earthian

Wipro's Sustainability Education Program
for Schools and Colleges

wipro

Sustainability & Water

An activity based learning

program for schools

earthian

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SUSTAINABILITY AND WATER

An activity based learning program for schools
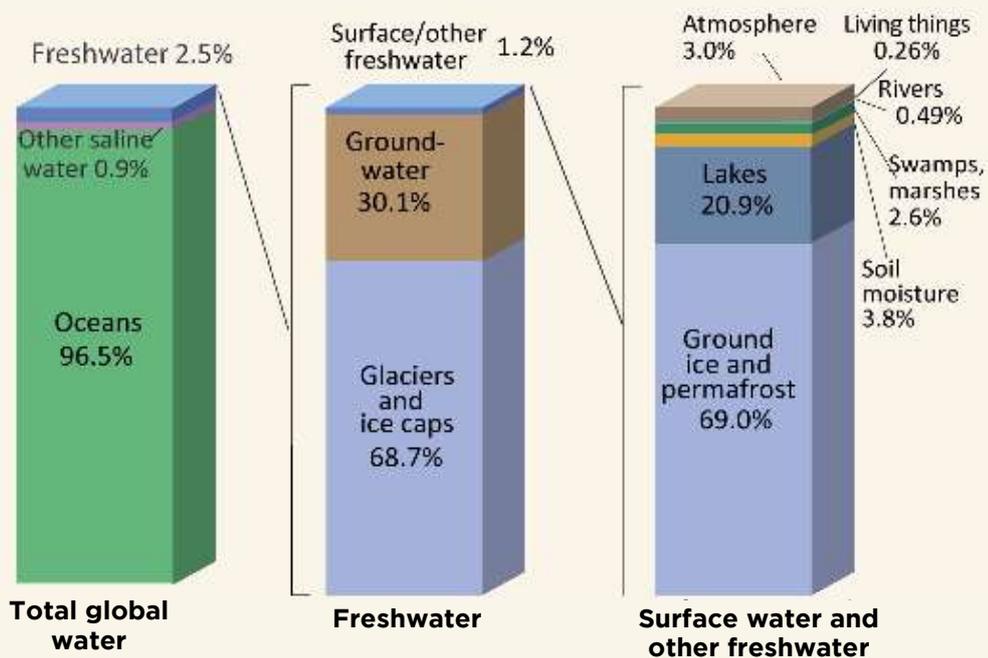
CONTENTS

INTRODUCTION

Wipro earthian is Wipro's Sustainability Education Program for schools and colleges. Through this program, we aim to help you develop more meaningful sustainablity education in your school. The objective is to provide exposure to multiple perspectives, develop an interconnected understanding of different disciplines in education and life. This will help educational institutions, their educators and students to make more informed choices about their lives and society. As a part of this, we invite you to form teams and participate in this learning program. The theme for this program is **'Sustainability and Water'**. Based on the submissions, the best entries will be selected for the earthian award.

WHY WATER?

Clean and reliably available fresh water is fundamental for human life, the economy and the ecosystem. **Only 2.5% of the world's water is fresh water, which must meet the needs and demands of 7.8 billion people, a population which is increasing further.** The demands are varied, ranging from agriculture and domestic use to energy generation and industry. Access to clean and safe water for drinking and sanitation purposes is still a problem for large segments of the global population.

BREAKDOWN OF EARTH'S WATER RESOURCES

Freshwater 2.5%

Other saline water 0.9%

Oceans 96.5%

Total global water

Surface/other freshwater 1.2%

Ground-water 30.1%

Glaciers and ice caps 68.7%

Freshwater

Atmosphere 3.0%

Living things 0.26%

Rivers 0.49%

Swamps, marshes 2.6%

Soil moisture 3.8%

Lakes 20.9%

Ground ice and permafrost 69.0%

Surface water and other freshwater

Only 0.49% of surface freshwater is in rivers, from where humans get a large portion of their water from.

Source: water.usgs.gov

Although water has the potential to be a renewable resource, there are many places around the world where human use is not sustainable. In some places, **over-extraction of water is lowering water tables and depleting aquifers.** In other places, **water pollution is making stocks unusable.**

Water management today is also **faced with new challenges brought about by climate change.** Increasing changes in rainfall patterns, frequent floods and droughts across the globe have led to various problems such as **environmental degradation, water scarcity, migration and violence within and between countries.**

CLIMATE CHANGE AND WATER

Increased greenhouse gases in the atmosphere from **human activities result in climate change and ocean acidification.**

There has been an increase of just under 1°C in the earth's temperature in the last 400 years. **This temperature is projected to rise by over 3°C by the end of this century.**

Nearly all regions of the world are **expected to experience a net negative impact of climate change on freshwater ecosystems. These changes will lead to water shortage**, threatening the lives and livelihoods of millions of people.
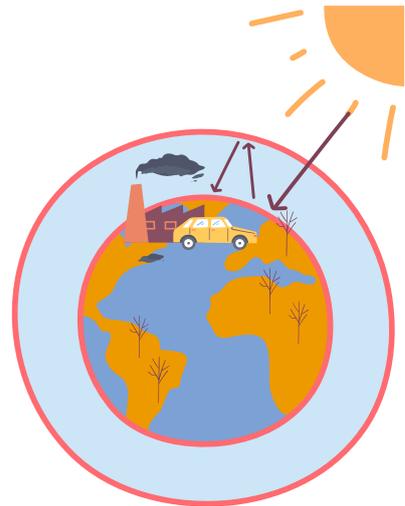
Increase in sea levels and melting of glaciers	**Increase in land temperatures, droughts and heat waves**	**Increase in frequency of natural disasters**	**Loss of wetlands, destruction of aquatic life and coral reefs**

Prediction is difficult not only because we have to understand how earth's systems work but we also need to predict what people will do. Will we continue to burn more fossil fuels as we have in the past, or will we change our industrial methods?
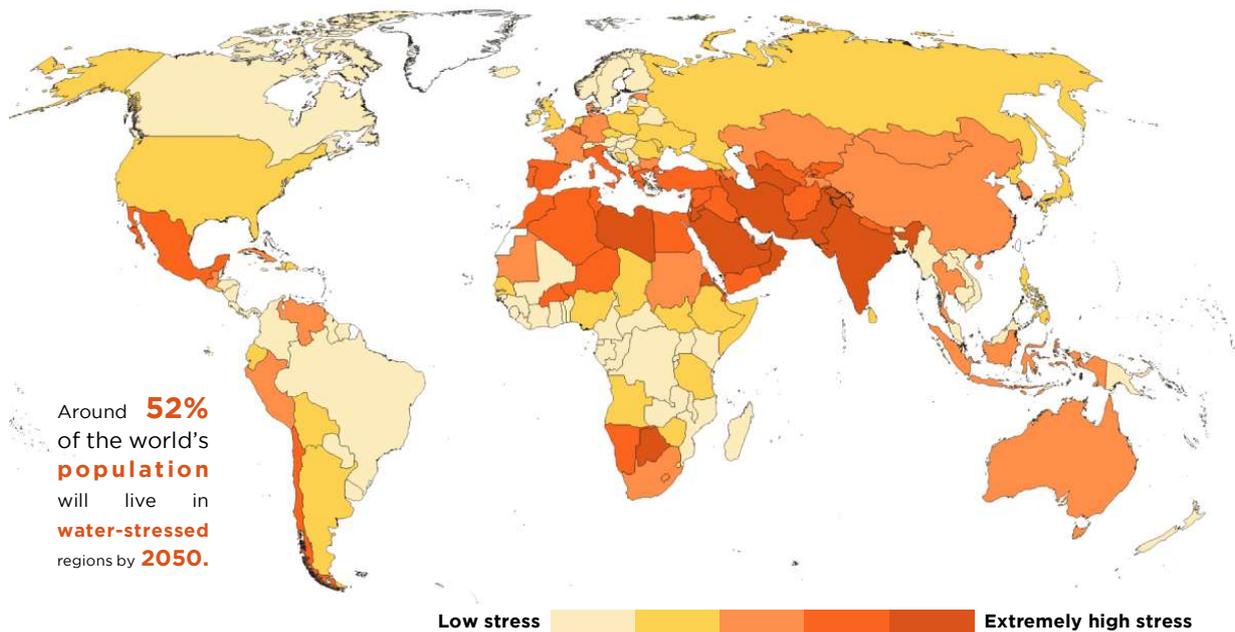
Across the globe, innovators are racing against time to come up with new sustainable solutions. To strengthen the global response to the threat of climate change, the **Paris Agreement** was signed on 12 December 2015, bringing together many nations in the common cause to combat climate change and adapt to its effects. All these nations agreed to work to limit global temperature rise to well below 2 degrees centigrade. Find out more at **https://www.un.org/sustainabledevelopment/climate-change/**

WATER DEMAND AND WATER STRESS

Currently, we are taking water out from aquifers faster than it gets recharged through natural hydrological cycles. This unsustainable human use is causing groundwater depletion. Water use has also been growing at twice the rate of population increase.

While the global supply of available freshwater is more than adequate to meet all current and foreseeable water demands, its distribution is unequal around the world.

WATER STRESS BY COUNTRY

Around **52%** of the world's **population** will live in **water-stressed** regions by **2050.**

Low stress   Extremely high stress

Source: World Resources Institute's Aqueduct Water Risk Atlas

Access to clean drinking water sources, and water for proper sanitation and good hygiene – known collectively as WASH – has been recognised as a basic human right by the United Nations. Lack of these leads to unsafe hygiene practices, and has severe socio-economic impacts, particularly for women and girls.

WATER POLLUTION

Water depletion and pollution are the major causes of **biodiversity loss and ecosystem degradation**, which in turn will **directly affect societies' resilience to climate risks.** Both industrial and agricultural processes contribute to pollution through discharge of untreated wastewater, sewage and effluents, which adversely impacts health and development. Poor water quality also restricts its use, aggravating the situation.

WATER RESOURCES–SITUATION IN INDIA

India has a long and rich tradition of water conservation and management. Almost every region in India has unique traditional water harvesting systems that have helped manage water resources sustainably.

Now, increasing population and economic demands are putting stress on both groundwater and our rivers. **The per capita water availability in the country has decreased from 1816 cubic metres in 2001 to 1544 cubic metres in 2011.** An area is said to be experiencing "water stress" if available freshwater is below 1700 cubic metres per person per year.

Water stress index
Renewable fresh water (m3/person/year)

>2500	ok
2500 - 1700	water vulnerable
1700 - 1000	water stress
1000 - 500	water scarcity
<500	absolute water scarcity

India is ranked 13th among the world's 17 'extremely water-stressed countries' and has more than three times the combined population of the other 16 countries in this category.

WATER STRESS BY INDIAN STATES

Low stress

Extremely high stress
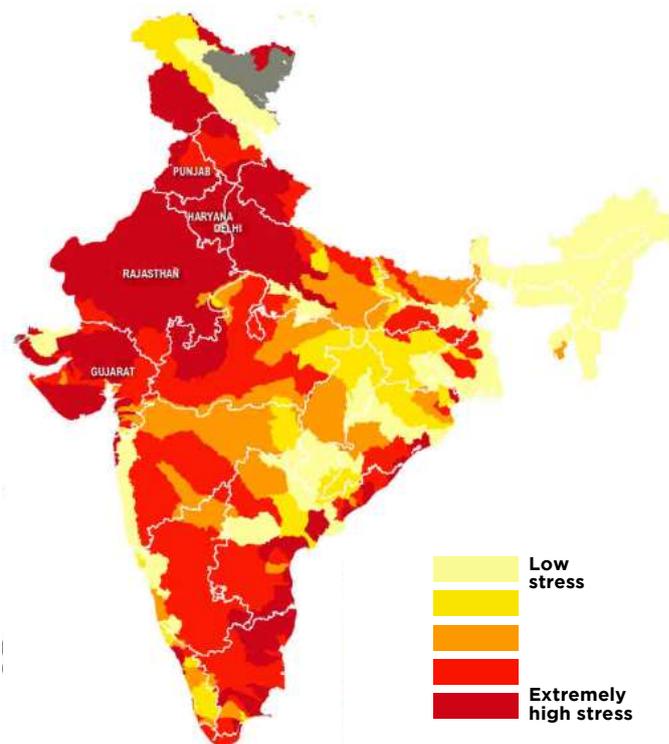
600 MILLION PEOPLE
face high to extreme water stress in India

75% of all households **do not have water on the premises**

70% of all the country's **water is contaminated**

54% of all the **groundwater is declining faster** than it is being replenished
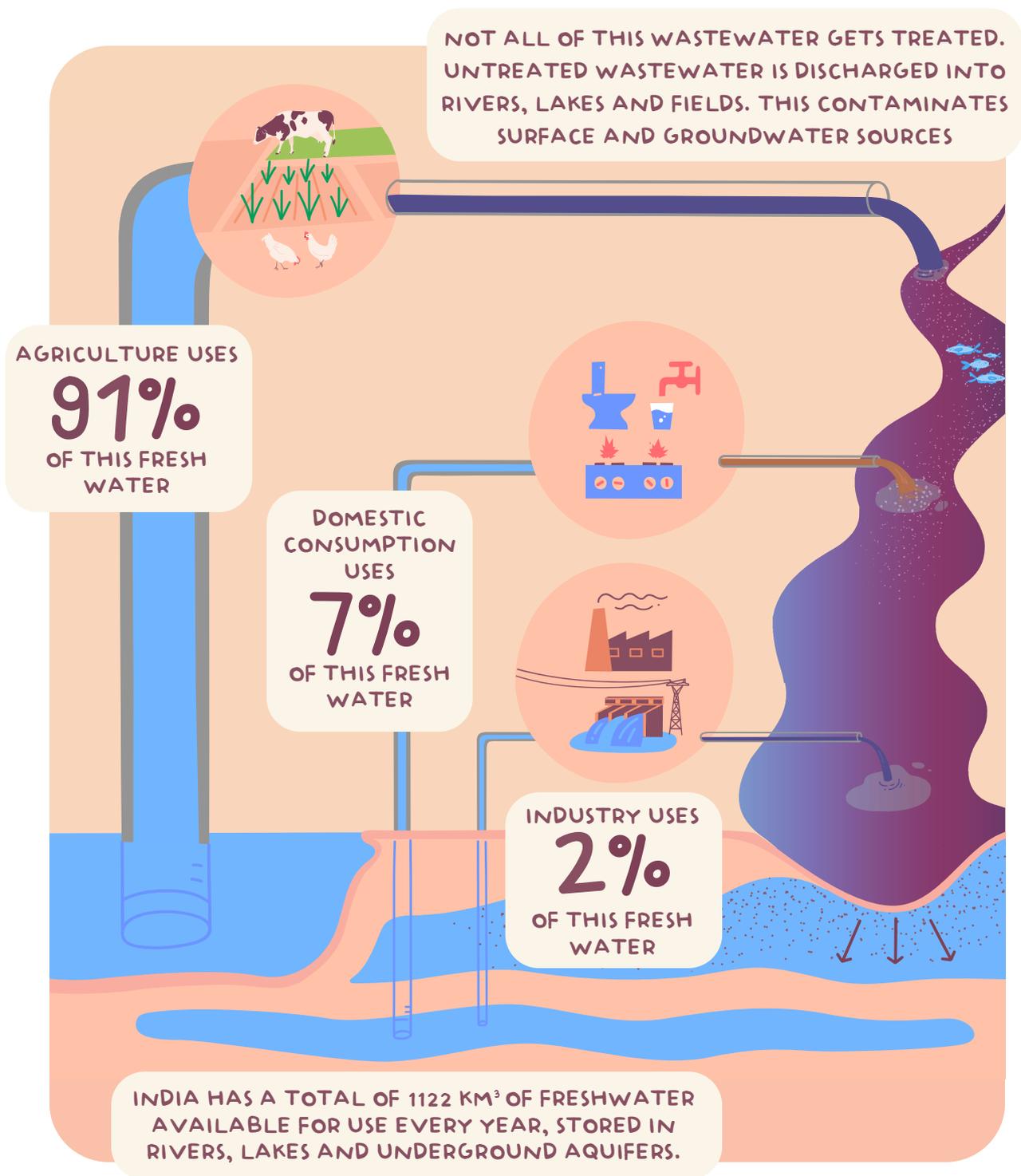
100s of small and seasonal rivers **are vanishing permanently**

12% of India's geographical area **is flood prone**

28% of India's geographical area **is drought prone**

7516 kilometres of India's coastline **is exposed to nearly 10% of the world's tropical cyclones**

Source: World Resources Institute. National Water Mission. NITI AYOG.

NOT ALL OF THIS WASTEWATER GETS TREATED. UNTREATED WASTEWATER IS DISCHARGED INTO RIVERS, LAKES AND FIELDS. THIS CONTAMINATES SURFACE AND GROUNDWATER SOURCES

AGRICULTURE USES
91%
OF THIS FRESH WATER

DOMESTIC CONSUMPTION USES
7%
OF THIS FRESH WATER

INDUSTRY USES
2%
OF THIS FRESH WATER

INDIA HAS A TOTAL OF 1122 KM³ OF FRESHWATER AVAILABLE FOR USE EVERY YEAR, STORED IN RIVERS, LAKES AND UNDERGROUND AQUIFERS.

Source: Water withdrawal by sector. FAO.org, 2010

To mitigate the hardships of water stress, the Central Government has introduced several flagship programmes including the **Nal Se Jal (Jal Jeevan Mission)** to provide piped water supply and **Swachh Bharat Abhiyan** for a clean and open defecation free India, **Namami Gange** aims at the conservation of the River Ganga. Civil society groups are also working towards water management in their villages/cities and many interventions have been successful, which we will explore through this booklet.

STRUCTURE OF THE BOOKLET

PART A

COMPULSORY ACTIVITIES

INTERVIEWS

WATER AUDIT

RAINWATER HARVESTING POTENTIAL

BUILD TO LEARN

CASE STUDIES

ELECTIVE ACTIVITIES

WATER QUALITY

HIDDEN WATER IN OUR FOOD

COMPARING SCHOOL CAMPUSES
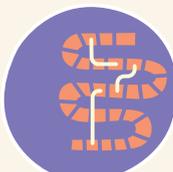
PLAY A GAME

PART B

COMPULSORY ACTIVITIES

THE WORLD OF WATER

STRUCTURE OF THE ACTIVITIES

All activities have 4 components:

OBJECTIVES tell you why you are doing an activity and what might be learned from it

INSTRUCTIONS tell you how to do the activity

RESOURCES provide you with tips and assistance to help carry out the activity. The formats shown under Resources are optional. You are welcome to present the information in a style of your choice, but observations and data need to be recorded.

REFLECTION is an important part of the learning experience. Use the questions to discuss, connect with, and explore issues beyond your immediate environment. You can also use the leading questions to

- Ponder on the observations and data collected during the activity

- Discuss with people from a wide range of backgrounds such as teachers, classmates, scientists, writers, naturalists, historians, forest officers, parents and grandparents, and experts from government institutions and universities

PARTICIPATION GUIDELINES

SCORING PARAMETERS PART A totals to 60% and PART B to 40%.

40% PART A COMPULSORY

40% PART B COMPULSORY

20% PART A ELECTIVE
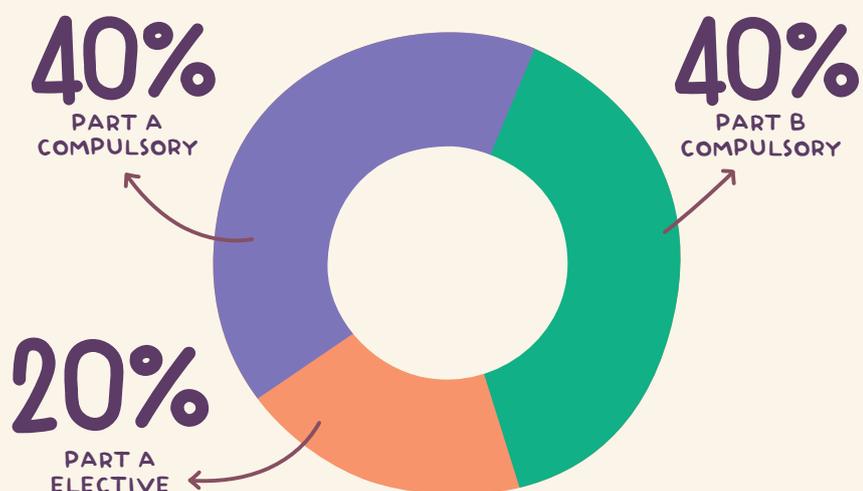
EVALUATION OF SUBMISSIONS

The submissions to Wipro earthian will be judged based on a broader approach as deemed appropriate by the jury.

