacher with support from parents. Participation by students in the entire process.
Waste of water in the kitchen, restrooms, and laboratories.	Students, teachers, and workers.	Campaign for responsible water use.	Prepare posters. Include the topic in the curriculum for all grades. Assign teams (of teachers and students) to monitor the ways in which water is used.	Decrease consumption. Raise the school community's awareness about the value of water.	Coordinated by the students' association.
Lack of knowledge about alternative technologies.	Inadequate time taken to investigate. Lack of informative material on the subject.	Appoint either a member of the administrative staff to investigate or a group of students (as part of classwork).	Find volunteers interested in the topic. Integrate the subject into the school curriculum, then plan and carry out a research project with students.	Increase knowledge about the topic. Options for water use in the school.	Coordinated by the science teacher with the support of administrative staff. Parents and students to lend support to the research.
Lack of financial resources to make repairs or modifications to the water system.	Insufficient budget allocated to schools for system maintenance and adaptation to new environmental conditions. Others.	Investigate possible support programs to develop alternative forms of water management.	Quote cost to make technical improvements in school. Obtain advice for the project planned. Contact potential sources of financial support and check requirements for support.	Organize financial support to carry out a plan or program of technical improvement in the school's water management.	Coordinated by the parents' association, with the participation of the school's teachers and administrators.

Decrease water consumption

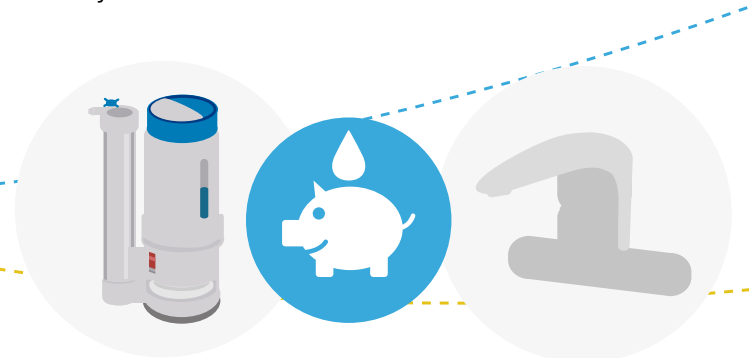
Options for reducing water consumption range from technical interventions to behavioral change. The following tips can help you create a water-saving plan in the school community. Even though this activity can be initiated and promoted by anyone in the community, experience has shown that excellent results are obtained when the plan is designed and coordinated by student groups and associations.

Emphasize the plan's objectives at your meetings and classes. Put up posters depicting your goals and your achievements.



Small technical changes

- Solve leakage problems by replacing old washers, changing or repairing small parts, or replacing whole sections of piping. For small problems, you can ask the assistance of community members or parents who know about plumbing and have the required tools. If the school conditions allow it, you can get help from a certified technician. The economic and water savings you will achieve will be worth it, as a dripping tap can waste up to 30 liters of water a day!
- Place a couple of plastic bottles (of 1 or 2 liters each) filled with sand, stones, or water inside the toilet tank if you have high-capacity toilet tanks (greater than 10 liters and usually built before 1999). By running tests to find the minimum amount of water the toilet needs to work perfectly, you can save up to 4 liters per flush. If your school has the budget, you could consider new equipment or dual flush valves, which can be adapted to any type of toilet (figure 9). Users of these valves can choose how much water to use when flushing—whether three liters for urine or six liters for solid waste.
- Place water-saving devices on taps or showers. Search for local organizations and institutions that can advise you on water-saving products. If you are unable to locate any, browse the Internet—many can be purchased and shipped to you.



- Change conventional 16-liter toilets to small 6-liter ones.
- Build dry toilets, also known as composting toilets.
- Put containers and tanks in place to collect rainwater for use in garden sprinklers or in bathrooms. Cover these containers with a fine mesh to prevent the breeding of mosquitoes.
- Install water-saving faucets in the sink, if possible. There are several different kinds—from the most sophisticated that automatically cut off water flow after a given time period, to those with a small lever at the faucet's center to adjust overall pressure (figure 10).

Figure 9. Dual flush valves

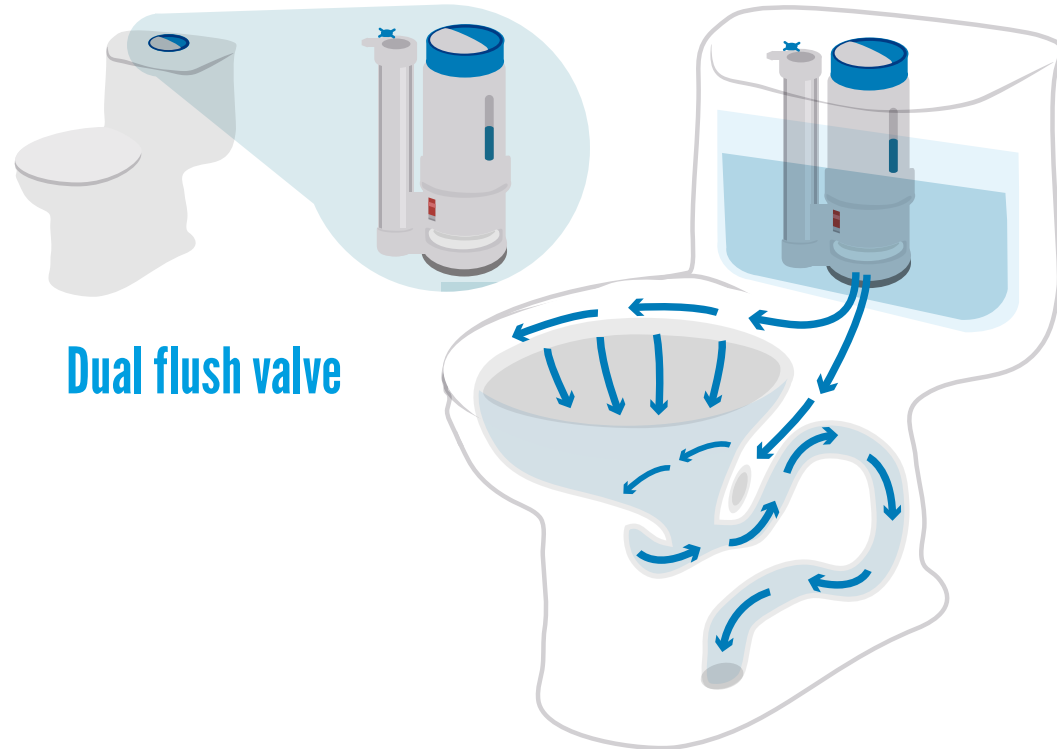
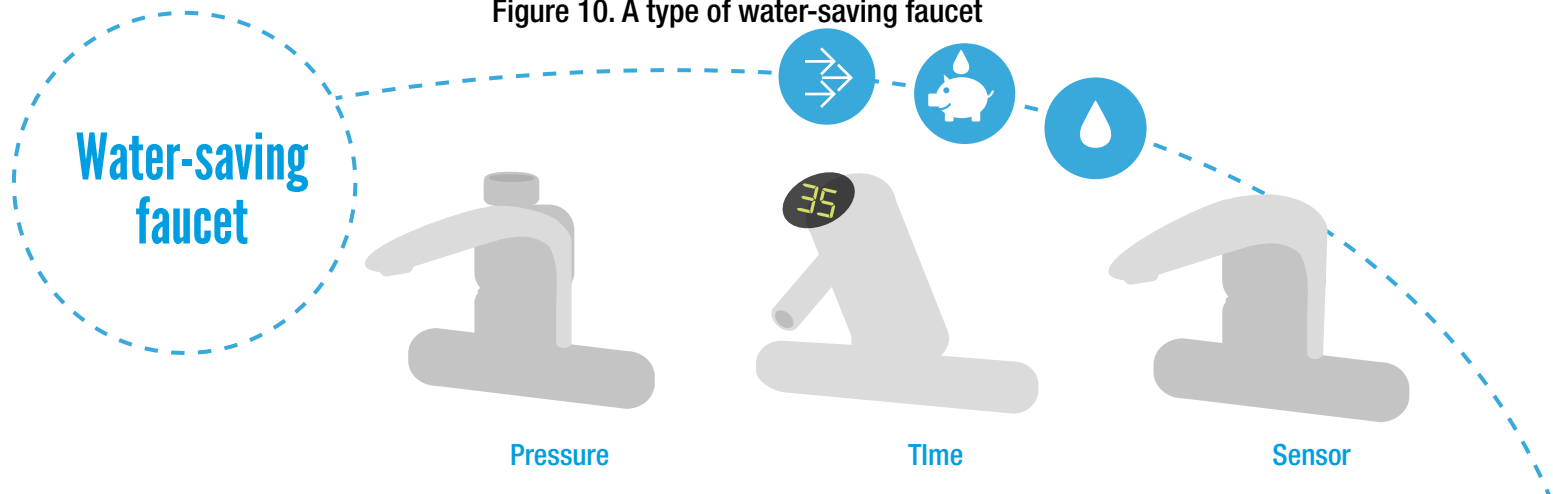