IT WILL BE BASED ON HOW GENUINELY THE ACTIVITY WAS DONE, THE COMPREHENSIVENESS AND CREATIVITY IN DOCUMENTING THE ACTIVITIES, THE ABILITY IN SEEING AND DRAWING THE BROADER CONNECTIONS WELL.

To give you a sense of direction and clarity we are listing a few key evaluation criteria. Do not blindly go by these alone and pay attention to the broader approach as mentioned above.

- **Genuineness in doing the activity** as displayed in the details in the documentation: observations recorded, the data provided and other evidence of having done the activity.

- **Creativity in documentation.** Usage of multiple formats and ways and methods of reporting that are woven together well into a whole. See the following page (specific pointers for Part A & B) where some ideas for documentation are given.

- Beyond just the data presented, **a sense of having understood the problems well**, as displayed in the documentation, is important.

- How well the activities done have been **connected to each other.**

- How well the connections to other issues have been drawn to expand the **understanding of sustainability.**

- How well the **different perspectives of the issues raised in Part B have been understood**, thought through and presented.
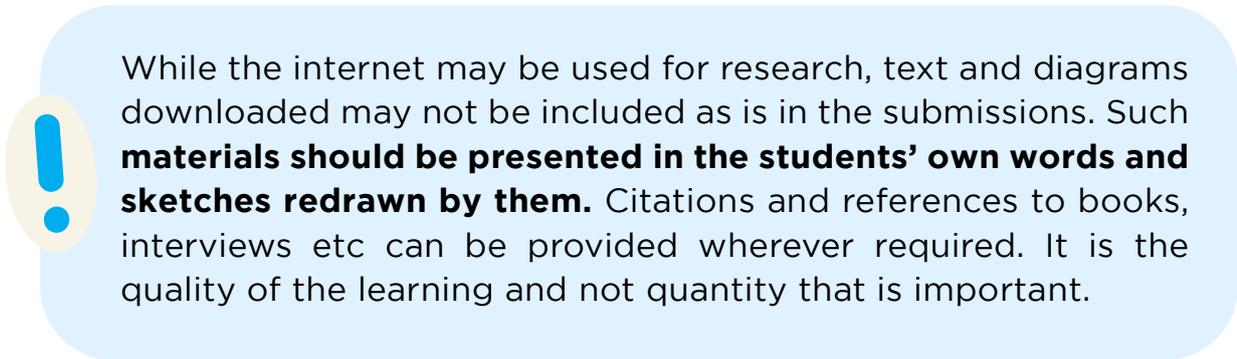
> While the internet may be used for research, text and diagrams downloaded may not be included as is in the submissions. Such **materials should be presented in the students' own words and sketches redrawn by them.** Citations and references to books, interviews etc can be provided wherever required. It is the quality of the learning and not quantity that is important.

SPECIFIC POINTERS FOR PART A

Part A can be made attractive, fun and engaging by using different tools or presentation formats.

Present observations, data and your experiences during the activity **as a narrative.**

Observations can be presented as short **poems, couplets, or haikus.**

Illustrate with **sketches, paintings and cartoons** to highlight something visually interesting.

Take **photographs or video screenshots** and paste them in the report at appropriate points.

Use **data charts / graphs and other such visuals** to present the data attractively.

Any other creative/innovative method of presenting the report as you choose.

You are required to complete only one of the two electives described under the 'Part A Electives', whereas all the five activities under 'Part A Compulsory' need to be completed.

SPECIFIC POINTERS FOR PART B

Part B requires a different approach from Part A. The purpose of part B is to connect what you learn about water in Part A to the local context and to other domains.

There are indicative questions given in Part B for you to explore. They are only to assist you to learn. The questions raised aren't easy to answer, and don't have a straightforward or correct answer.

The teacher coordinator could play a key role in facilitating this exercise, making sure that the team covers a wide range of views and provides sufficient data points to support their arguments.

Connect your understanding of water to other areas like:

Climate change

Agriculture, food security and health

Energy

Biodiversity and ecosystem loss

Biodiversity dependent livelihood Issues

Relationship with local communities

Indigenous culture and practices

Conservation and adaptation measures

And more...

Reflections will help you in the activities of Part A and Part B. We encourage you to document them in any format (written, audio or video) of your choice and share them with us.

APPROACHES TO PART B

There are two approaches the teams can adopt to answer Part B. Read the complete section thoroughly and then choose either, or a combination of the two approaches in framing the submission.

DEPTH:

For example, one team may decide that they want to focus on the question of rainwater harvesting practices and take up all questions related to that, such as their design, pros and cons, value addition to water management compared to other systems, their geographical relevance to your city/town/village and how it will help solve water shortage issues.

BREADTH:

For example, another team might want to focus on water equality within their city/town/village. They would focus on population and water demands, understand usage patterns and statistics. They might find issues linked to their water supply source and groundwater usage and link it to environment degradation, influence on health and economy. They might further look at greywater and sewage treatment facilities, energy consumption, revenue loss due to water loss, influence on culture, traditions, health and corruption.

The answers to questions given in Part B are not for submission. The essay should let us know in your own words what your learning has been, which will not be possible by merely giving answers to the questions that are provided for guidance.

GATHERING DATA

1° **PRIMARY DATA** is data that has been collected from first-hand experience. Example: rainfall data that you have obtained from a rain gauge built by you.

2° **SECONDARY DATA** is data that has been collected from a source that has already been published in some form. Example: rainfall data sourced from the meteorological department.

ROLE OF THE TEACHER

GUIDE TEAMS BY:

1. **Providing general guidance**

2. Helping students connect the activities with what they study in dass and also foster skills of collaboration, enquiry and empathy.

3. **Facilitating discussions and group reflection sessions so that everyone can share what they understand, raise questions and together think through what needs to be done. Each activity has leading questions to start off the reflection. Apart from adding your points for the students to reflect on, encourage them to come up with their own views and questions.**

4. Encouraging them to talk to their friends, teachers, school administrators, friends and family to get as many perspectives as possible.

5. **Building connections to subjects/topics learnt in class, as this will not only help with building a strong understanding, but give clues leading to more reflection. This will come in handy for all activities and Part B of the submission.**

TEACHERS AS MENTORS AND GUIDES SHOULD HELP STUDENTS CREATE THEIR MATERIALS BUT MUST RESIST FROM WRITING OR DRAWING FOR THEM.

SOURCES OF INFORMATION

NEWSPAPERS, RESOURCE BOOKS, PUBLISHED PAPERS

DEPARTMENTS OF PUBLIC WATER RESOURCES

EXPERTS

INTERNET

POINTS TO REMEMBER

1. While trying to make the documentation creative, please **do not forget the core tasks/requirements as outlined in Parts A and B.**

2. **Attempt two elective activities** out of the four mentioned here in the activity book.

3. Remember to **capture as much data as possible** from reflections.

FREQUENTLY ASKED QUESTIONS

How much time will this require?

Ideally, Part A activities and documentation should take each team around 3 - 4 weeks, requiring approximately 2 - 3 hours a week. Teachers can assist teams in getting free time from classes to do these activities. The Part B write-up requires research and discussions. Research work can be done in free periods or outside of school hours by taking the help of teachers and parents.

How is this useful?

This program is designed as a project-based learning activity and has topics that can be connected to the regular school syllabus. Hence the work done here **can be considered for the CCE (Continuous and Comprehensive Evaluation) within the school curriculum.**

Participation in Wipro earthian program will help strengthen the concepts in science and social sciences. It will also help with development of language. It also provides the teacher and students **opportunities for developing important skills like teamwork, observation, recording, documentation, research, analysis, synthesis, reflection, writing, creative writing and design.**

UNDERSTANDING WATER IN OUR ENVIRONMENT

INTERVIEWS

WATER AUDIT

CASE STUDIES

BUILD TO LEARN

RAINWATER HARVESTING POTENTIAL

INTERVIEWS

An interview is a conversation for gathering information, involving an interviewer and an interviewee. By talking to people/organizations who work with water resources and management, students can collect in-depth information on people's opinions and experiences, and enquire into on-ground issues and solutions.

Students are required to conduct a minimum of 3 interviews, one each with people from different professions as listed in the Resources section. There is no upper limit but we encourage the students to drive the interviews themselves, and gain enough insight for reflection.

OBJECTIVES

To understand

- **relationship between water and livelihoods**
- the importance of the **attitude of people towards water use and conservation**
- the impact of growing **agricultural and industrial demands on water** resources
- the factors involved in **water conservation and management**

INSTRUCTIONS

BEFORE INTERVIEW

1. **Identify people to speak to** (see the suggested list of people in the Resources section and choose people from different categories).

2. Discuss amongst yourselves what you know/don't know about the professions, so you understand what questions need to be asked.

3. **Prepare a set of questions you'd like to ask.** Make sure they are framed meaningfully and are asked in a way that does not affect the sensitivities of the respondent.

SUGGESTIONS FOR PREPARING A QUESTIONNAIRE
- Name, job role and years of experience
- Local or migrant from another region - difference in work conditions (only where relevant)
- Work methods and processes
- Changes seen over time; causes and effects of the change
- Impact of these changes personally and for the environment
- Attitudes of people towards their work
- Their views on environmentally friendly practices and reasons for adopting or not adopting such practices.

Keep the questions open-ended. For example: "Is the water quality good?" is a restrictive question that can be answered with a 'yes' or 'no'. Instead ask "What are the changes you've noticed in water quality?"

Note: Teachers should go through the questions prepared by the students to ensure they are framed meaningfully and don't affect the sensitivity of the respondent.

4. **Do a role play interview.** Assign characters from the interview, get into character and act it out.

5. With the help of your teacher, contact the groups to be interviewed and **arrange for a visit.**
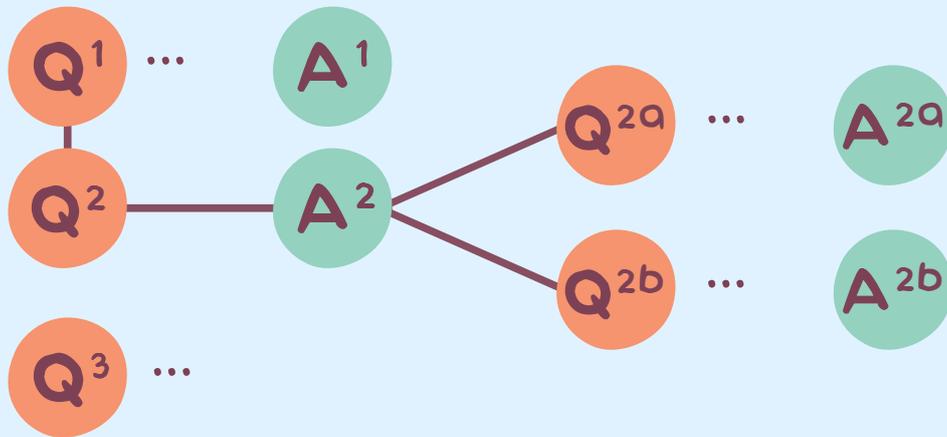
DURING THE INTERVIEW

6. **Introduce yourself**, and let the interviewee know the purpose of the interview. Start by asking questions about the respondent's name, their job role and years of experience in the profession.

If you plan to record on camera, ask for permission before taking photos/videos of the interview.

7. Listen carefully and take time to make sure and **write down exactly what the person says.**

BE SEMI-STRUCTURED WHILE ASKING QUESTIONS

Have a set of questions prepared, but feel free to ask new questions based on the responses received. Do not deviate too much from the main objective.

AFTER THE INTERVIEW

8. Make sure the interview was properly recorded. Make additional notes, if needed.

9. Organize your data and list down what you learnt from the interview. Have a reflection session, and **share a report of your findings**.

Dos

- Conduct interviews as a team of three, with a clear role for each team member (i.e. interviewer, note-taker, photographer).

- Conduct your interviews in the interviewee's space, and talk to them where they live or work.

- Ask the respondent to show you the things they interact and work with, wherever relevant.

Don'ts

- Do not ask questions that can be answered with a 'yes' or 'no', which will generate no information.

- Do not jump to fill in silences. Wait a little longer, so as to hear stories from the respondent.

- Do not insist if the respondent is unwilling to answer.

🔑 RESOURCES

LIST OF POSSIBLE PEOPLE TO INTERVIEW

There are various professions that are related to water management, and different types of water users, some of whom have been listed below. Choose people from different categories for conducting the interviews.

1. **Service providers** - Well diggers, borewell diggers, plumbers, sanitation workers

2. **Scientific organizations/experts** - Hydrologists/ hydrogeologists, water quality labs, NGOs and activists working on water conservation

3. **Water users** - Family members, commercial users, farmers, fishermen

4. **Water resource departments** - Personnel who work with various state/city/panchayat water departments

SAMPLE QUESTIONNAIRES

The objective of this activity is to understand how issues of water are closely linked to sustainability, social contexts and livelihood. These are questions only to help aid the process. Students should come up with more questions on their own, for each category.

WELL DIGGERS

1. How did you get into this profession and how long have you been in it?

2. Do you have any financial concerns? How do other people and your children view your work?

3. What are the changes you have seen over time, in the quantity and quality of groundwater?

4. What are the challenges in your work, and what is the help you seek from the government and citizens to help address them?

Key points: Well digging, livelihood, groundwater, water scarcity

NGO/ECOLOGISTS/ACTIVISTS INVOLVED IN WATER CONSERVATION

1. What is the nature of your work with issues related to water?

2. What is the status of the local water resources, and what have been the changes over time?

3. Can you tell us about any successful projects that have addressed these issues? What are the challenges faced during implementation?

4. How has your organization engaged with the local community for conservation and rejuvenation of water resources?

Key points: Status of local water resources, water pollution, community engagement, water supply and conservation

FAMILY MEMBERS (PARENTS /GRANDPARENTS/ AUNTS & UNCLES)

1. Have there been any changes in the quality and quantity of water supply over time?

2. Has your consumption of water increased or decreased over time? Why?

3. What are the ways by which you can decrease your usage and conserve water in your home?

4. Do you have any festivals celebrating the importance of water in your lives? Can you tell us more about these festivals?

Key points: domestic consumption of water, patterns of usage, minimising water use, significance of water in communities

MUNICIPAL BODY FOR WATER SUPPLY OR WATER BODY REJUVENATION

1. What are the roles and responsibilities of your organization?

2. What are the different careers/job roles within the water department?

3. What are the existing policies for integrated water resource management?

4. What is the status of the local water resources? What are the major issues faced by them?

Key points: Policies on water, status of local water resources, water pollution, different job roles, water supply and conservation

REFLECTION

- Have there been noticeable changes in attitudes of people towards water use and conservation?

- Have sustainable practices been implemented for conscious use of water resources?

- Does livelihood generation in fishing/farming/tourism etc. contribute to deterioration or improvement of water ecosystems?

- Which categories of interviewees did you find were the most conscious of the need for water conservation? Why?

WATER AUDIT

A water audit is an assessment of how much water is used, with details on different usage points and wastage. It is useful to understand how a school's water system is managed, to achieve the most efficient utilisation of existing water resources on campus. It will also create awareness on simple conservation methods such as fixing leaking taps and turning off taps while soaping hands.

The students are required to map the flow of water on their school campus, and identify points of water source, usage and disposal. They will also calculate total monthly water consumption, and identify points where water can be conserved, recycled and reused.

OBJECTIVES

- To understand **the flow of water on campus** (points of origin and storage of water, points of use and disposal)

- To collect and analyse data on water and understand **how water is being used currently**, as well as identify **points where water can be conserved/usage be minimised**

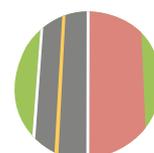- To understand **impacts of inefficiencies in water usage**

INSTRUCTIONS

MAP THE FLOW OF WATER ON CAMPUS

1. **Draw a map of your school campus** showing
   - Buildings (classrooms, labs etc.)
   - Paved surfaces (pathways, courts etc.)
   - Open areas (grounds, gardens etc.)

BUILDINGS   PAVED AREAS   OPEN AREAS

2. **Identify support staff** (cleaning, security, administration) that is responsible for

   - Ensuring supply and storage of water

   - Cleaning and maintenance of water tanks and pipes, checking and repairs of leakages

   - Monitoring of water use on campus (recording quantity of usage, bill payments)

   Talk to them to understand water management.

3. Mark locations on the campus drawing to **indicate different points of water source, storage, use and disposal.** Use 'components of a water system' to tick points relevant to your campus.
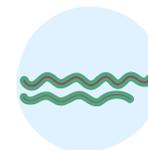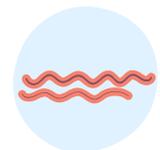
   WELL   WATER DRUMS   SEWAGE

4. Draw lines connecting these points to **indicate the flow of water, from origin to use and disposal.** If there is any reuse or recycling of water, indicate those on the map.

   FRESH WATER SOURCE   FRESH WATER DELIVERY   GREY/BLACK WATER

IDENTIFY CONSUMPTION PATTERNS AND CALCULATE USAGE

5. From your map, identify all the locations of usage. **Estimate the amount of water used** for different purposes at all these points. You can use the 'water usage estimation tables' as an aid to calculate the total monthly consumption.

   GARDENING   HAND WASH   DRINKING WATER

6. Check if there are water meters at any points and get the readings/ data from the administration. Write down figures in kilolitres (kl).

7. Based on data collected, **calculate individual per capita consumption.** Include all people, including students, teachers, administration and non-teaching staff in the total school population.

8. **Analyse how the school can reduce its overall consumption** and conserve water.

01.
Draw buildings on your school campus

02.
Show paved surfaces (pathways, parking etc.)

03.
Show open areas (gardens, grounds, mud roads etc.)

OVERHEAD TANK

CLASSROOM BLOCK

WATER USE

OVERHEAD TANK

CLASSROOM BLOCK

DINING HA

PERFORMANCE AREA

UNDERGROU SUMP

SCHOOL GROUND

OVERHEAD TANK

KINDERGAR

PARKING

WASHING VEHICLES

STORM WATER DRAIN

UNDERGROUND SEWAGE DRAIN
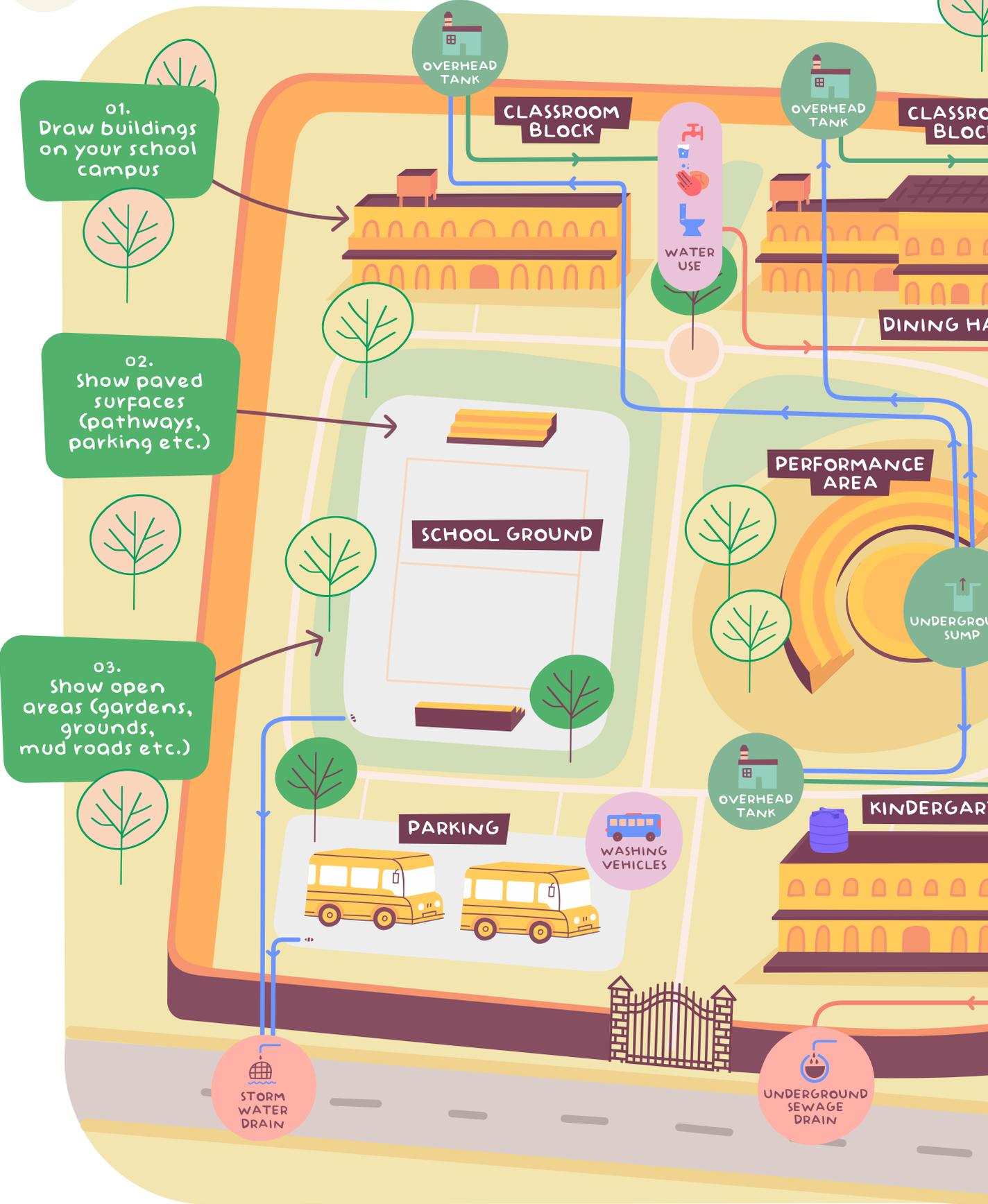
MAPPING FLOW OF WATER ON CAMPUS
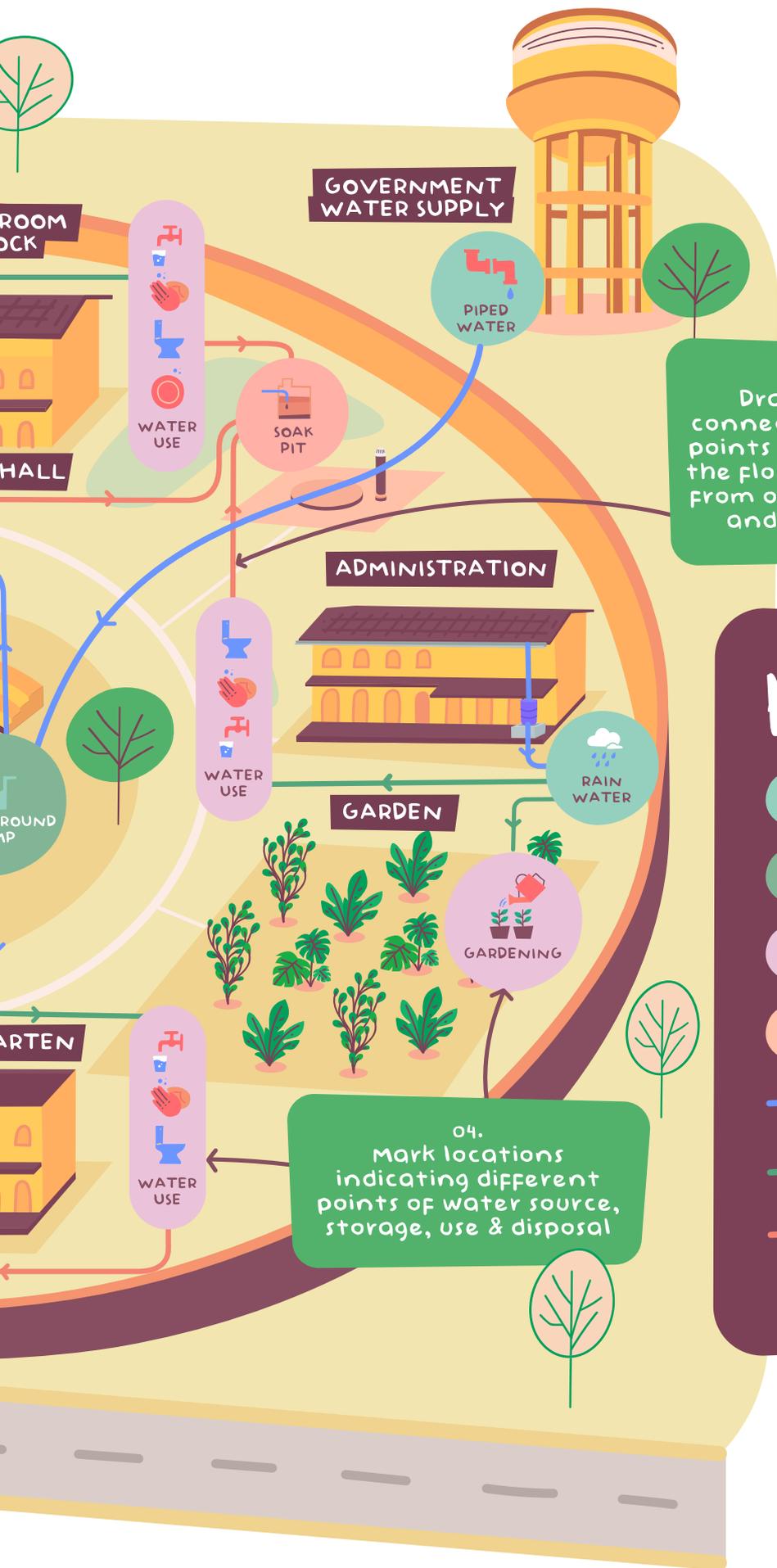
GOVERNMENT
WATER SUPPLY

PIPED
WATER

WATER
USE

SOAK
PIT

...ROOM
...CK

...HALL

ADMINISTRATION

WATER
USE

RAIN
WATER

GARDEN

GARDENING

...ROUND
...MP

...ARTEN

WATER
USE

06.
Make a key to
explain symbols
used on the map
and what they
mean

05.
Draw lines
connecting these
points to indicate
the flow of water,
from origin to use
and disposal

KEY

⬤ SOURCE

⬤ STORAGE

⬤ USE

⬤ DISPOSAL

— WATER SOURCE LINE

— WATER USAGE LINE

— WASTEWATER
DISPOSAL LINE

04.
Mark locations
indicating different
points of water source,
storage, use & disposal

N

NOT TO SCALE

COMPONENTS OF A WATER SYSTEM

Here are some possible types of source, storage, use and disposal that you may find on your school campus. Use relevant icons on your map.

SOURCE

BOREWELL	WELL	COMMUNITY TANK	BOTTLED WATER
RIVER	RAIN	WATER TANKER	PIPED WATER

STORAGE

OVERHEAD TANK	UNDERGROUND TANK	WATER DRUMS

USAGE

TOILETS	HAND WASH	MOPPING FLOOR	WASHING VEHICLES
WASHING DISHES	COOKING	DRINKING WATER	GARDENING

DISPOSAL

UNDERGROUND SEWAGE DRAIN	STORM DRAIN	SOAK PIT	SEWAGE TREATMENT

CALCULATING WATER CONSUMPTION ON CAMPUS

Total water consumption of the school should be estimated by adding water consumption at various usage points. This should be compared with the water supplied from the source or storage points.

Table 01 can be used as an aid to calculate the total water drawn from various sources, for a period of a month. If you don't know how much water is being pumped from the source, check the total capacity of the storage it fills along with the total number of times it is filled in a month. Fill in the details in Table 02.

Table 01 Quantity of water drawn from various sources

Source	Volume of water sourced in a day (kl)	Number of days in a month when water is sourced	Total quantity of water sourced per month (kl)
Borewell			
Well			
Water tanker			
Piped water			
Rain			
Bottled water			
Others			
Total quantity of water sourced per month (kl)			

Table 02 Quantity of water calculated from storage capacity

Source	Volume of water stored (kl)	Number of times it is filled in a month	Total quantity of water per month (kl)
Underground tank			
Overhead tank			
Drums			
Others			
Total quantity of water consumption per month (kl)			

Table 03 can be used as an aid to calculate the actual consumption of water at various usage points across campus.

Table 03 Quantity of water used at various locations

Usage	Quantity of water per use (litres)	Number of times used per day	Total water used per day (litres)	Total water usage per month (kl)
Toilets				
Handwash				
Floor cleaning				
Cooking				
Washing dishes				
Drinking water				
Gardening				
Washing vehicles				
Others				
Total quantity of water consumption per month (kl)				

Leakages are recorded by the water meter as usage. Use Table 04 to identify broken fixtures and calculate water lost per month in leakages. See how you can repair the fixture or utilise the water.

Table 04 Quantity of water lost in leakages

Description of the leakage point	Quantity of water lost per minute (litres)	Quantity of water lost per day (litres)	Quantity of water lost per month (kl)
Total quantity of water lost per month (kl)			

WATER USAGE ESTIMATION TECHNIQUES

The following techniques can be used as aids to calculate quantity of water used at various usage points.

CALCULATING THE CAPACITY OF A MUG

Mugs typically have a capacity of 1 or 2 litres. To estimate the quantity of water held in a mug, count the number of times you use a 500 ml bottle to fill the mug till the brim.

Example: You use 2 bottles of 500 ml to fill the mug. The mug has a capacity of 1000 ml or 1 litre (500 ml x 2).

To understand the quantity of water used in the toilet per person for washing, calculate **number of mugs used per person X volume of mug = __ litres**

CALCULATING THE CAPACITY OF A BUCKET

Buckets are varied in size.

To estimate the quantity of water it can hold, count the number of times you use a 1 litre mug to fill the bucket till the brim.

Example: You use 20 mugs of 1 litre to fill the bucket. The bucket has a 20 litre capacity (1 litre x 20).

To understand the quantity of water used for cleaning purposes, calculate the **total number of buckets of water used per cleaning X volume of bucket = __ litres**
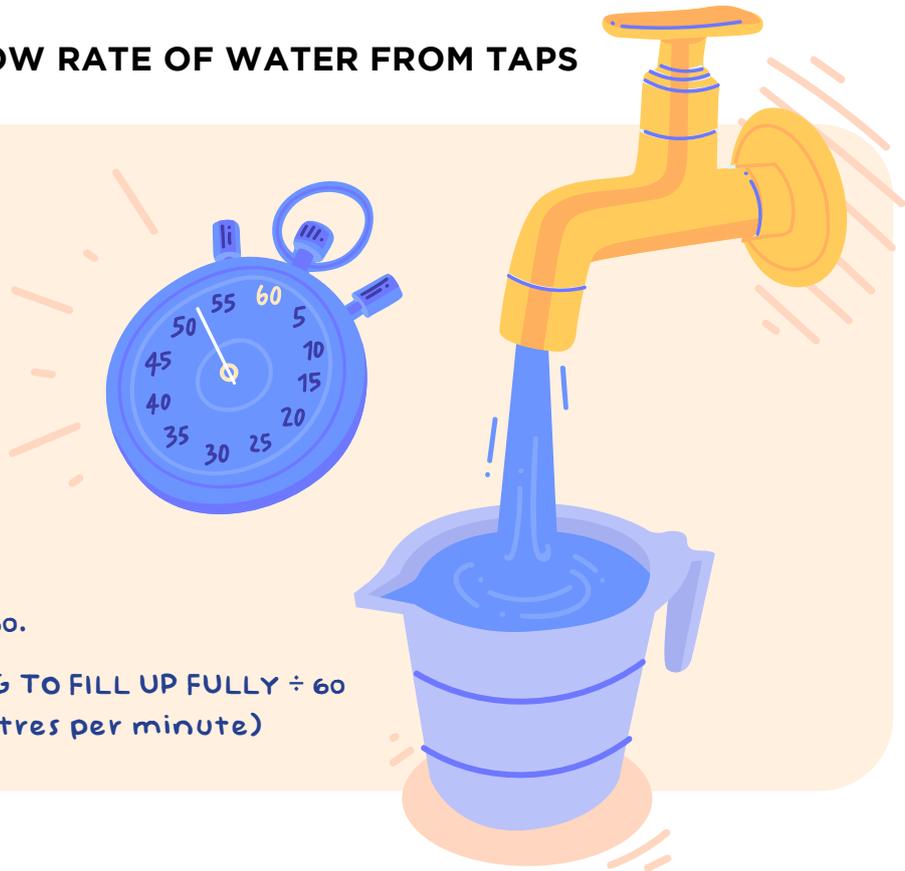
CALCULATING FLOW RATE OF WATER FROM TAPS

Open the tap completely to Fill a 1 litre mug.

Use a stopwatch to monitor the time taken to Fill the mug till the brim. Record it in seconds.

Divide this time by 60.

TIME TAKEN FOR MUG TO FILL UP FULLY ÷ 60 = FLOW OF WATER (litres per minute)

To understand quantity of water used per student while washing hands, calculate **time taken per wash (min) X flow rate of the tap (litres/min).**

Example: On an average, assume a student takes 10 seconds to wash hands. Assume flow of water from tap to be 6 litres/minute. Therefore, a student uses 1 litre per wash. There are 200 students washing their hands, four times a day. This means the tap is used 800 times a day. Overall quantity of water used is 800 litres (800 times x 1 litre/wash).

CALCULATING THE QUANTITY OF WATER LOST IN LEAKAGES

Using a 1 litre mug, calculate how much water is lost at different locations.

Example: A tap is leaking and fills a 1 litre mug in 30 seconds. It is leaking 2 litres in 1 minute.

Since the water is not shut off, the tap is leaking 24 hours.

Therefore the school is losing: 2 litres per minute x 60 minutes/ hour x 24 hours = 2880 litres/ day.

CALCULATING THE QUANTITY OF WATER USED IN A FLUSH TOILET

STEP 01.

Take the lid off the tank.

→ Mark the water level, using a marker or tape.

Shut off → the water supply valve

STEP 02.

* If the valve can't be shut off, try holding the float mechanism in the tank in the "up" position to keep the toilet from refilling.

↓ Flush the toilet (it won't automatically refill now).

STEP 03.

Use a 1 litre mug to fill the flush tank till the marked level. Count how many mugs of water it takes, to know the total quantity of water used per flush.

STEP 04.

Re-open the valve, make sure the flush tank is filling up and close the lid.

To estimate how many times the toilet is used in a day, leave a chart on the toilet door, asking students to mark each time they use the flush.

Example: Each flush uses 12 litres of water. 200 students use the toilet twice a day. The total water used is 4800 litres (200 x 2 x 12 litres/use).

REFLECTION

On supply and flow

- Do you think there can be any improvements in the design of the water management system at the school? Is it easy to detect and report leakages?

- Which river/reservoir does your school get water from? How does the supply of water get affected on campus due to events occuring outside?

- Are there variations in quantity of supply through the year? Do you think the same sources will continue to supply water to your campus, say 10 years down the line?

On usage

- Compare the estimation of water at source and at storage, and see if they are the same. What are the reasons for the difference, if any?

- What are your thoughts on the overall water consumption quantity - both at school and at individual level?

- Which areas consume the most amount of water? Can this water be recycled and reused? How does the school (teachers, support staff, students, administration) feel about it?

- Discuss water conservation practices that are currently being followed and others that the school can adopt in order to reduce consumption.

RAINWATER HARVESTING POTENTIAL

Rainwater Harvesting (RWH) is the act of capturing rainwater and storing it for use as well as recharging it into the ground. RWH helps its users by reducing their dependence on piped or groundwater. A RWH system can be as simple as directing runoff water to garden beds or collecting it in a rain barrel. More complex systems may include gutters, storage tanks, pumps, and delivery pipes.

Schools have a vast catchment area consisting of not only building rooftops but also huge playgrounds that can generate large volumes of runoff water. This exercise can make the students aware of the enormous benefits of implementing RWH systems on their premises.

OBJECTIVES

- To estimate the **total rainfall that can be harvested** in the school campus and to see what **percentage of the water demand the harvested rainwater will be able to meet**

- To understand the **benefits of implementing RWH systems**
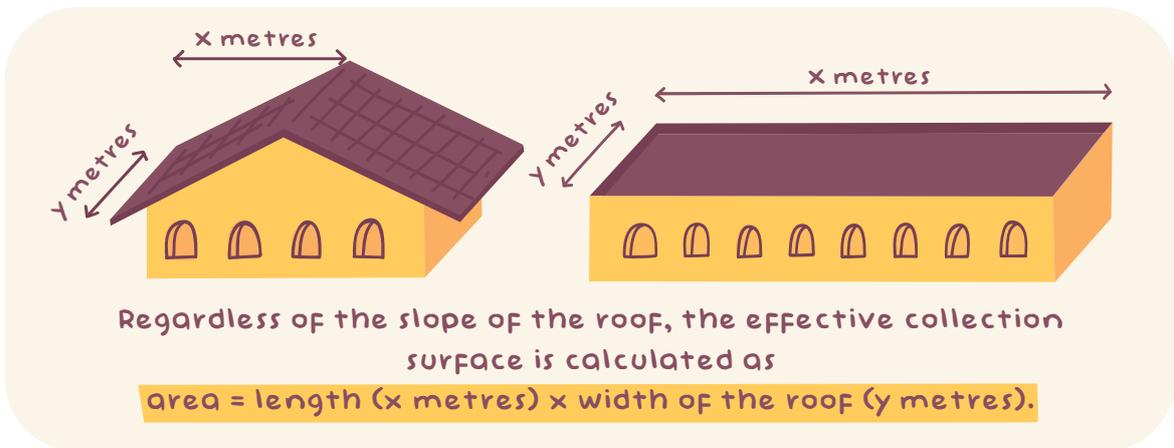
INSTRUCTIONS

1. **Get access to records on average annual rainfall for your area.**

   For designing a rainwater harvesting system, it is very important to consider the rainfall pattern, magnitude and frequency.