Figure 10. A type of water-saving faucet



New habits and behaviors

- Establish new ways to save water, and create posters containing this information to educate the school community. The most simple ways to achieve significant water savings include:
 - Shutting the tap while washing hands or brushing teeth.
 - Turning off the shower while soaping up. If the school offers shower facilities for athletes or workers, emphasize their role in this water-saving practice.
 - Watering gardens or filling containers in the afternoon or evening (to prevent loss by evaporation) and decreasing the frequency of watering.
 - Not using toilets as trash cans.
- Eliminate or reduce the use of cleaning products with ingredients toxic to the ecosystem. Use organic soaps and detergents that have no phosphates and, without violating any hygiene rules, use natural cleaners such as white vinegar for cleaning glass.

Adopt alternative technologies

There is a wide range of techniques and technologies to improve the way we use water—both drinking water and wastewater (gray and sewage water). Some of them (such as diffusers or low-consumption toilets) will only help you save water, while others capture rainwater. Yet others treat and make wastewater reusable. These tools range from sophisticated and high-cost products to replicas of natural ecosystems that are simple to build and maintain and much more economical.

As you read below, you will find some of the alternative techniques available to schools, and recommendations for further reading. In some cases, you will need to rely on an expert or a person with experience and knowledge from your immediate school community or locale. Basic requirements for success are available space and the will to work hard.

When this work is performed as a component of a school project involving teachers and parents as volunteers, not only is water management provided, but the cohesion of the school community and social networks is also strengthened.

Dry toilets

Although building dry toilets is not possible in all situations, they can be an excellent option in rural schools with yards, areas where water is scarce, and communities with no access to town drainage networks.