   Average annual rainfall for a place is calculated by averaging the last 30-35 years of annual rainfall. This data will be available for your region at the local weather station or an online resource.
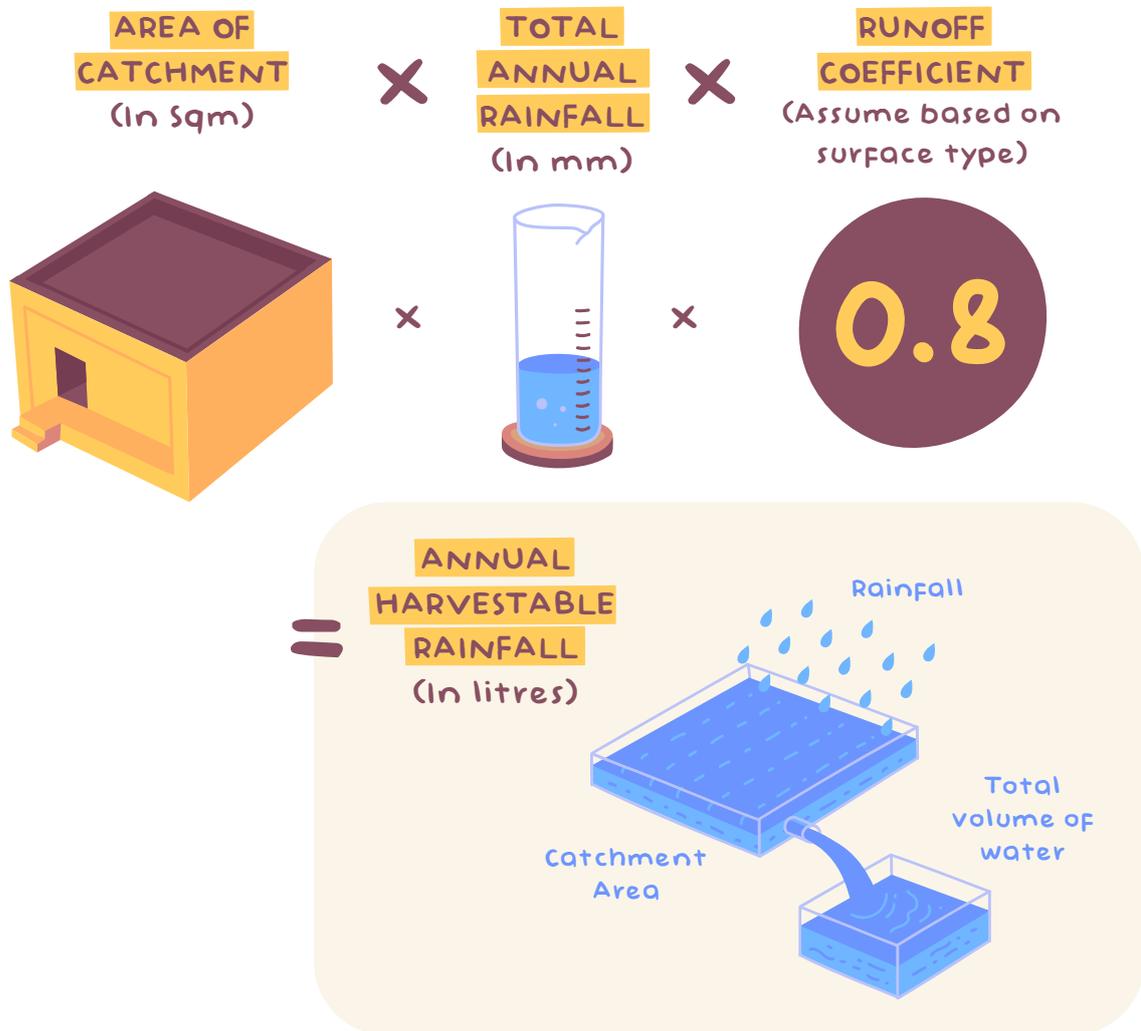
2. **Calculate the total roof area of the buildings** from where rainwater can be harvested.

Regardless of the slope of the roof, the effective collection surface is calculated as

area = length (x metres) x width of the roof (y metres).

3. **Calculate the total open area on campus**, and categorize it as
   • Paved (roads, concreted playgrounds etc.)
   • Unpaved (gardens, mud pathways etc.)

4. **Factor in runoff coefficient**. Based on surface type, runoff coefficients can be assumed. A few have been given below:
   • **Concrete surface, metal or tiled roofs = 0.8**
   • **Paved surfaces** (pathways, courts etc.) **= 0.5**
   • **Unpaved surfaces** (grounds, gardens etc.) **= 0.1**

Tiled Roof   Metal Roof   Concrete Roof   0.8

Paved surfaces   0.5   Unpaved surfaces   0.1
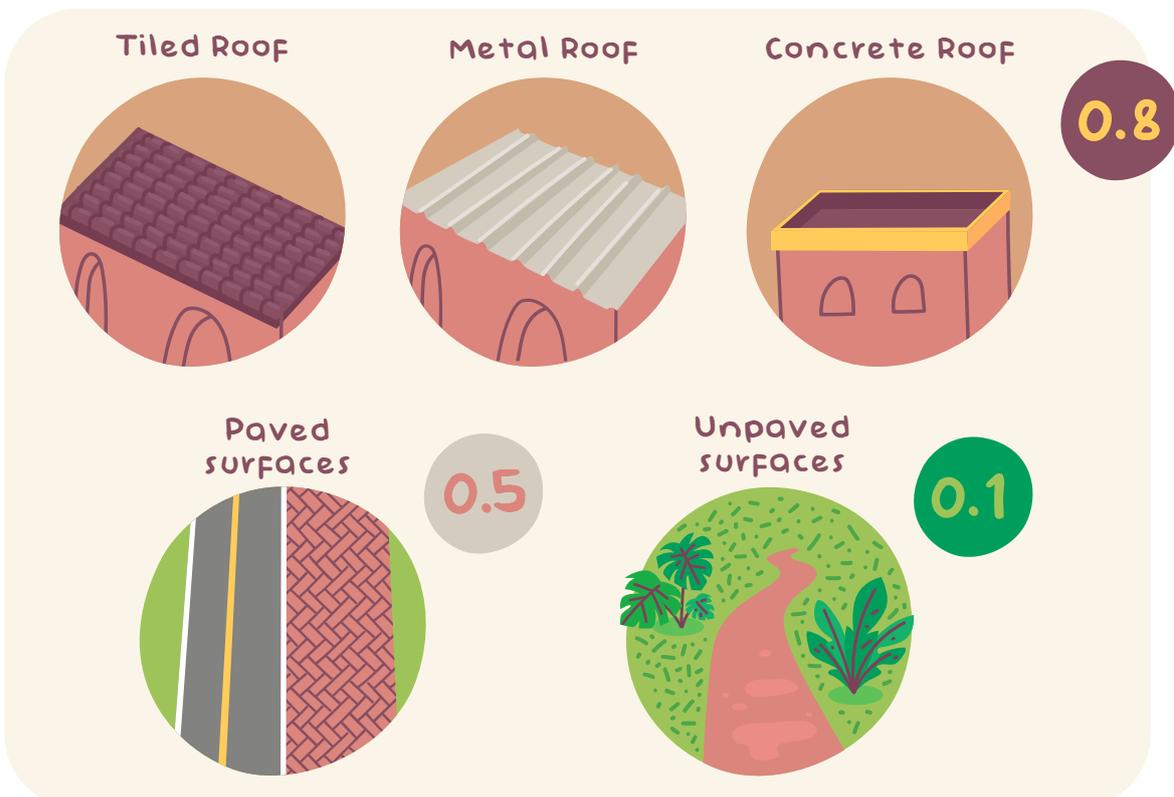
5. **Calculate volume of rainfall that can be harvested** from a given surface. Use the following equation: **Area in square metres (sqm) x total annual rainfall in mm x runoff coefficient**

AREA OF CATCHMENT (In Sqm) × TOTAL ANNUAL RAINFALL (In mm) × RUNOFF COEFFICIENT (Assume based on surface type)

× × 0.8

= ANNUAL HARVESTABLE RAINFALL (In litres)

Rainfall

Catchment Area

Total volume of water

Example: For an annual rainfall of 300mm falling on a concrete rooftop of 100sqm, the potential harvestable rainfall is 100sqm x 300mm x 0.8 = 24,000 litres or 24 kl

For an annual rainfall of 300mm falling on a grassy patch of 100sqm, the potential harvestable rainfall is 100sqm x 300mm x 0.1 = 3000 litres or 3 kl.

6. From the water audit exercise, **determine the activities that rainwater can be used for.**

7. **Calculate the percentage of total demand that can be met by harvested rainwater.** Use Table 05 to fill in all the details and see if there is a deficit or surplus of harvested rainwater.

🔑 RESOURCES

Table 05 Calculating potential harvestable rainfall on campus

Type of catchment	Built area (sqm)	Open area (sqm)	
	Roof area	Paved area	Unpaved area
Example: Building 1 Building 2		–	–
Paved road Gardens	–		
Total annual rainfall			
Run-off coefficient	0.8	0.5	0.1
Potential harvestable rainfall/year (kl)			
Total rainfall captured	**(can be stored and used for various activities)**	**(water from paved and unpaved surfaces can be used for groundwater recharge)**	
Total estimated water demand (kl)			
Percentage of demand that can be met by rainwater			

💭 REFLECTION

- What activities can rainwater can be used for? Is rainwater potable?

- What are the benefits of harvesting rainwater? Compile stories about RWH, by talking to different user groups.

- Do residential homes and other commercial buildings in the neighbourhood have RWH systems? Why have they been implemented?

- If everyone captured all the rain falling in their area, will rivers and lakes downstream run dry?

- What maintenance do you think RWH systems require?

COMPONENTS OF A RAINWATER HARVESTING SYSTEM

The rainwater that falls on the rooftop (both the flat and sloping roof) are collected through gutters and downtake pipes. The initial rain that falls on the rooftop is separated using a first rain separator.

The remaining water is made to flow through a filter, which consists of layers of gravel and sand that remove suspended particles. The water is then sent into a storage tank, from where it can be supplied through delivery pipes for various uses.

OVERHEAD STORAGE TANK

CATCHMENT AREA (ROOF)

GUTTER

RAIN WATER DOWNTAKE PIPE

DELIVERY PIPES

RAINWATER FILTER TANK

WATER PUMP MOTOR

FIRST RAIN SEPARATOR

UNDERGROUND STORAGE TANK

BUILD TO LEARN

As water scarcity worsens, it has become increasingly important to adopt environmentally friendly practices and be conscious about how we manage our water resources. School campuses require large quantities of water daily for several purposes such as drinking, laboratories, cleaning toilets and landscaping, thereby providing students with an opportunity to implement solutions that optimise the use of freshwater and reuse greywater to the maximum extent possible.

To actively engage with the problem and solution, we recommend building a complete working system. In cases of constraints in resource/space availability, small experimental setups can also be made to understand the principles.

Our criteria are simple: the project should be made from readily available materials and be effective, durable and affordable/low-budget. Most of these projects are to be tested over a period of time (during and beyond the duration of the earthian project) to be able to observe the results, and identify and make improvements to the system.

OBJECTIVES

º To build systems to understand **principles of water conservation and management**

º To enhance **creativity and innovation** in thinking

> All information given in the Resource section are **indicative ideaswith instructions** on how to set up the same. **The students will need to improvise based on site conditions and materials that are available to them.**
>
> These are small scale versions and if successful, the same can be replicated at larger scales.

📄 INSTRUCTIONS

1. **Define your challenge.**
   Select one topic related to water from the list given below (or come up with any idea or project of your choice).
   A. **Washing hands: Tippy Tap**
   B. **Filtering greywater: Planted gravel filter**
   C. **Harvesting rainwater: Rainwater filter**
   D. **Preventing soil erosion and increasing percolation: Bunds and swales**
   E. **Garden irrigation: Wick and bottle irrigation**

   Discuss why it can be a useful setup for the school, and the impact you hope to have.

2. **Select a suitable location in your school campus where you can install this system.**
   Estimate how your project can add value to the place. Assess the location to see if there is enough space for building, if it is convenient to access and if the water inflow and outflow can be controlled hygienically.

3. **Create a design along with your team.**
   Sketch the ideas that come to mind. Discuss your design with your peers, teachers and the school's maintenance staff, so that they can share useful inputs.

   - **Draw a map of your site**, and make a drawing of your design.

   - **Make a list of all the materials and tools required.** Choose materials that are recycled/second-hand, sturdy and durable for use. Ensure that the resources are well within your budget.

4. **Build the system.** Once the design is finalized, plan each step. Prepare the site. Assemble your design.

5. **Test your design.** Once your project is in use, analyse what is working well and what needs fixing. Get feedback from others who are using your project.

6. **Carry out regular maintenance.** All of these systems require routine check-ups and maintenance to ensure their smooth functioning.
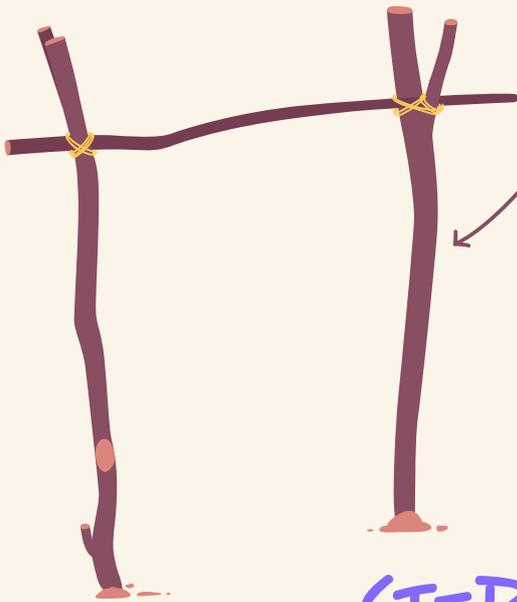
🔑 RESOURCES

A. WASHING HANDS: TIPPY – TAP

YOU WILL NEED
- Long sticks (1-1.2 metre long)
- 3-5 litre container
- Large Nail and candle
- Rope
- Bar of soap
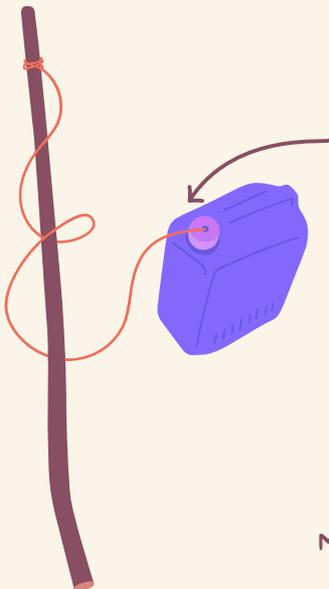- Stones/gravel
- Shovel

STEP 01.

Construct the frame out of sticks, by inserting them Firmly into the ground and tying them together with rope.

Note: You can also hang the container from an existing branch or a wall anchor. Make sure the movement of the container is not obstructed.

STEP 02.

Heat the nail in a candle Flame and make 2 holes in the container as shown.

STEP 03.

Insert a rope through the hole in the cap and tie the other end to a stick that will act as foot lever.

STEP 04.

Make a hole through the bar of soap and pass another rope through it.

TIPPY-TAP

Handwashing with soap at critical times such as before and after eating, after using the toilet, after coughing, avoids spreading of germs and prevents people from getting diarrhea and other diseases. **A Tippy Tap is a hygienic device that uses a container, and is operated by a foot lever.** This reduces the chance for the transmission of pathogens, as the user only touches a bar of soap suspended by a string.

These simple devices serve as a convenient access point for water and a visual reminder to wash one's hands with minimal water. Students can install tippy taps near the toilet or/and kitchen.
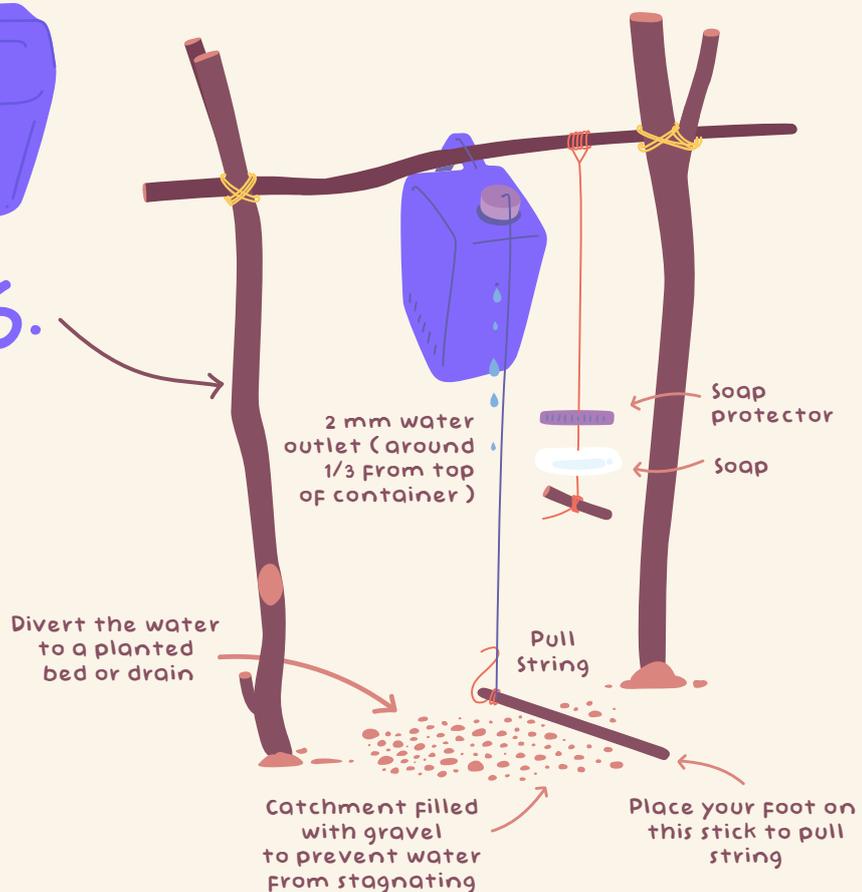
STEP 05.

Fill the container with water upto the level of the hole, and hang it up on a pole.

STEP 06.

When you place your foot on the stick, the container will tip forward and you can wash your hands!

Put the gravel on the ground underneath to stop puddles forming.

2 mm water outlet (around 1/3 from top of container)

Soap protector

Soap

Divert the water to a planted bed or drain

Pull String

Catchment filled with gravel to prevent water from stagnating

Place your foot on this stick to pull string

B. HARVESTING AND FILTERING WATER: RAINWATER FILTER

YOU WILL NEED
- A water drum (60-100 litre capacity)
- Netlon mesh
- 40 mm gravel
- 20 mm gravel
- Coarse Sand
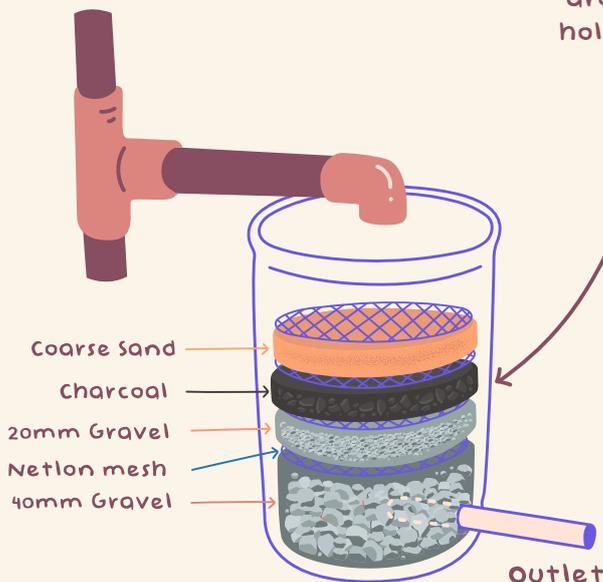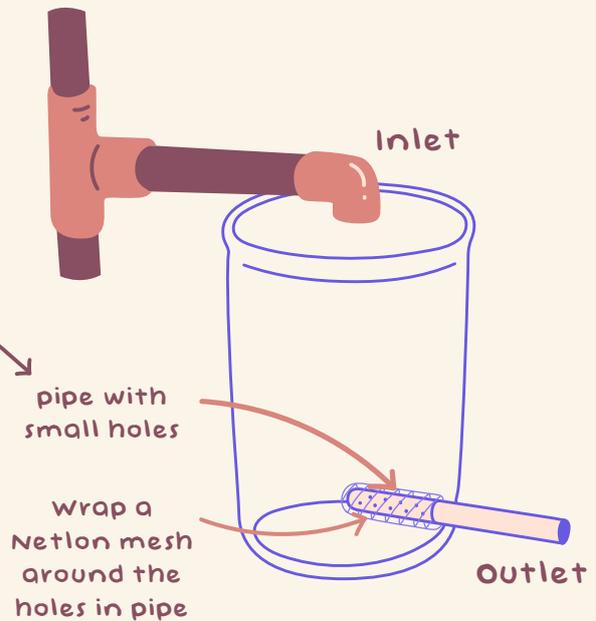- Hammer, nails and a hacksaw

Inlet

STEP 01.

Set up a 60-100 litre water barrel below a rainwater downtake pipe.

STEP 02.