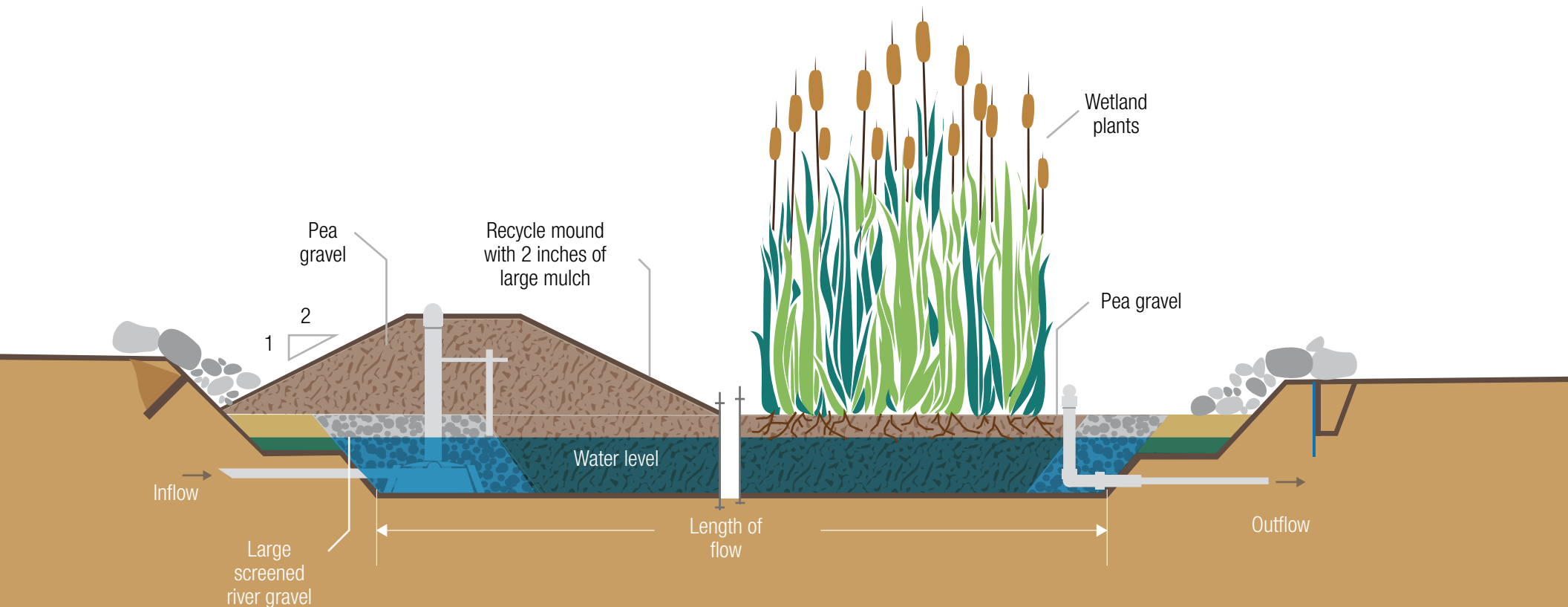
Dry toilets offer several advantages: they do not use water, do not require a sewer system, do not pollute bodies of water (because the organic material first breaks down in the decomposition chambers), can produce compost, and are easy to build and maintain. A dry toilet essentially separates solid waste from liquid. Solid waste accumulates in a treatment chamber consisting of a tank, where it is broken down slowly and eventually transformed to compost.

Artificial wetlands and biofilters

Artificial wetlands replicate the action of sewage treatment plants and the aquatic ecosystems known as wetlands (which include lakes, lagoons, rivers, marshes, estuaries, swamps, and so on). The role that these ecosystems play in the world is crucial: they are important retainers of carbon dioxide (CO_2) and they generate oxygen (O_2). Moreover, they protect many diverse creatures, serve as shock absorbers against the impact of natural phenomena such as cyclones and storms, and help filter and clean water.

There are two types of wastewater treatment devices—those that use surface flow and those that use subsurface flow. In the first instance, water flows on the surface and is exposed to the environment; in the second, water flows underground. The second option produces no bad smells, does not foster mosquitoes, and is easy to maintain. It is also the best option for a school because of the safety it affords: students are not tempted to play in the water. Just as with dry toilets, the construction of biofilters is a great opportunity for rural schools.