Get a pipe and make holes as shown. Create an opening near the bottom on the side of the container such that the pipe fits tightly into the same.

Inlet

pipe with small holes

wrap a Netlon mesh around the holes in pipe

Outlet

STEP 03.

Layer the barrel with gravel, sand and netlon mesh, as shown. Pack loosely, so that water can flow out easily.

Charcoal can be added for improving water quality.

Coarse Sand
Charcoal
20mm Gravel
Netlon mesh
40mm Gravel

Outlet

RAINWATER FILTER

Rainwater from the roof carries dust, leaves and suspended particles from the rooftop. These physical impurities can be filtered using a rainwater filter. However, chemical or dissolved contaminants, if any, may need further purification.

A filter unit is a chamber filled with filtering media such as fibre, charcoal, coarse sand and gravel layers to remove physical impurities such as debris and dirt from water.

Students should identify a suitable rainwater downpipe on the school campus, from which rainwater can be harvested and add necessary plumbing. A filter of suitable size should be built, into which rainwater can be directly diverted. After filtration, the rainwater can be captured in a storage tank.

STEP 04.

Try to evenly spread the in Flowing water across the barrel.

Once water passes through the layers, observe the quality of water collected, and find appropriate activities for its use.

Inlet

Outlet
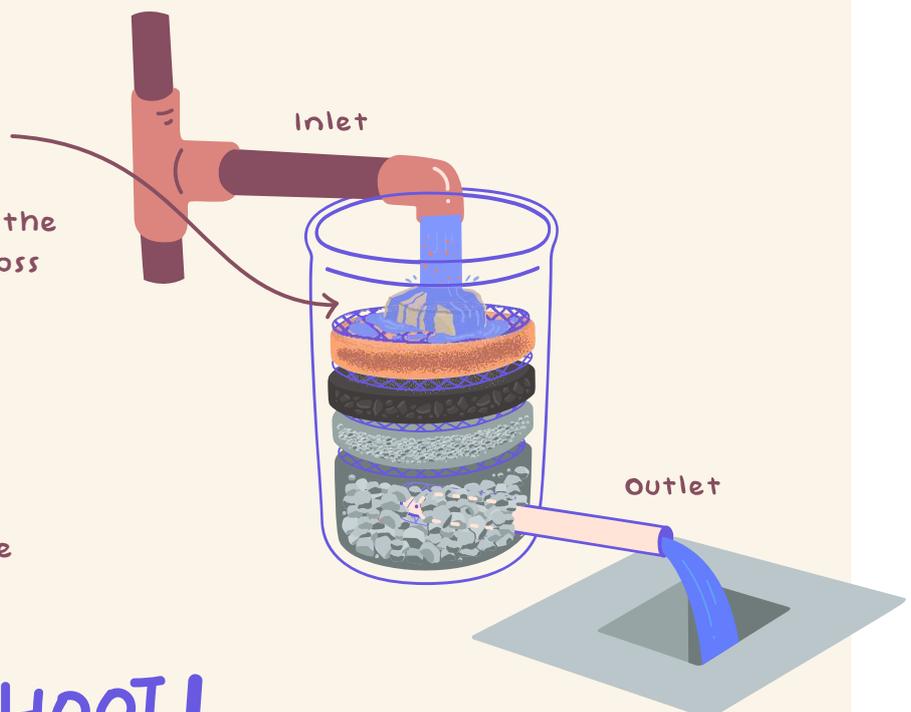
TROUBLESHOOT!

If it clogs, what should you do? Find out where the problem lies. First check the pipes for any blockage and clean it up. If still not functioning, try to clear the debris from the top of the Filter bed.

If the system overFlows? As it's a through Filter with no retention time, water may overFlow if the inFlow is high. You can try to divert excess water and reduce inFlow into the barrel.

C. IRRIGATING GARDENS: DRIP IRRIGATION
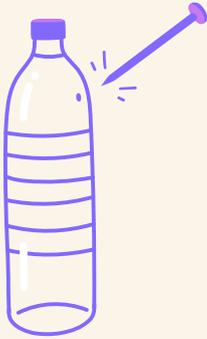
STEP 01.

Choose a bottle depending on the size of the plant. Make a small hole in the bottle. The hole size should be large enough to thread some rope through.

STEP 02.

Cut a piece of rope that is long enough to reach from the water bottle near the root of the plant (60cm). The rope should be of jute or cotton.

STEP 03.

tie a knot on the inside to prevent it from slipping through

Take one end of the rope through the hole made in the bottle and keep the inside end long so it is immersed in the water.

You can add a weight using a stone so it always remains submerged in water.

STEP 04.

Dig a hole near the root of the plant, coil one end of the rope near the roots and bury the bottle into the soil.
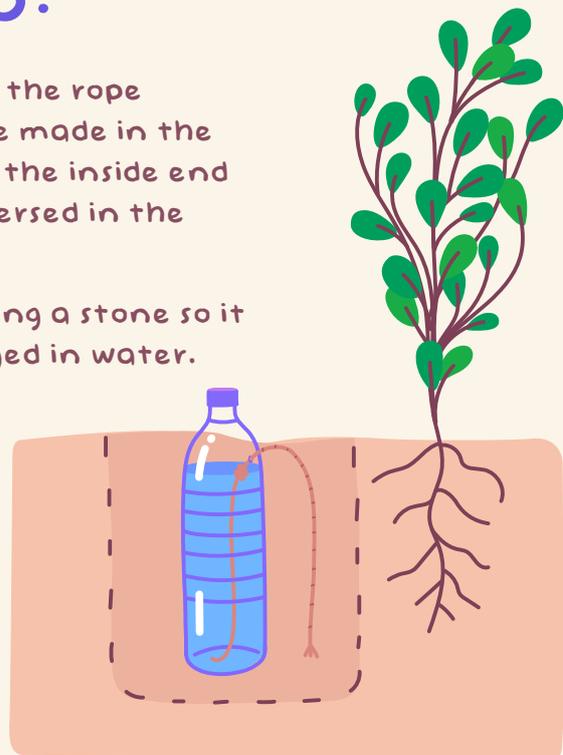
DRIP IRRIGATION

Unlike surface and sprinkler irrigation where the entire area is irrigated, **in drip irrigation water is applied directly to plant roots at a slow discharge rate.** It helps in conserving water and avoiding wastage by surface evaporation. Due to optimum moisture level in the soil, plants can grow much faster and healthier.

While modern drip irrigation systems include pipes, distributors and sprinklers, simple systems using plastic bottles or terracotta pots can be designed and planned for your school's garden areas.

OR

There are several ways to make your own drip irrigation system. You can do it for plants in a pot or for planted beds.
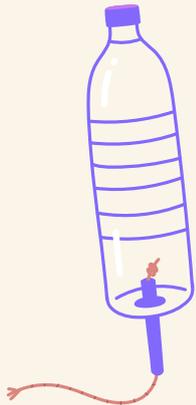
You can also cut a hole in the bottom of the container. Pass the wick through this hole, and seal it so there's no leakage of water through the hole.

You can also use earthen pots buried in the ground to their necks. Water is filled in these pitchers at regular intervals.

The seepage of water through the pot keeps the nearby soil moist.
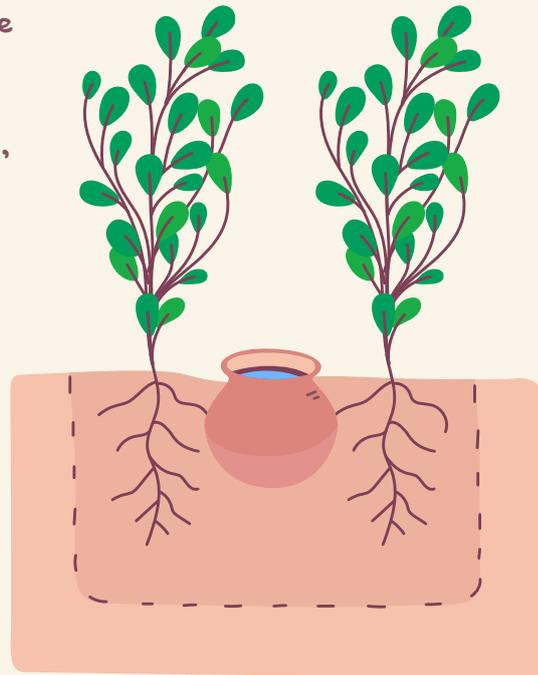
TROUBLESHOOT !

Is the water flowing out too quickly? Tighten the cap, the water will flow out slowly. Loosen the cap if you want the water to flow faster.

D. PREVENTING SOIL EROSION AND INCREASING PERCOLATION: SWALES AND BUNDS

BUNDS AND SWALES

A swale is a shallow trench dug along the land's contours. The earth dug from the swale is piled on its downhill side to make a raised mound or bund. **Making swales and bunds, digging ponds, mulching the soil and planting vegetation helps protect soil from flooding and erosion as well as allows water infiltration into the ground.**

STEP 01.

Identify the pathways where there is natural water runoff. You can do this just after a rain to see how the water flows and collects.

STEP 06.

Fill the bottom of the trench with organic matter such as leaves, twigs and branches.

Slope 5°-15°

Infiltration
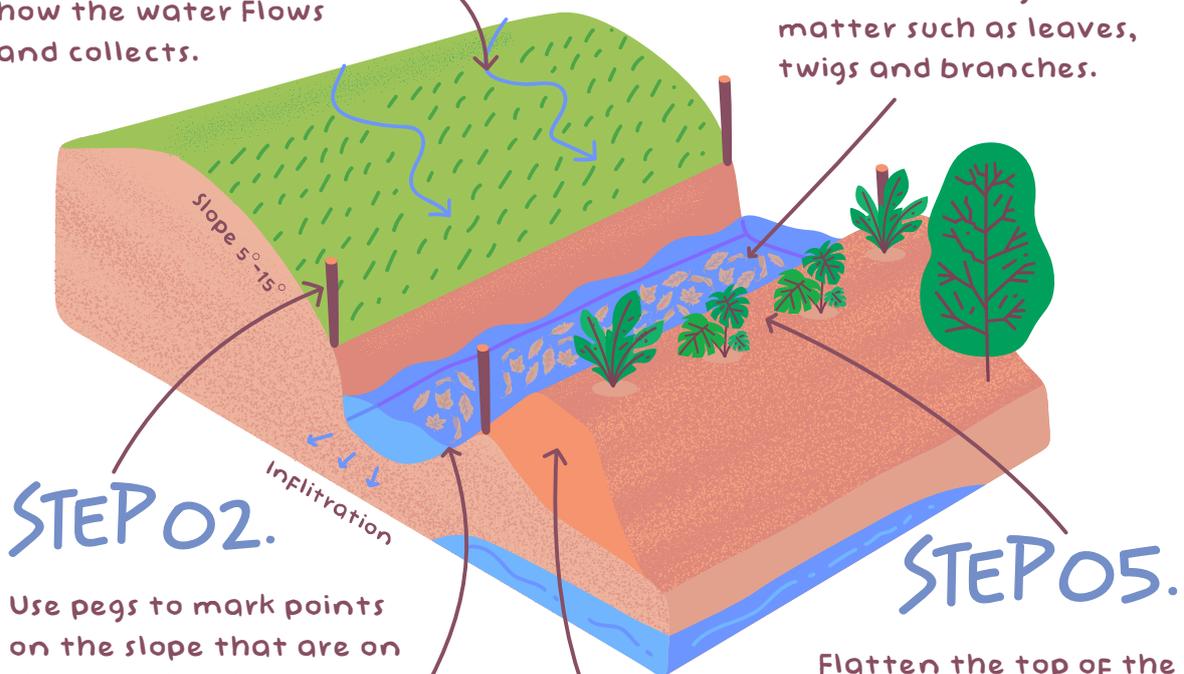
STEP 02.

Use pegs to mark points on the slope that are on the same level.

STEP 05.

Flatten the top of the bund and plant any grasses, food crops or fruit trees on the bund, to prevent erosion of the bund.

STEP 03.

Dig the swale. Swales can be between 1-3ft deep and 2-3ft wide and 3-10ft in length, depending on the amount of water it must handle.

Erosion   More Erosion

STEP 04.

Make a bund, using the excavated soil on the downhil side of the swale.

EXPERIMENTAL MODEL

Note: If you do not have the space or the slope to build a bund and swale, you could also build this model to see how vegetation can prevent soil erosion.

STEP 04.
Slowly pour equal amounts of water in each of the containers, to simulate rain.

STEP 02.
Fill both containers with tosoil, and grow plants in only one of them.

STEP 03.
Wait till the plants establish themselves, before you do the next step.

STEP 01.
Take two large containers and make two outlet holes as shown.

STEP 05.
Observe the colour and quantity of the water collecting in the mugs.

TROUBLESHOOT !

Is the water overflowing from the swale? Dig the swale deeper. If it is takes longer than a week to percolate after the rain stops, then drain the water from the swale.

Is the water uniformly distributed in the ditch or does it accumulate at one end? Check if the swale is at the same level all along its length. Adjust and make corrections so that the ditch is uniformly level.

E. TREATING GREYWATER: PLANTED GRAVEL FILTERS/REED BEDS

YOU WILL NEED

- A 8-10 cubic feet container. You can use a larger size container if available.
- 2-3 inch pipe and distribution hose pipe
- 20 mm and 40 mm gravel
- Netlon mesh
- Plant species that grow in wastewater

STEP 01.

Set up a container into which the greywater will flow. You can use any large vessel or upcycled plastic boxes.

2 - 3" INLET PIPE

STEP 02.

Add an outlet pipe and ensure the outlet is at a lower level than the inlet.

STEP 06.

Allow the greywater to flow through this tank, and collect the water in a small tank or container, from where it can be used.

STEP 05.

20mm Gravel

40mm Gravel

Plant native non invasive species in the gravel media. You can plant chinese umbrella, cattails, canna, vetiver etc.

OUTLET

STEP 03.

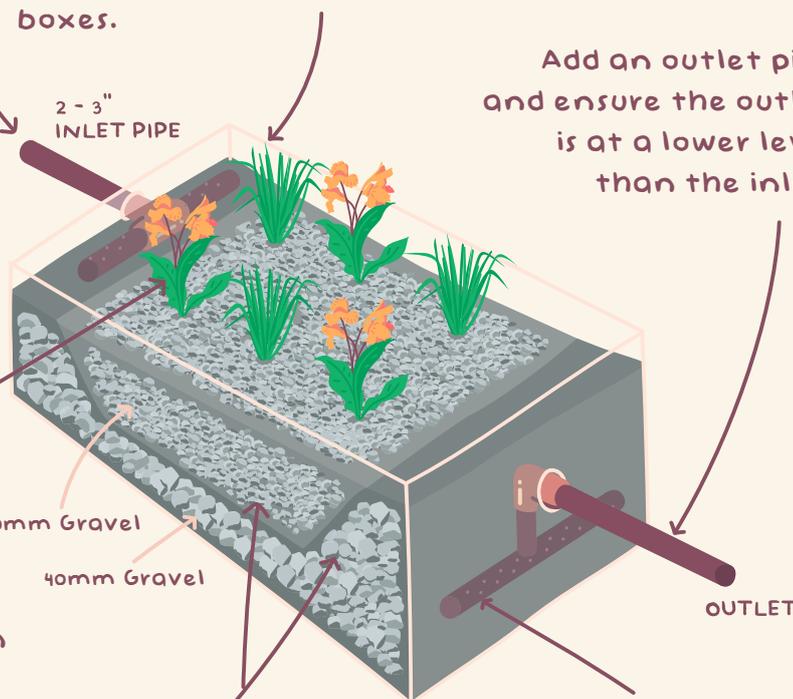Make holes around another pipe, and wrap the entire end with a netlon mesh.

Connect the outlet pipe to this pipe after it is laid at the bottom of the reedbed filter.

STEP 04.

Fill the container with 20 and 40mm gravel in layers as shown in Figure.

PLANTED GRAVEL FILTER/ REED BEDS

Greywater is the wastewater from baths, sinks and washing machines with detergents in it and little or no organic matter.

Planted gravel filters / reedbeds are attempts to recreate natural wetlands, which host a diversity of aquatic plants and animals that create a biological balance. The aquatic plants absorb nutrients from wastewater and clean it up.

Students can identify a handwash area to install a greywater treatment system. The treated greywater can be used for watering the garden and in toilet flush tanks.

It is recommended to eliminate or atleast minimise the use of chemical based cleaning agents and use natural soaps and cleaning agents wherever possible. This will help to ensure that the greywater treatment system functions efficiently.

REFLECTION

- What are the lessons you learnt from this activity?

- What are the reasons to have chosen your particular project? How does this system help in water management on the school campus?

- What were the challenges you faced during implementation, in terms of site selection, budget and technical details? Are there any hygiene concerns that you had to address?

- How often does this system need maintenance? What kind of maintenance does it require?

- What is the feedback you received from the users? Can this project be improved and implemented for the entire school?

CASE STUDIES

It is estimated that climate change will not only increase the frequency of extreme events such as floods, storms and droughts, but will also aggravate the situation in countries currently experiencing water stress. Poor water management tends to impact not only water resources but our society as a whole.

To cope with the future challenges posed to us, it is essential to look into various water management solutions that have been implemented in the past. Students will study examples and examine the factors affecting successes and failures. They will apply the learnings from the case studies to resolve problems seen around them.

OBJECTIVES

- To understand **real world scenarios** and be able to research and do in-depth analysis of a particular case

- To **describe an individual situation, identify the key issues of the case, understand approaches used as solutions** and analyse the short/long term impacts of projects

- To see how to do things differently for any other case with similar problems, in their own context - now or later

INSTRUCTIONS

Select case studies have been shared in the Resources section, but students are encouraged to do additional research.

Students can also select any other case study of their choice and write a summary. References should be included where applicable.

SELECT A CATEGORY, AND FIND AN APPROPRIATE CASE STUDY

1. **Select a case study of your choice**, based on the broad categories mentioned below. Read the story and gather as much information as possible.
    *   **Innovations in technology/management**
    *   **Participatory community projects**
    *   **Water and climate change**
    *   **Water and human action (dams, embankments, water pollution)**
    *   **Traditional water management systems**
    *   **Water scarcity and water conflicts**

SUMMARIZE AND ANALYSE THE CASE

2. **Examine the case and write a short summary** with a narrative that is memorable, in no more than 400 words. It is recommended to write according to the following structure:

Structure to write a summary

TITLE	
Introduction	Introduce the case, including its context and issues. • What is the background of the case? (eg. location, type of project and community) • What are the key issues of the situation?
Action or project description	Summarise the processes that were implemented. • What activities/interventions took place in response to the issues faced? • Where and how were these activities/interventions implemented? • Who was responsible for implementation?
Outcome	Explain the outcome of the project, its advantages or disadvantages. • What were the results of the implemented project? • What factors influenced the results?
References	Make a list of all the sources you refer to in the report. It could be people, journals, books, online websites or any others.

3. **Analyse the results of the solution implemented**, at local and national levels. **Write out your thoughts in no more than 400 words** around the reflection questions given, and mention the lessons learnt from the project.

A. WATER AND HUMAN ACTION – RIVER FLOODS IN KOSI, BIHAR

People living along the banks of Kosi river, affected by the 2008 floods

In August 2008, the Kosi river, described as the **'Sorrow of Bihar'** burst through its embankments, shifting its course 108km to the east, drawing a straight line to join the Ganga. This **Himalayan river has been known to rise to 10m within a day, frequently flooding agricultural lands** and cutting new channels almost every year.

To control the impact of the floods, earlier rulers built low-level embankments, locally called bandhs, which often broke and were temporary in nature. Over time, British engineers built higher embankments and this practice continued in post-independence India, as **longer embankments were built along the main channels of the river for controlling floods and providing water for irrigation to the surrounding villages.** This resulted in the villagers living and farming in the floodplains which worsened their situation when the river flooded.

The massive 2008 floods caused great loss of lives, livelihoods and property of nearly 3 million people in north-eastern Bihar. Thousands of villages remained waterlogged for nearly 2 months. Without disaster preparedness, there was a severe shortage of food and clean drinking water, causing widespread disease. The devastation also had a strong psycho-social impact on the people, particularly on women and children.

- Do embankments prevent floods? What is the lesson we can learn from this? What are other the impacts of the flood?
- There is a recent idea or concept called 'living with the floods'. In case of the Kosi, what would living with the floods mean?
- What will happen to Kosi river as climate change progresses?

Source: https://www.indiawaterportal.org/articles/anatomy-flood-case-kosi-2008

B. TRADITIONAL WATER HARVESTING STRUCTURES, RAJASTHAN

A woman draws water from a 'tanka' in Rajasthan

Rajasthan has India's driest regions which face periodic droughts. With an extremely low annual rainfall (less than 100mm) coupled with a lack of perennial rivers and presence of saline groundwater, western Rajasthan often faces acute water scarcity. While in rural areas, women have to walk miles in the scorching summer heat to fetch water for their homes, urban areas are unable to supply water to the growing urban population.

Rajasthan used to be self-sufficient during pre-British times with **traditional water harvesting structures such as kunds, nadi, tankas, talab, bandha, sagar and sarovar.** These systems have evolved over generations and **were built, owned and maintained by the communities to capture water and ensure year-round water supply** despite long dry spells. In kunds, a raised open surface is used to collect rainwater and direct it to the bottom of a well, which can be accessed by steps that reach the water level.

However, these **have been degraded and forgotten due to larger dam and canal projects** that were constructed to bring water from hundreds of kilometres away. History provides us with valuable lessons on how to manage and conserve water resources efficiently. It is important to restore and revive local systems, based on their context.

- How can ancient and traditional water systems teach us important lessons on water management?
- Find out more about any two traditional water systems of Rajasthan.
- Describe two traditional water harvesting systems from your state.

Source: https://www.ted.com/talks/anupam_mishra_the_ancient_ingenuity_of_water_harvesting/transcript?language=en

C. WATER MANAGEMENT – RECIPROCAL WATER ACCESS, PALAMPUR, HIMACHAL PRADESH

Meeting of the villagers with the head of the Village Forest Development Society (VFDS) and Palampur Muncipal Council (PMC) regarding forest management

Palampur, one of Himachal Pradesh's towns and a famous hill-station, had **become water-stressed on account of increasing population and over-extraction from mountain streams**, leading to water conflicts between the various resident communities.

Palampur derives a portion of its water supply from the Bohal spring just to the north of the settlement. Although the land on which the spring emerges was bought by Palampur Municipal Council (PMC) in 1952, **the recharge area of the spring falls in Bheerni forest, which is managed by the local villages** upstream of Palampur, who use it for grazing, fodder and fuel wood needs through the year. Due to intensive forest extraction, flowing water quantities declined towards the centre of town.

In order to address this issue, the PMC in 2010, signed a 20-year agreement with the villagers, to pay them an annual fee of INR 10,000 as **'Payment for Ecosystem Services (PES)'**. In return, **the villages were to modify their practices to protect the forest and conserve the spring recharge area.** These efforts have not only transformed the ecology of the once degraded land, but also led to a renewed flow of the spring water.

- How do regions become water stressed?
- What are springs and why are they important to local communities?
- Find out more about recharge zones of springs.
- What does 'payment for ecological services' mean?

Source: https://www.downtoearth.org.in/news/environment/payment-for-ecosystem-services-palampur-in-himachal-has-a-model-in-place-65908

D. PARTICIPATORY WATERSHED MANAGEMENT – HIWARE BAZAR, MAHARASHTRA

Hiware Bazar's landscape after watershed development

Watershed development activities taken up by community

Between the 1970s - 1990s, **Hiware bazar was a typical semi-arid village.** It had run out of most natural assets - forests had been cut down, water sources ran dry and the land had become unproductive. Inability to cultivate the land led to increasing poverty, unemployment and migration to cities.

Hiware Bazar **began its watershed development program in 1992 under the leadership of Padmashree Popatrao Pawar**, the then gram panchayat president. They worked on a 5 year plan that included a ban on liquor, cutting trees and free grazing, and contribution of village labour for development work. **The villagers took up the work of planting trees and forest regeneration, dug contour trenches and percolation tanks to harvest rainwater.** They decided to ban the use of borewells, adopt drip irrigation and discouraged water-intensive crops.

The **water table rose from a depth of 70-80ft to 20-25ft.** With increased agricultural production and cattle rearing, income levels and standard of living improved. Hiware Bazar's story has set an example for well-planned sustainable development through participatory water management, and is **one of the few villages in India where reverse migration was observed.**

- What is the role of leadership in successful stories like Hiware Bazar?
- How can communities influence water management policies?
- Where has the model of Hiware Bazar been replicated?
- What does reverse migration mean and is it a desirable goal?

Source: https://hindi.indiawaterportal.org/content/hiware-bazar-water-led-transformation-village/content-type-page/53529

E. CITIZEN-DRIVEN INITIATIVES – REVIVAL OF LAKES, BENGALURU, KARNATAKA

Kere Habba (Lake festival) in progress at one of the lakes, Bengaluru

A child's drawing of the lake cleanup

Due to increasing population, **Bengaluru city has seen the loss of tree cover, open land and what is of utmost concern - the city's lifelines – its lakes and ponds.** Its once popular name "city of a thousand lakes" has lost its significance, as most of these lakes have been encroached upon, polluted with sewage or have disappeared.

Since 2010, a number of **citizen-driven initiatives have emerged with the objective of restoring these lakes and their local ecology.** Local residents and volunteers worked with the Government to take responsibility for maintenance and rejuvenation of some lakes. **They conducted plantation drives and also created nurseries, walking paths, and gathering areas for the public.** Today, all these lakes have increased biodiversity and attract numerous migratory birds and have a variety of local trees. Some of the lakes have a wetland which acts as a natural filter and helps remove contaminants from the inflowing sewage water.

This system is a **self-sustainable way of lake management while benefiting all stakeholders** - citizens, government, educational institutions and local SHGs - and has been successfully running for the last 8-10 years.

- How important is the role of citizens in the lake revival process?
- Find out more about the success story of any one lake.
- Name a lake near your school and see if it can be revived using a similar approach.

Source: https://www.youtube.com/watch?v=m7vpSz_DCeM
https://www.youtube.com/watch?v=RAN4IGZi3pl

The illustration below shows various aspects of a lake revival in Bengaluru.

JAKKUR LAKE

CATCHMENT AREA

JAKKUR SEWAGE TREATMENT PLANT

CASCADE OF LAKES
All our urban lakes are manmade tanks that are connected to each other through streams. A series of connected lakes is called a cascade

LAKE WETLAND
The kidneys of our cities! Wetlands are biodiversity hotspots and play important roles in water purification. They manage the health of the lake and the species that live off it.

APARTMENTS WITH LAKE VIEW & RECREATIONS
Rooms with a view!

KALYANI
A temple pond, typically filled with lake water. Nowadays, these structures adjoining lakes are used for immersing idols and other rituals

DHOBI GHAT
The location where the washermen wash clothes

INLET
These are the points where water flows into the lake

OPEN WELL
A lined hole in the ground that lets us access the shallowest groundwater available in the area

INLET

INLET

FISHERMAN'S CORACLE
Fishermen get over 200 kg of fish daily from some of our city's lakes in the fishing season! The circular boat that they use are called coracles

Overflow weir
This is the outlet point for the lake – from here the overflow flows through streams, canals or drains to the next lake in the cascade series

TANKBUND
The bund is normally used to refer to the embankment that is created to control the flow of water. However, these days the embankment all around the lake as well as the wall separating the wetland area from the waterspread is also referred to as the bund

Source: Biome Environmental Trust

REFLECTION

Use these as indicative questions to write your thoughts on the case study.

- What were the actions and circumstances that led to the main problems and solutions in the case study?

- Were there unexpected results of the project implemented? How should long-term/ short-term effects be considered and evaluated during decision making?

- Who were the people involved in the project, and at what stages did participation become important? What were the challenges in bringing various stakeholders together?

- What is the future of water governance? How can citizens influence and support/oppose government actions?

- What would the impact of climate change be on any of the case studies chosen?

- Describe any other learnings from the project.

UNDERSTANDING WATER IN OUR ENVIRONMENT

WATER QUALITY
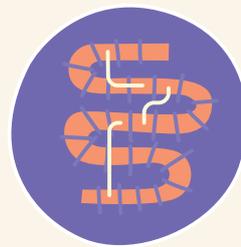
PLAY A GAME

HIDDEN WATER IN OUR FOOD

COMPARING SCHOOL CAMPUSES

WATER QUALITY

All life forms depend on water for survival. When the quality of water is compromised, ecosystems face problems of survival. Increasingly, human activities are altering the quality of freshwater resources, by polluting them with use of fertilizers, chemicals and other hazardous wastes. **Water quality indicates the suitability of water for a particular use, and is based on selected physical, chemical, and biological characteristics.**

By assessing the quality of water, the students will identify how water can be used, treated and reused. The students are required to carry out field and labaratory tests and list factors that affect water quality.

OBJECTIVES

- To assess the **quality of water at various points** inside and outside your school campus

- To perform some **basic water quality tests** and techniques

- To understand the **effects of pH, suspended solids, presence of chemicals and bacteria in water**

- To identify **human activities and natural phenomena that impact water quality**

- To learn **methods for improving water quality**

CLEAR ....MUDDY

📄 INSTRUCTIONS

ASSESS WATER QUALITY

1. **Select 5 different sites (both on and off campus) for sampling.** Make sure samples are from different sources such as a surface water body, a groundwater source, fresh rainwater or municipal water supply. Be careful when you collect water from the sources. Make sure you get necessary permission and take for help from teachers.

2. **Fill a clear container at the site, and complete the following tests on field. Note down all observations.**

   - **Temperature** - record the temperatures of air and water on site.
   - **pH** - measure pH at site using litmus paper
   - **Odour** - Smell the samples and classify the kind of odour emitted
   - **Colour** - Notice any colour differences at location
   - **Suspended solids** - Collect the water sample in a clear jar, shake the contents well and allow it to settle. Hold it against the light to check the presence of any suspended materials

3. **Collect water samples in a clean container from all these locations, for additional labaratory tests. Label each sample.**

4. By talking to your science teachers and using the laboratory facilities at the school, or **using an available water quality testing kit*, some of the following water quality parameters can be tested for.**

   - **Nitrates**
   - **Total dissolved solids (TDS)**
   - **Hardness**
   - **Fluoride**
   - **Coliform bacteria**
   - **Any other contaminant known to be present in your locality**

5. Based on the water quality of the samples, **identify the end uses each sample can be put to and why.** Example: cooking, cleaning etc

* Water quality testing kits can be sourced from **People's Science Institute, Dehradun** www.peoplesscienceinstitute.org/resource/techs/kits_eqmg_intro.html or **Jal TARA kits** from www.devalt.org/newsletter/may03/of_8.html or any others

IMPROVE WATER QUALITY

6. Try experiments to **purify the water using any one of these methods - sand and charcoal filter/moringa seeds/alum/SODIS or any other method** that is known to you or your teachers. The idea is to use traditional and simple ways to improve water quality. Retest the sample to observe improvements in quality.

Note: Students should ensure that they treat atleast one sample using one purification method.

🔑 RESOURCES

Table 06 Water quality tests analysis for samples collected

Parameters	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Sample location					
1. Color					
2. Smell					
3. Temperature					
4. pH					
5. Suspended solids					
6. Total Dissolved Solids (TDS)					
7. Nitrates					
8. Hardness					
9. Fluoride					
10. E.coli Bacteria					
11. Any others (specify)					
Your observation & remarks					
Treatment method used					
Observations after treatment	**(After performing the treatment, retest water for above parameters (1-11) and report any changes seen for any particular concerns of water quality)**				

WATER PURIFICATION USING MORINGA OR ALUM

Moringa seeds (commonly known as drumstick, murungai in Tamil, Sehjan in Hindi, Shevga in Marathi) and alum (aluminium sulphate) act as coagulants as well as antimicrobial agents.
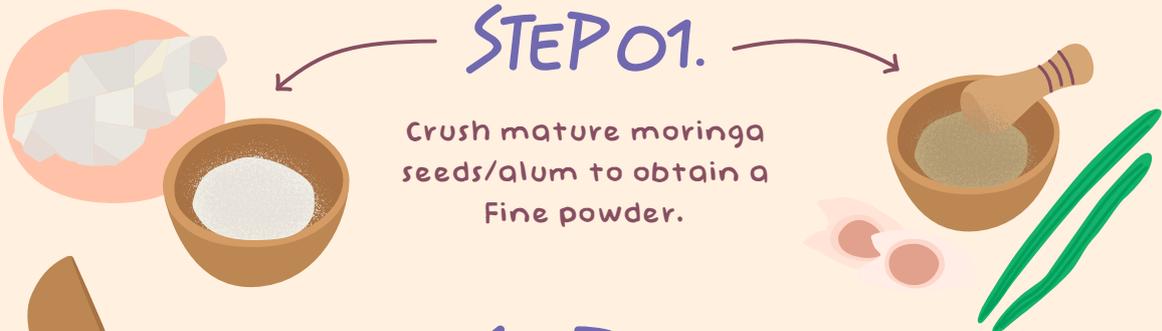
STEP 01.

Crush mature moringa seeds/alum to obtain a fine powder.

STEP 02.

Mix the crushed moringa seeds/alum with the water that needs to be purified (Add powder of 1 seed or 10 milligrams to 1 litre of water).

STEP 03.

Stir the water rapidly for 1-2 minutes and then slowly for 5-10 minutes. Allow it to rest without disturbing for 1-2 hours.

It attracts other finer suspended particles present in the water, grows bigger in size and settles down.

STEP 04.

After the particles and contaminants have settled down, clear water at the top can be decanted into a separate container.
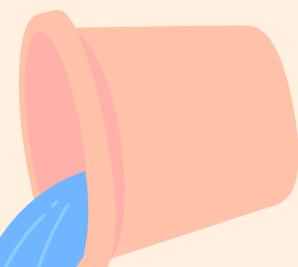
STEP 05.

The water may now be disinfected by boiling before using for drinking purposes.

WATER PURIFICATION USING SODIS METHOD

SODIS (Solar Disinfection) is a method of purifying water for drinking by using sunlight. The UV rays from sunlight are used to kill any harmful bacteria present in water.
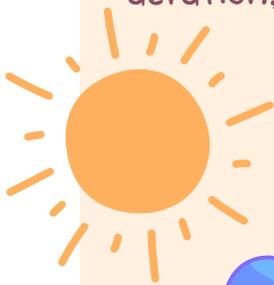
STEP 01.

Clean a plastic bottle, remove the wrapper/sticker from the bottle and ensure it is free of dirt or dust.
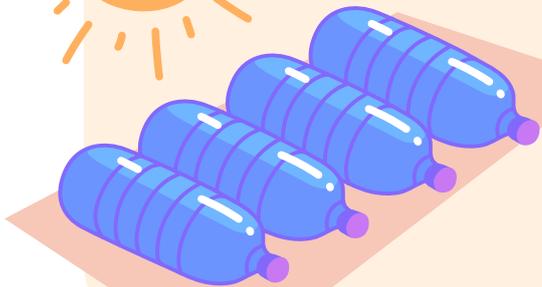
STEP 02.

Fill 3/4th of the bottle with water, shake it well for aeration, then fill the bottle completely with no air gap.

STEP 03.

Place the bottle horizontally in direct sunlight. Wait for 6 hours if the weather is sunny, and upto 2 full days if the weather is cloudy.

Test the water to check if safe to drink.

WATER QUALITY TEST PARAMETERS

Table 07 Quality of drinking water : test parameters

Physical properties	
1. Colour	Water must be clear with no visible colour changes, as it may be objectionable from an aesthetic and psychological point of view.
	Colour may be imparted to water due to presence of organic matter such as decaying vegetation, algae and weeds or mineral matter such as iron, manganese or coloured soils.

2. Smell	Water must not contain any objectionable or undesirable taste and odour.
	Dissolved organic matter, inorganic salts or some dissolved gases impart taste and odour.
3. Temperature	Temperatures between 10°C - 25°C are desirable.
	Temperature strongly affects the biological, chemical, and physical properties of water.
4. Suspended solids	Water should appear clear with no obvious presence of suspended matter.
	If water appears to be muddy or cloudy, it indicates the presence of suspended matter such as clay, silt or other fine organic matter and minerals.
Chemical properties	
5. pH	Desirable pH of water is between 6.5 and 8.5. Alkalinity is caused by the presence of calcium and magnesium bicarbonates. Acidity is caused by the presence of mineral acids, free carbon dioxide, iron sulphates etc.
	Lower pH values may cause corrosion, whereas higher pH values may cause scaling deposits.
6. Total Dissolved Solids (TDS)	TDS represents the total amount of dissolved solids in water. Permissible amount is limited to 500 ppm although higher amounts up to 1000 ppm are permitted.
	Dissolved solids originate from natural sources, sewage, industrial wastewater and chemicals used in water treatment.
7. Nitrogen	It may be present in the following forms: Free ammonia should not exceed 0.15 mg/litre. Nitrites should be completely absent. Nitrates should be limited to 45 mg/litre.
	Excess nitrates affect the health of Infants causing Blue Baby syndrome.

8. Hardness	It is caused by the presence of calcium and magnesium salts in water. For drinking purposes, water must be soft; however water with hardness below 75 ppm is generally tasteless and hence the desirable limit ranges from 75 - 115 ppm.
9. Fluoride	Fluoride exists naturally in water sources but maximum permissible limit = 1 mg/litre (1 ppm). Higher concentration of fluorides exceeding 1.5 mg/litre may cause fluorosis, in which effects range from mottling of teeth to skeletal deformities.
Bacteriological characteristics	
10. Coliform bacteria	For drinking water purposes, bacteria should not be present in water and it should be free of contamination, as it causes gastrointestinal infections in humans.

Source: As per BIS 10500 - cgwb.gov.in/Documents/WQ-standards.pdf

REFLECTION

- Were there differences noticed in the quality of water at various source points? What were the reasons for change in water quality?

- Based on your findings, is the drinking water in your school potable and safe for drinking?

- Are there impacts of water quality on your school campus and in your local environment?

- What are the commonly dissolved substances found in water?

- Are you aware of traditional purification methods that were implemented and used earlier? How effective are home treatment methods for water quality? What did you observe?

- How do natural or human activities affect the quality of water?
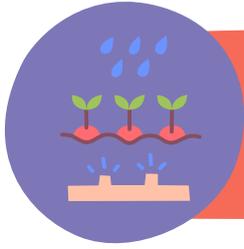
HIDDEN WATER IN OUR FOOD

The volume of water you consume per day is much more than you think. The amount of water consumed depends not just on the duration of your bath or the number of clothes you wash, but also on the food you eat, clothes you wear, fuel you use for travel and various other things you buy. **Practically everything we make - houses, electronic gadgets, automobiles, roads - uses water in the manufacturing process.**

Globally, agriculture is the largest user of freshwater resources. Generating electricity from coal, oil, gas and hydropower is the second biggest use of water. **The amount of water used to produce each of the goods and services we use is called 'embedded' or 'hidden' water.**

For this exercise, students will visit agricultural farms and analyse the water requirement for growing crops. Students will also explore their dietary habits and reflect on strategies and choices that contribute towards **a well-balanced but less water-intensive meal.**

OBJECTIVES

- To understand **direct and indirect consumption of water**

- To understand **the variations in water requirements between local/whole foods and processed foods**

- To understand **nutritional value and crop water requirements of local cereals/grains**

- To explore **strategies to reduce one's water footprint**, through consumption of locally produced foods.