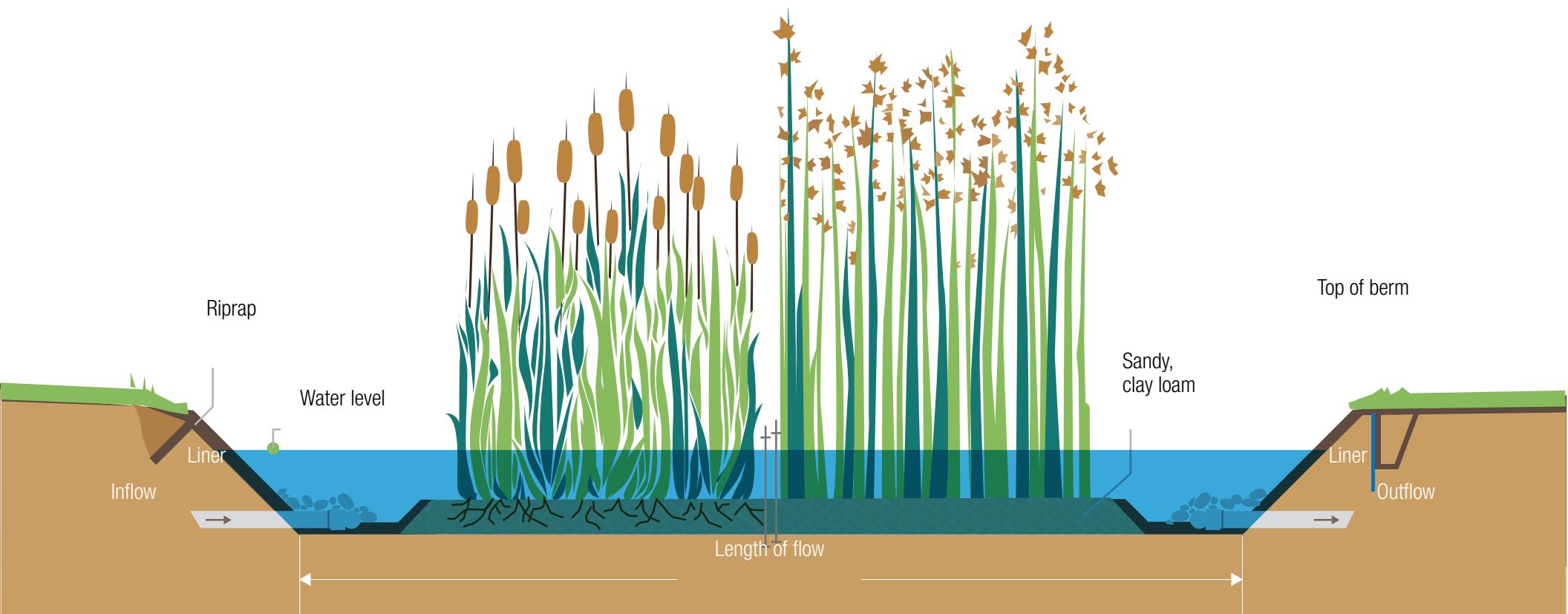
Figure 11. An artificial wetland



Building a wetland calls for certain space and soil constraints:

- Wetlands require roughly 3 square meters (m²) for every 10 users, which means that a school of 100 people would require 30m² of biogarden or artificial wetland.
- Soil that is impermeable or exposed to very high rainfall is not suitable for wetlands. Consult an expert to assess soil conditions.