Find out more about water footprint at:

- **https://waterfootprint.org/en/resources/school-resources/**

- **https://www.watercalculator.org/educational-resources/**

🗒 INSTRUCTIONS

**CALCULATE THE WATER REQUIRED TO GROW
ANY AGRICULTURAL CROP**

1. Go through the resources given in this booklet, to **understand water footprint and your direct and indirect consumption of water.**

2. **Visit a farmer and understand water requirements for growing agricultural crops.**
    If you know any farmer or agriculturist, find out if it will be possible to visit their farmland to understand how they grow their crops. When you visit,

    -   Talk to them and list what crops they grow annually. What is the total area of the farmland and what is the total agricultural yield obtained?

    -   Find out how much water is required for their farmland, for a full crop cycle. Ask if the crops are rain-fed or irrigated.

    -   Understand their extent of dependence on irrigation. Where does the water supply come from?

3. Based on data collected, try to **calculate the water used per crop. Write a short summary on your visit** and how you went about collecting data to arrive at a number.

CALCULATE THE WATER FOOTPRINT FOR ANY ONE MEAL YOU ATE

4. **Choose any one meal at home and list everything you ate.** With your parents' help, **write down the ingredients used for making one full meal at home.** Include items in the following categories: cereals, pulses, vegetables and dairy.
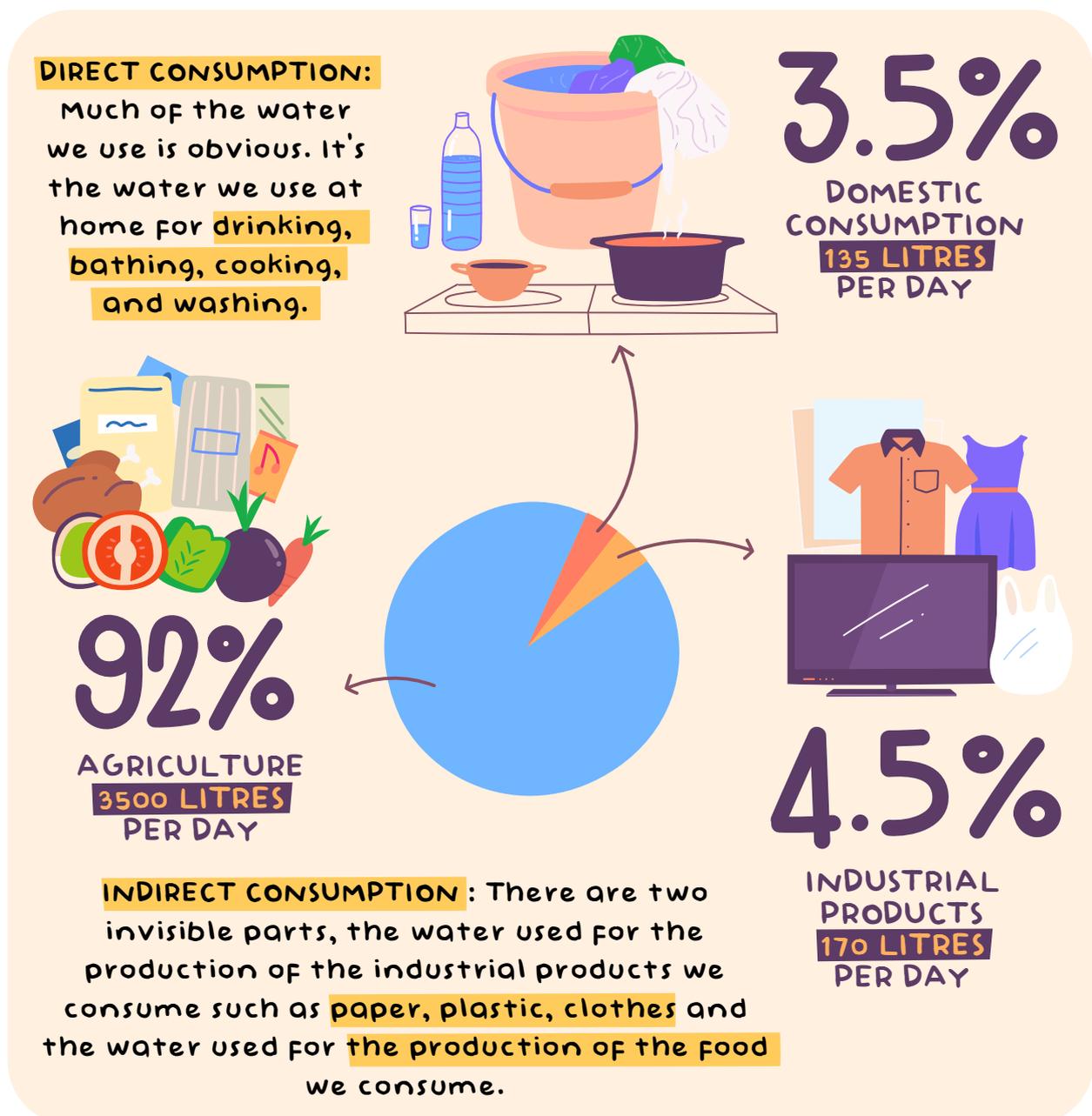
    Note: Each student in the group can do this activity separately with their families, and submit all data collected during the process.

5. **By checking against the list provided in Table 09, calculate the total water footprint of your meal. Use Table 08 to fill the details.**

For items not in the list, try to do some research and find out the water requirement to produce the food item. If no details can be found, mention the list of items whose water footprint has not been added to your overall calculation.

🔑 RESOURCES

WHAT IS OUR WATER FOOTPRINT?

DIRECT CONSUMPTION: Much of the water we use is obvious. It's the water we use at home for drinking, bathing, cooking, and washing.

3.5%
DOMESTIC CONSUMPTION
135 LITRES PER DAY

92%
AGRICULTURE
3500 LITRES PER DAY

4.5%
INDUSTRIAL PRODUCTS
170 LITRES PER DAY

INDIRECT CONSUMPTION: There are two invisible parts, the water used for the production of the industrial products we consume such as paper, plastic, clothes and the water used for the production of the food we consume.

Source: thewaterweeat.com, waterfootprint.org

69

HOW MUCH WATER DO YOU EAT EVERYDAY?

Food accounts for 3500 litres per day which is about 80-90% of the total water footprint of a person per day. This further increases the more food is transported from farm to the storehouse; on a flight, ship or truck, to another storehouse; then to a supermarket or shop and finally to your home.
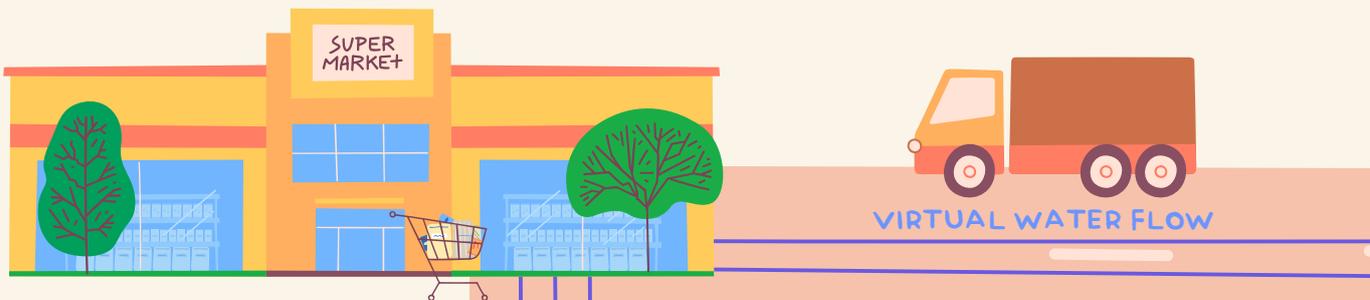
AGRICULTURE

Agricultural crops grow with rainwater, surface water and groundwater (from rivers, lakes and aquifers). Irrigation requirements vary from crop to crop, based on how they are grown and processed.

REAL WATER INPUT
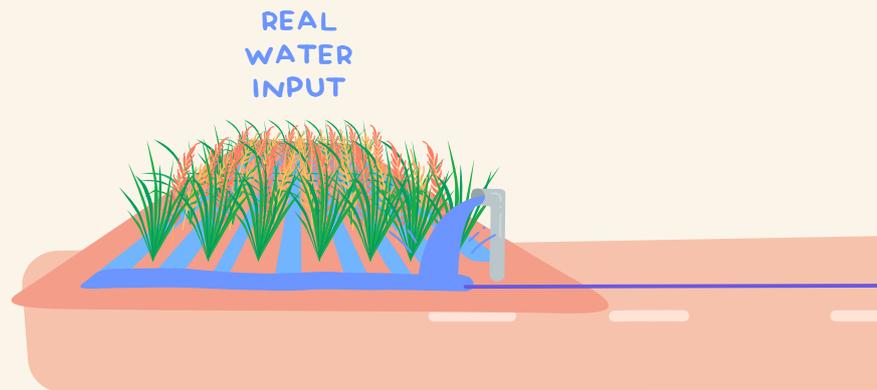
RETAIL STORE

It then travels to various retail stores, from where people buy these products.

SUPER MARKET

VIRTUAL WATER FLOW

DOMESTIC CONSUMPTION

Water is used to cook the food at home, and a part of this ends up as food waste in the bin. That ends up as solid waste in landfills.

Source: thewaterweeat.com,waterfootprint.org

The virtual water chain consists of a farmer at the primary production end, a consumer at the consumption end, and depending on the commodity, some intermediate stops such as a food processor and a retailer. Each stage has some real water input and a virtual water inflow, as shown in the Figure below.
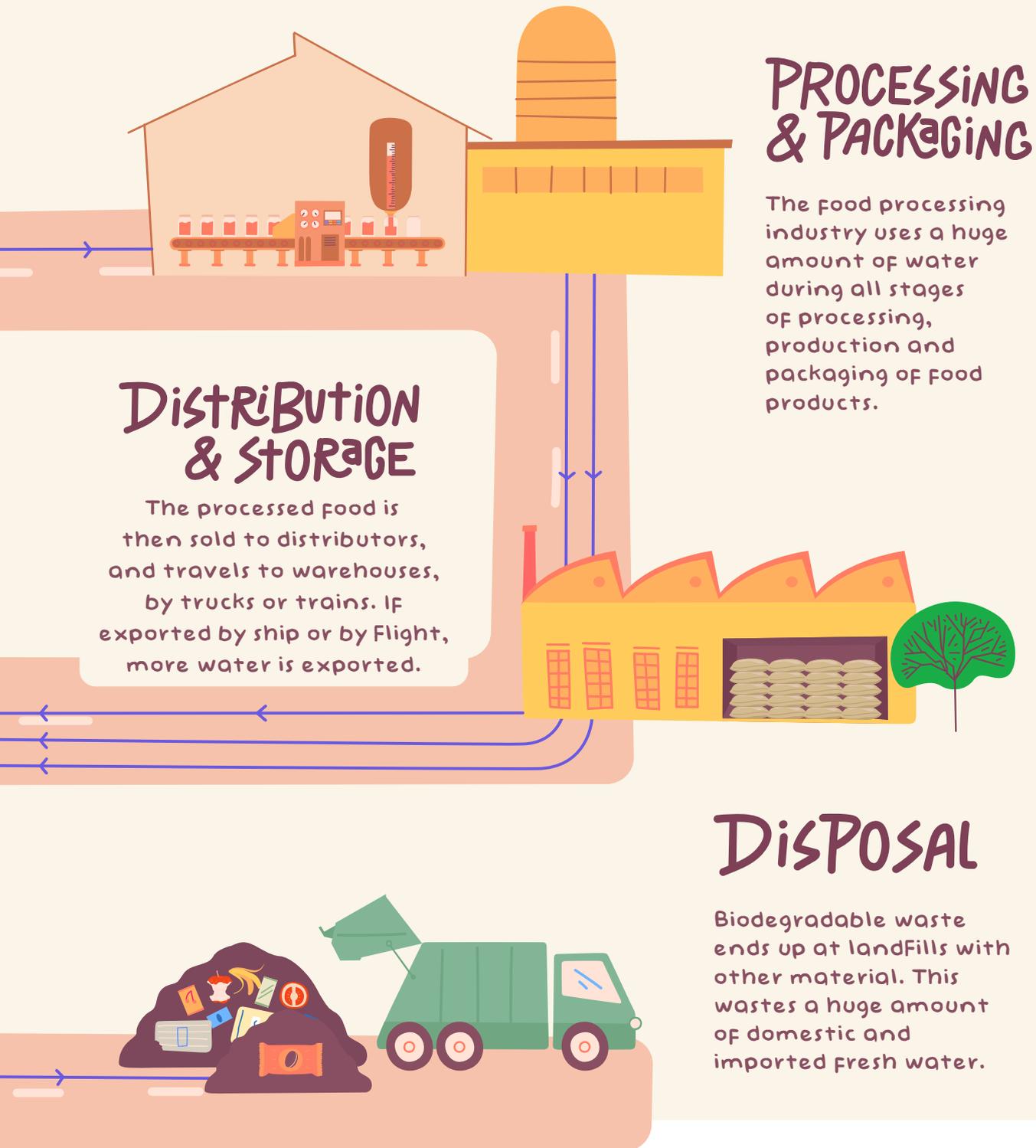
PROCESSING & PACKAGING

The food processing industry uses a huge amount of water during all stages of processing, production and packaging of food products.

DISTRIBUTION & STORAGE

The processed food is then sold to distributors, and travels to warehouses, by trucks or trains. If exported by ship or by flight, more water is exported.

DISPOSAL

Biodegradable waste ends up at landfills with other material. This wastes a huge amount of domestic and imported fresh water.

Table 08 Calculating water footprint of any one meal

Meal considered: (List the foods you ate)			
Ingredients used for preparing the meal	**Quantity required (write the units in kg or litres)**	**Water footprint per unit of food item (Refer table 09 or online)**	**Water footprint (litres) (Multiply column 2 x column 3)**
Example: Wheat Flour (Atta)	0.2kg (200g)	1854 litres/kg	370.8 litres
Potato	0.1kg (100g)	277 litres/kg	27.7 litres
Tomatoes	0.25kg (250g)	380 litres/kg	95 litres
Total water footprint of the meal (in litres)			
Water footprint per person (Total divided by number of family members)			

REFLECTION

- What are the advantages of locally grown, indigenous varieties of food?

- What constitutes a sustainable and balanced diet?

- What is more beneficial - eating wholesome, unprocessed food, or processed, shelf-stable foods? What do you think is the water footprint for a bottle of soft drink?

- What is the difference in the water footprint for local meat and processed meat?

- What are the reasons for differences in water footprint between families? What are the variations in food choices that add to this difference?

- What are the reasons for variation in the water requirement for the same crops across different regions?

Table 09 Water required for various food items

Food item	Water footprint (in litres per kg)	Food item	Water footprint (in litres per kg)
Milk	1789	Spinach	292
Maize	2092	Tomatoes	380
White rice	3571	Brinjal	326
Wheat	1854	Onions	230
Millets - Ragi	2241	Cauliflower	233
Pigeon pea (Tur/Arhar)	8601	Broccoli	233
Chickpeas (Chana)	4986	Cabbage	200
Bengal gram	3984	Lady's finger	245
Soybean	7121	Potatoes	277

Note: These numbers are indicative of a national average water footprint for various crops. The comparison will vary for specific states, due to difference in agricultural practices, crop yields and climatic conditions.

For example, the chart below shows the variations in water requirement for rice between various states, met through both rainwater and irrigation.
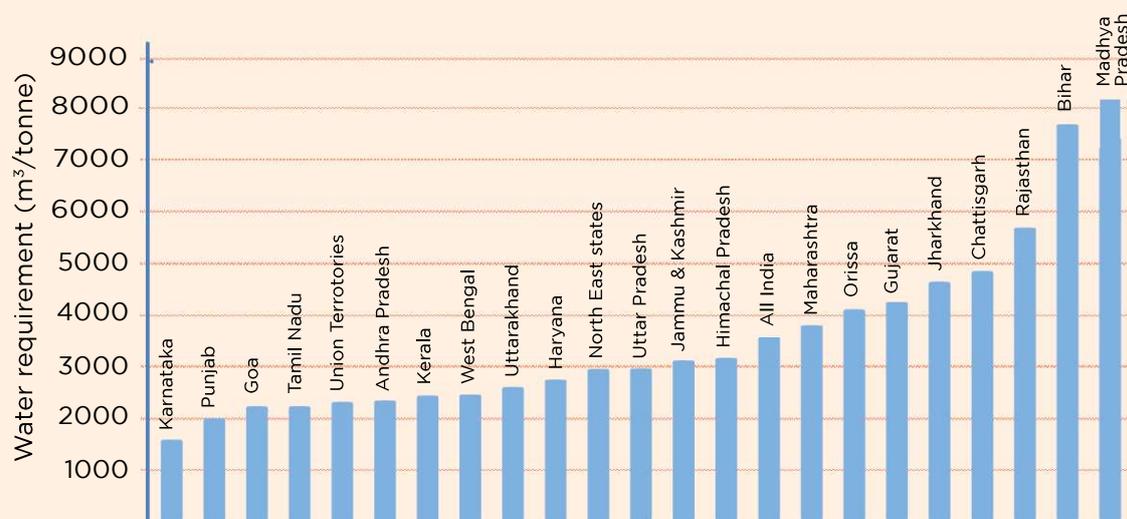
Average water requirement per tonne of rice in different states

Source: Jayaram, K., 2016. A Water footprint Analysis For Agriculture In India. Ph.D. ICAR.

COMPARING SCHOOL CAMPUSES

Sustainable water management is an important concept that can be integrated into the functioning of the school. It can be demonstrated through water use efficiency and reuse of wastewater. This will help reduce demand on the existing water resources, maximize benefits of use and therefore reduce overall costs of water consumption.

By working with other schools and talking to students and staff, students will be able to understand water usage patterns in other schools. This also provides an opportunity to share ideas and help each other achieve sustainable water management goals.

OBJECTIVES

- º To understand **the difference in per capita consumption between two different schools**

- º To share ideas about **any best practices in water management that can implemented** in the schools

- º To understand **behaviour patterns** and influence change

INSTRUCTIONS

VISIT A NEIGHBOURING SCHOOL

1. **Arrange a visit to a neighbouring school of your choice.**
   After getting permission from relevant authorities, take a guided tour of their school campus' water management system. Pay close attention to how they are using water, who is using water and where it is being used.

   Understand if there are any problems being faced by the school or any best practices they have adopted.

2. **Source the school's water consumption data**
   With the school's help, find out the details about:

   - **The number of people on campus** (including students, teachers, administration and non-teaching staff)

   - **Total water consumption per month** and **per capita water consumption** (you can share the template from Part A - Water Audit, to help the other school in filling it up)

   - **Expenses on water consumption**

   - **Top five uses of water**

   - Any other observations or **any conservation practices adopted**

NO. OF PEOPLE ON CAMPUS	PER CAPITA WATER CONSUMPTION	EXPENSES ON WATER CONSUMPTION	TOP FIVE USES OF WATER	ANY CONSERVATION PRACTICES
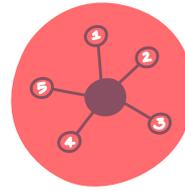
COMPARE THE DATA WITH YOUR SCHOOL

3. **Make a comparison chart of both schools.**
   Fill up Table 10, by using data collected on water demand from earlier exercises. Compare the data and write down similarities/ differences that you notice, between the per capita consumption of water of a student from each school.

4. **Find out why there are differences.**
   Identify any particular points where the usage varies between your school and the other, and analyse why there are differences. Summarize how and what practices could either school adopt from each other, and where there is scope for improvement.