Figure 12. Covered or underground or subsurface wetland



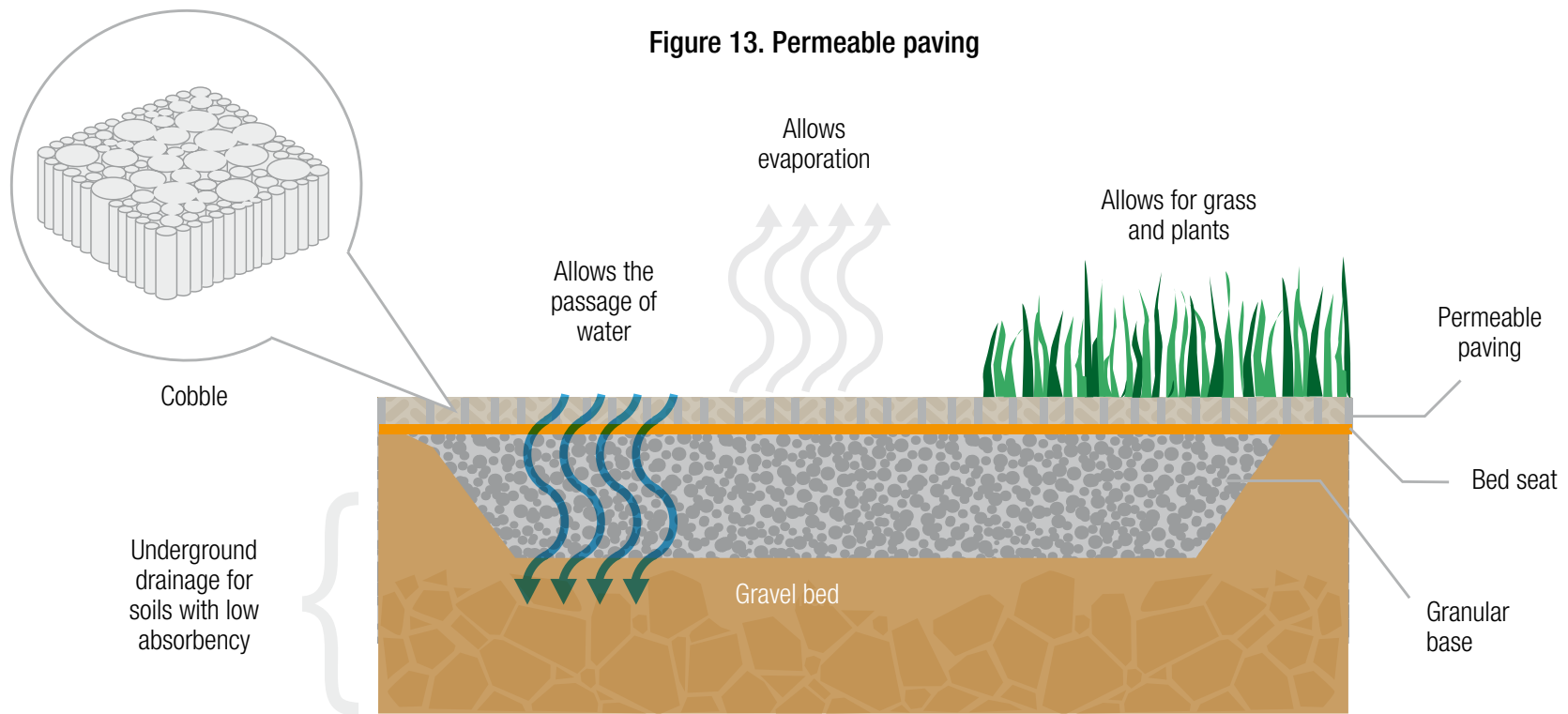
Permeable paving

The waterproofing of most current buildings requires rain water to flow into drainage systems, which prevents it from contributing to the underground aquifers. If your school has or needs to have covered soil spaces, build them with permeable paving. This allows water to pass through. This material creates a yard in areas that have to be covered with soil (useful for a play area, park, or sports court) or are used for vehicle transit, while allowing water to filter into the subsoil.

Some kinds of permeable paving must be installed by specialists; there are also options that anyone with basic building knowledge can install. Each region has its own name for such materials: cobblestone, *adob-*

loque, *adopasto*, and so on. Any construction material warehouse will give you more information.

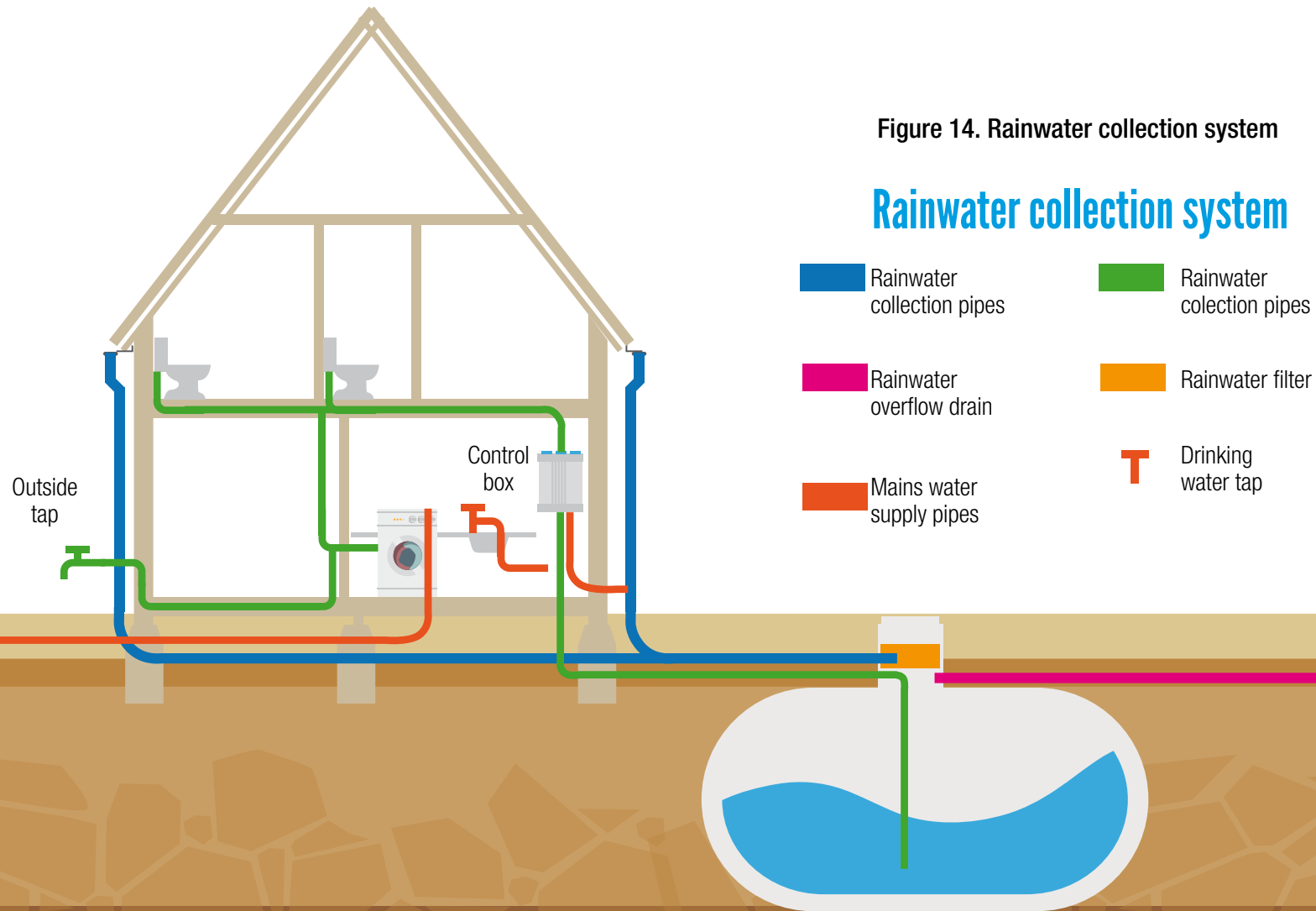
Moreover, you have to take precautions to ensure that the permeable paving is a genuinely environmentally friendly option. If the area is used as a parking area as well as a patio, drippings of oil, gasoline, and other car-related liquids could contaminate the water by seeping into the garden or water table. You must guard against this. Finally, permeable paving cannot withstand high-density traffic or heavy vehicles.



Collecting rainwater from roofs

During the rainy season, it is estimated that over 80 percent of the water flowing in drainage areas is rainwater that could be collected and used.

The catchment, or collection, of rainwater is not a new practice. In many countries, especially in urban areas where water can become scarce, people collect water for irrigation, housecleaning, and drinking. Most collection systems are simple containers placed at the end of gutters to collect the water that runs off roofs.