For example, one school may have larger gardens where large quantities of water are being used, which adds to higher per capita consumption. The other school may have a greywater treatment set up to reuse water for toilet flushing, which decreases their overall consumption.
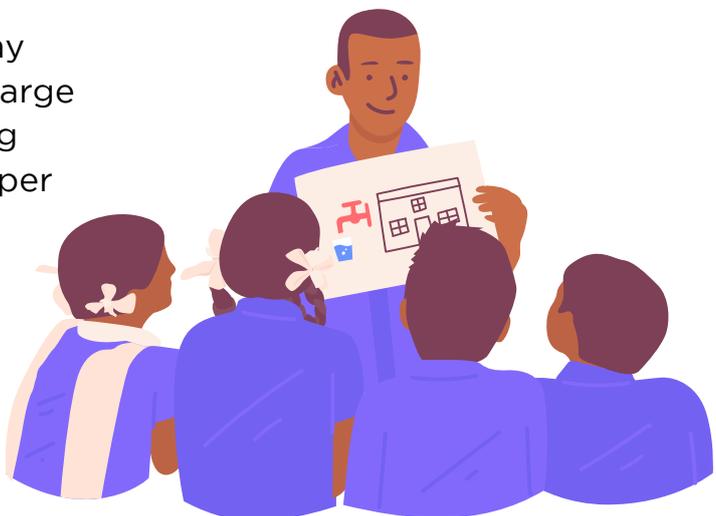
🔑 RESOURCES

Table 10 Comparing water management systems between two schools

Parameters	School 1	School 2	Differences
A. Total water usage/month			
B. No. of people on campus			
Per capita water usage **(Divide A by B)**			
Water expenses			
Top 5 uses			
Other observations			
Conservation practices adopted			

💭 REFLECTION

- What are the reasons for variation in per capita consumption of water between the two schools?

- What practices can either school learn from each other, and where is the scope for improvement?

- Does water usage influence students' health, the school's general and toilet cleanliness, expenses and maintenance?

- How can you engage with other schools - both staff and students - to make changes in behaviour and conserve water?
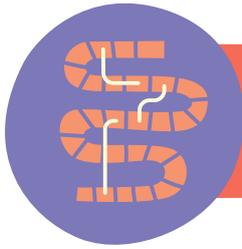
PLAY A GAME

When it comes to conserving water, small changes to ensure conscious use of water can have a big impact. By changing our habits and making choices that have less harmful effects on the environment, we have the power to confront adverse effects of climate change.

This game has been designed similar to a "snakes and ladders" game with a twist! Here, there are drains and springs; good practices represented by springs and bad practices represented by drains. Students can play this game and write down their experiences related to their real-life actions. This game will help students build a roadmap for individuals, households and communities to adopt sustainable water management practices.

OBJECTIVES

- To understand **individual and collective action towards sustainable water management**

- To raise awareness on the power of individual action to bring reforms in **water management practices at a household and at community level.**

- To help build a **roadmap for sustainable water management**

INSTRUCTIONS

PLAY THE GAME BY FOLLOWING THE RULES GIVEN BELOW

1. Each player puts their counter on the space that says 'start here'.

2. Take turns to roll the dice. Move your counter forward the number of spaces shown on the dice.

3. **If your counter lands on a spring source, you can move up to the other end of the water source. If your counter lands on the opening of a drain, you must slide down to the bottom of the drain.**
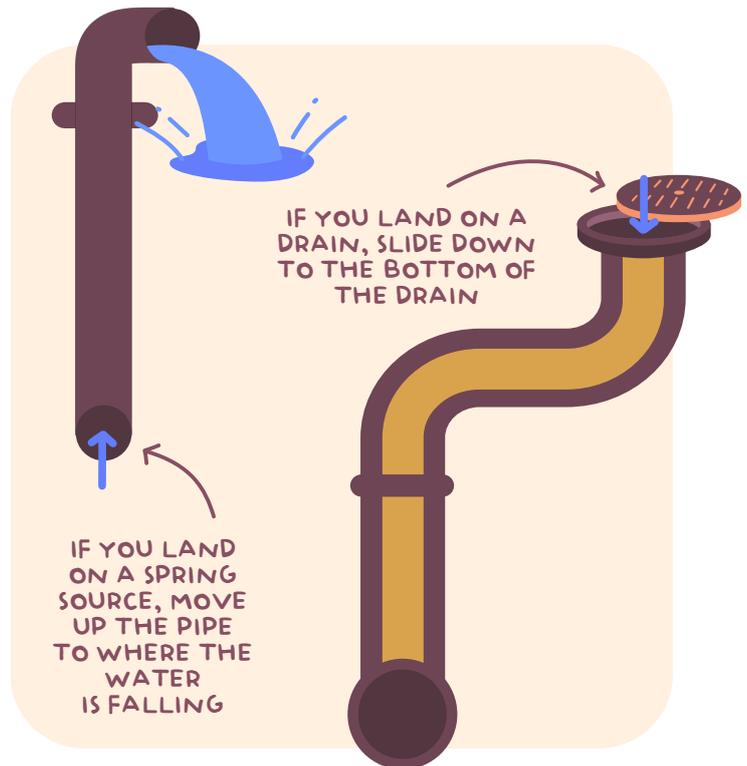
4. The first player to get to the space that says 'home' is the winner. To win, the player will need to roll the exact number to get to the last space.

IF YOU LAND ON A DRAIN, SLIDE DOWN TO THE BOTTOM OF THE DRAIN

IF YOU LAND ON A SPRING SOURCE, MOVE UP THE PIPE TO WHERE THE WATER IS FALLING

BUILD A ROADMAP FOR ADOPTING GOOD PRACTICES

5. By reflecting on the various springs and drains in the game, **create a roadmap to move towards sustainable water resource management**.

   Make a list of all actions that can be adopted to reduce our dependence on external sources for water at the individual level, at the household level, at the neighbourhood /community level.

REFLECTION

- What were the different drains and springs you got? What are the consequences of the practices you came upon?

- Which are the practices that you think are good to adopt or not adopt? Do you plan any changes to be more sustainable?

- Any other best practices that you have adopted at a personal level that you would like to share?

- If you were to make your own game, are there other practices not included in this game that would help better or worsen water management practices?

OPENING THE WORLD OF WATER

THE WORLD
OF WATER
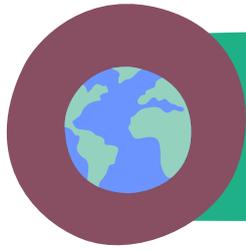
OPENING THE WORLD OF WATER

While sustainability applies to different areas, it is one part of environmental thinking that **focuses on the resilience of human civilisation to respond to environmental events.** Humankind's actions are transforming the earth's landscapes, oceans and even the atmosphere, little knowing if societies can endure as the climate changes. Are humans immune to the laws of nature?

This part is aimed at understanding how water is a fundamental element needed for the survival of various species on Planet Earth, including us humans. We will explore how freshwater is a vital and finite resource and should be conserved for all non-human species and our future generations.

Students are expected to take this opportunity to venture out of their school campuses and find out about local issues impacting water resources. They will investigate what kind of water stresses are present in their respective village/town/city and **understand how or what role the citizens and users play towards this issue.** Students will also brainstorm on ideas and solutions for long-term sustainability.

OBJECTIVES

- To understand the **concept of sustainability and water, within cities/villages/towns**

- To discover the **condition of local water bodies and resources**, and **issues affecting their availability, quantity and quality**

- To connect issues of water to other aspects of **socio-economic development**

- To understand **water as a vital resource for domestic, agricultural, industrial and ecosystem needs** and development

- To brainstorm on **solutions for efficient water management**

📋 INSTRUCTIONS

1. **Identify a water resource, or water and sanitation related issue or solution in your own city/village/town**, which you can observe and investigate.

   It could be a local river, local lakes, groundwater resource or the water and sanitation system in your city/village/town. Find out more about its role in the lives of people and the local ecosystem.

   ## WHAT SHOULD YOU INVESTIGATE?

   - Question the condition of these water bodies and water management systems. Are they healthy and clean? Identify the issues.

   - Explain who shares this resource. Why do they share it? Explain how these people are dependent on the resource for their needs and profit.

   - Have there been changes and depletion to the resource/issue, from the past to the present? What are the impacts of human activities on them, if any?

   - What ideas do you have to improve the situation and enable long-term sustainability of the resource? How can these changes be implemented? What challenges would be faced for implementation and how could they be helped?

   - Speak to local resource persons such as the forest department, water department, local ecologists, environmentalists etc. to gain more insights.

2. **Write an essay.**

   Describe and summarise your findings of the case/issue. Include details of the issue, explaining its condition, the changes from past to present, the role of the water resource/case and any solutions adopted to solve the problem.

- Essay should not exceed 2500 words.

- Include your insights and learnings from various conversations you have had.

- Include sketches and drawings. Photographs are optional, but cannot be used as substitutes.

- Include citations and references to books, interviews etc wherever required. For example, when you quote material, remember to cite your source: "But, as expressed by the World Economic Forum, water crises have been in the top five in terms of global risk ("The United Nations world water development report 2020. source: https://www.unwater.org/").

Remember, the submission should be entirely yours. Do not copy from online sources or/and books.

RESOURCES

You can find below a list of questions that will help you think about water resource management.

Please remember, do not directly answer these questions. These are only guiding questions to help you think along a certain line and analyse your own local water resource/issue.

Some questions might be relevant to you based on the context of your neighbourhood, and will help you ask questions about your chosen local water resource/issue.

WATER FOR AGRICULTURE

- How does water scarcity or water excess affect farmers and agriculture?
- What is the impact of agriculture and livestock rearing on water? How does chemical and industrial farming contribute to water pollution?
- What solutions could be adopted to conserve water?
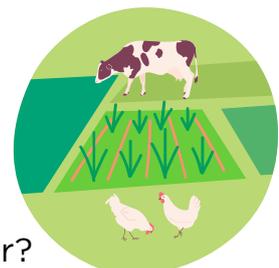
WATER FOR ENERGY AND INDUSTRY

- How do water-related effects of climate affect businesses and industries?

- How can industries reduce their high demands on water for manufacturing or energy generation?

- How do water infrastructure projects (dams, embankments, irrigation canals) affect local communities that rely on them?

WATER FOR DOMESTIC USE AND HUMAN SETTLEMENTS

- How do growing urban population and urban water management systems affect water resources?

- How can domestic regulation of water consumption help in better management of water resources?
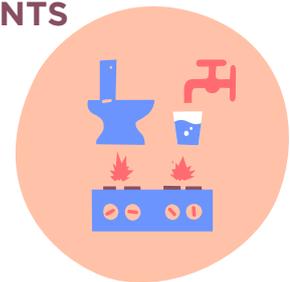
GOVERNANCE AND MANAGEMENT OF WATER RESOURCES

- How can governments help in managing water resources, locally/nationally? What is the role of the government in mitigating water related risks?

- Are there planning and budget allocations for different purposes that use water?

- How can citizens play a role in managing local water resources?
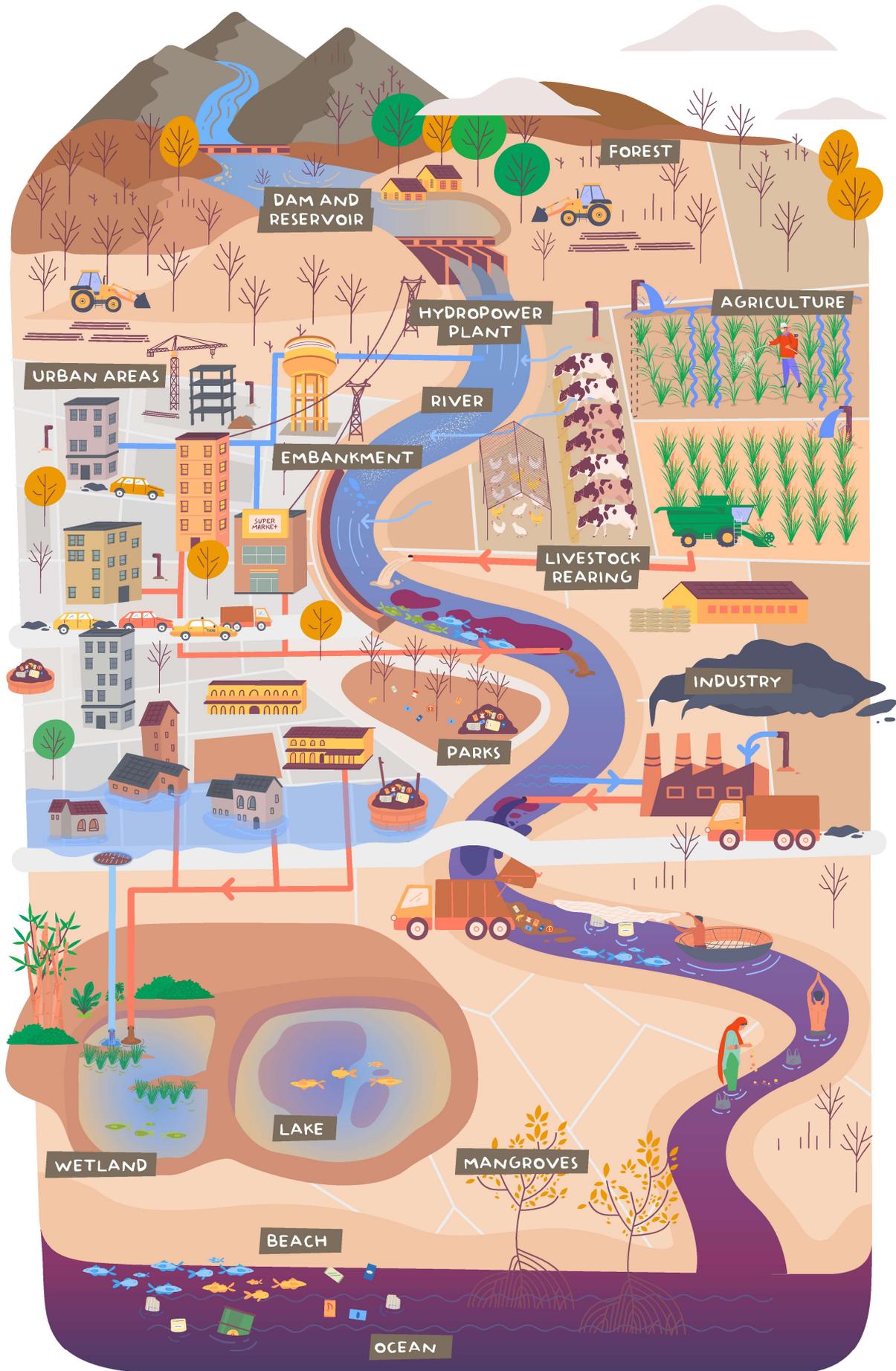
SANITATION AND WASTEWATER REUSE

- How does lack of water and sanitation facilities cause impoverishment and lack of development?

- How does lack of water treatment facilities cause degradation of water and environment?

- How was wastewater managed earlier and now? What are the changes to be made in the way we use, reuse and conserve water in our homes, schools, agriculture and other places?

Lastly, what power do we have as individuals in the way we use and dispose of water? How can we work together towards sustainable management of water resources, at an individual, community, village/city level? Share your ideas that address a local water body/issue.

Spot the differences between the two images and reflect on them. Identify within your own city/village/town if you have come across any of these problems/solutions.

FOREST

DAM AND RESERVOIR

HYDROPOWER PLANT

AGRICULTURE

URBAN AREAS

RIVER

EMBANKMENT

SUPER MARKET

LIVESTOCK REARING

INDUSTRY

PARKS

WETLAND

LAKE

MANGROVES

BEACH

OCEAN

FOREST

URBAN AREAS

RIVER

AGRICULTURE

PARKS

INDUSTRY

SEWAGE
TREATMENT
PLANT

EFFLUENT
TREATMENT
PLANT

WETLAND

LAKE

MANGROVES

BEACH

OCEAN

SUPER
MARKET+

85

'Clean water and sanitation' is one of the 17 **Sustainable Development Goals (SDG)** set by **The United Nations**, with a view to ensuring access to safe water sources and sanitation for all.

The water related targets set by the UN are essential for society's health and well-being, preserving ecosystems and biodiversity, ensuring food security and peace. Water is an essential component of economies, and good water management will ensure socio-economic equality through creation and support of jobs across all sectors of the economy. Find out more about SDGs on **https://www.un.org/ sustainabledevelopment/water- and-sanitation/**

REFLECTION

We have only highlighted some questions to ponder upon. There are many other questions that students could reflect upon and write about. Water and sustainability lie at the core of many of these questions. Identify various other environmental issues (climate, hazardous waste, biodiversity, livelihoods) and the possible solutions that people are working on and understand how they function. Explore, learn, ask questions and think innovatively. Share these learnings in your essay.

WATER PROGRAM COMPLETION CHECKLIST

At the end of your project, please tick the boxes for completed activities to ensure that you have not missed any. This will also help in the evaluation process. *This is compulsory.

PART A
COMPULSORY ACTIVITIES

☐ **INTERVIEWS**

☐ **WATER AUDIT**

☐ **RAINWATER HARVESTING POTENTIAL**

☐ **BUILD TO LEARN**

☐ **CASE STUDIES**

PART A
ELECTIVE ACTIVITIES
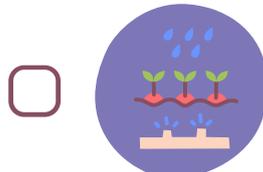
☐ **WATER QUALITY**

☐ **HIDDEN WATER IN OUR FOOD**

☐ **COMPARING SCHOOL CAMPUSES**
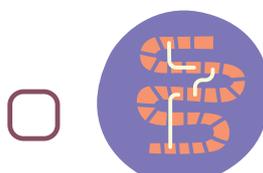
☐ **PLAY A GAME**

PART B
COMPULSORY ACTIVITIES

☐ **THE WORLD OF WATER**

GLOSSARY

Black water - The wastewater coming out of toilets and urinals that contains human feces and urine.

Catchment area - An area on which rain falls. This could be a roof surface or land from where water could be harvested for storage or for groundwater recharge.

Climate chart - A chart which shows yearly temperature and rainfall data for a particular area.

Coagulant - A substance that causes fine particles to clump together.

Conservation - The practice of protection of a natural resource from change, loss or damage.

Decomposition - The process by which dead organic matter is broken down into simpler forms.

Drip irrigation - A micro irrigation system that helps to save water by allowing water to drip slowly on to the roots of plants.

Ecology - The study of the relationship of organisms to one another and to their physical surroundings.

Ecosystem - A community of living organisms and their surrounding environment.

Embankment - A wall built to prevent a river flooding an area.

Environment - All the external factors influencing the life and activities of people, plants, and animals.

Filtration - The process of separating suspended solid matter from a liquid, by passing it through a filter.

Freshwater - Water found in rivers, lakes and under the ground; fresh water is not salty and it is potable.

Greywater - The wastewater coming out of baths, sinks, washing machines, kitchen drains, car parks.

Groundwater - The water beneath the surface of the ground, consisting largely of surface water that has seeped into the ground.

Infiltration - The process by which water seeps into the ground.

Inundation - The submergence and flooding an area of land.

Irrigation - The supply of water to agricultural fields for the purpose of growing crops.

GLOSSARY

Livelihood - The means of securing the basic necessities of life (food, shelter, clothing).

Participatory governance - A process that empowers citizens to take part in public decision making.

Per capita consumption - The average quantity of water consumed by one person per day.

Rainwater harvesting - The process of collecting and storing rainwater for use instead of allowing it to flow away.

Recharge wells - Wells constructed to send rainwater into the ground to increase groundwater levels

Reservoir - An artificial lake created by building a dam for the purpose of storing water for use by a city or town.

Runoff - The part of precipitation or snowmelt that flows on the ground and collects in streams or surface water bodies.

Runoff coefficient - The percentage of rainwater that can be collected from a particular surface.

Sanitation - Refers to public health conditions related to clean drinking water and the provision of facilities and services for the safe management of human excreta.

Seepage - The process through which water leaks through a porous substance/surface.

Septic tank - An underground chamber through which wastewater flows for basic treatment.

Sewage Treatment Plant - A treatment unit where the wastewater from domestic sewage is treated to remove contaminants and make it safe for release into the environment.

Stormwater drain - A channel to drain out excess rainwater from roads, pathways, car parks, footpaths etc.

Watershed - An area of land that drains or "sheds" water into a specific waterbody.

Wetland - A marsh, swamp, or other area of land where the soil near the surface is saturated or covered with water that forms a habitat for wildlife.

Thankyou for participating in earthian!

Hope you enjoyed the experience

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