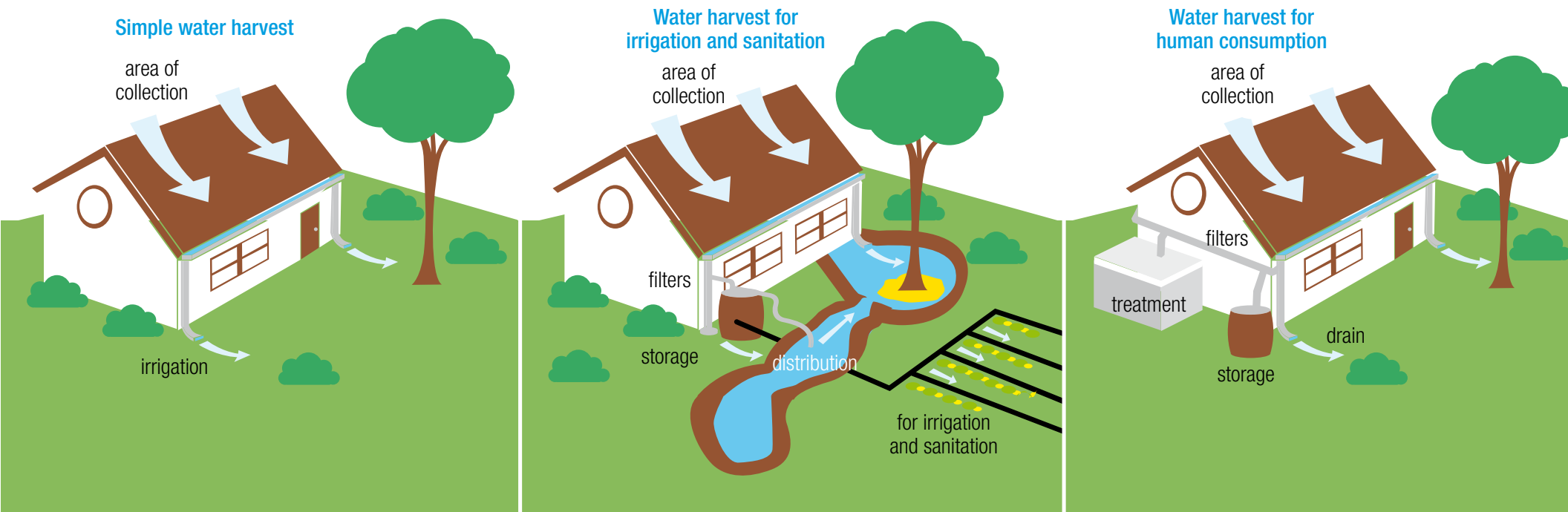
This simple and useful educational practice can decrease the pressure exerted on the area's water resources and make more gardening projects possible.

Rainwater collection can be performed through these steps:

- An analysis of conditions at the school during the rainy season: Where does the rain on the roof flow? Are there gutters to collect it? Are roofs in good condition? Is there space in the schoolyard to place large containers for collection?
- An analysis of the school's financial status to decide whether to develop a simple or complex plan to collect rainwater, based on planned water use (figure 15):

- A simple plan involves installing gutters on the roofs and directing the water toward garden areas that need more moisture.
- A complex plan can be as elaborate as the uses to which you would like to devote the water. If you want to use rainwater for irrigation or toilets, include an area for collection, piping, filtering, storage, and distribution. If you also want to use it for human consumption, you must have a treatment plant to ensure the health of those who drink it.

Figure 15. Rainwater harvesting techniques



Source: Adapted from Water Use and Conservation Bureau, *A Waterwise Guide to Rainwater Harvesting* (New Mexico Office of the State Engineer); www.ose.state.nm.us/.

Monitoring and evaluating progress

The first indication that your plan is progressing well is the water bill. Log such bill amounts monthly or as frequently as they arrive at the school.

If the school does not get water bills, you can keep a record of water meter readings. This will allow you to see how much you have spent every month and to adjust your plan accordingly.

If your consumption remains very high despite your campaigns and new technologies and techniques, you may have persistent major leaks. If so, audit the leaks.

One indicator that your plan is functioning well is a reduction in the presence of toxic cleaning products—which ensures that the water that you are sending down the drain or to a wetland contains no highly toxic pollutants.

Finally, monitor interest in participating in the project. Regularly ask participants about their experiences with the program. Ask what they would change, and what new interventions they would like to promote.

Tips for finding financial support

An important part of the research involves visiting the offices responsible for managing the water system in your hometown and asking for information (that is not possible to collect through your diagnosis) and training. These professionals can explain to you how the water system works in your town and region. Many of these institutions provide training in environmental education that might be of great help to the school staff.

These offices may also offer advice on possible funding that enables you to initiate projects and improve water management at your school. In many parts of the world, such institutions have initiated technology replacement programs for restrooms and other resource-saving devices.

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Module 5

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