CAWST
Centre for Affordable Water and Sanitation Technology

SEHGAL FOUNDATION

ACCELERATING INFORMED WASH BEHAVIOR

A participatory community learning guide

TOGETHER
WE EMPOWER
RURAL INDIA

Preface

Marginalized communities in India still struggle with waterborne diseases, mostly due to unsafe drinking water, no toilets, and lack of hand hygiene. Less than 50 percent of India's population has access to safely managed drinking water, which is further exaggerated by climatic extremes.

Water, sanitation and hygiene (WASH) are the issues that often affect poor population in terms of their growth, health, and well-being in addition to socioeconomic conditions. For a large number of people, poor WASH practices increase the incidence of illness, thereby affecting finances. Unsafe and poor quality of water, sanitation, and hygiene precipitate greater poverty, and affect education, development opportunities, and gender inequality.

According to a Joint Monitoring Programme Report by WHO in 2021, two billion people across the globe lacked safely managed WASH services. Among the Indian rural population, safely managed services for drinking water are available only for 56 percent, sanitation for 50.5 percent, and basic hygiene is practiced by only 60 percent. Achieving universal coverage by 2030 will require multiplying current rates of progress in safely managed drinking water services, safely managed sanitation services, and basic hygiene services.

Many communities and even WASH implementers are not aware of simple and affordable household water treatment technologies for drinking water, which can facilitate safe water coverage for the needy population. A low-cost hand washing station can stop the spread of infections; as most marginalized households use the same source of water for different purposes.

Lack of resources and awareness are the major barriers for poor households in India adopting appropriate WASH practices. Through sensitization and awareness building, community members realize the need of safe drinking water, hand hygiene, toilet use, and affordable drinking water technologies to pave the way for communities at the last mile to correct and practice consistent and continuous WASH behaviors. Innovative low-cost and situation-friendly hardware is another need in this context.

This manual has been designed to sensitize community members about water, sanitation and hygiene (WASH). This will help facilitate a sensitization and awareness-building process. This reference manual is intended for field trainers based on an activity-based learning approach. Each session topic is designed to promote understanding of the concepts and importance of adopting safe WASH practices to sustain happy and healthy lives. These sessions on WASH aim to prevent water-related diseases affecting overall health and growth, bring about healthier lifestyle changes, and decrease the occurrence of waterborne diseases and economic stress at the last mile.

Mr. Lalit Mohan Sharma
(Principal Scientist)
Water Research and Training Team
S M Sehgal Foundation

Ms. Aparajeeta
Ms. Yashi Gautami
(Assistant Program lead)
Water Research and Training Team
S M Sehgal Foundation

Acknowledgement

This manual was developed with much assistance, support, and inspiration from many individuals and organizations. We are very grateful to *Dr. Suri Sehgal (Chairman), Ms. Anjali Makhija (CEO of S M Sehgal Foundation), Mr. Jay Sehgal (Vice-President)* for their support and motivation in bringing this unique assignment on WASH.

We also thank the *CAWST Team, Ms. Shauna Curry (CEO); Mr. Suneel Rajavaram (Senior Global WASH Advisor); Ms. Leanne Madjidi (Global Learning Advisor); Ms. Karen Joe (Knowledge and Research Advisor)* for their wonderful guidance during the development of the modules by interacting with us consistently and giving information about the programs and materials.

We also thank *ENPHO, Nepal,* for the rich resourceful information developed locally on training material and *Mr. Sumit (Staff Member with S M Sehgal Foundation Foundation in Bihar)* for his groundwork on the manual.

We acknowledge *Ms. Pooja O Murada (Principal Lead), Ms. Arti Manchanda (Senior Program Lead), Ms. Sonia Chopra (Program Lead), Mr. Siprian Kiro (Assistant Program Lead) and Ms. Debika Goswami (Senior Program Lead)* for their contributions to the advancement and development of the module.

We also thank the editorial team Marly for their final review and value addition to this module for Training of Trainers.

Water Research and Training Team

S M Sehgal Foundation

Foreword

The mission of S M Sehgal Foundation is to strengthen community-led development, particularly those that achieve positive social, economic, environmental change across rural India. S M Sehgal Foundation designs and promotes rural development interventions to address some of the most pressing challenges in India's poorest communities. We believe that partnerships can bring about lasting impact. Our partnership with CAWST is one such example of sharing organizational strengths serving the people in need.

Access to safe drinking water has been a serious challenge in India, both in rural and urban areas, while lack of access to safe drinking water has become a huge burden on the economy and public health of the country. Training and capacity building have long been established as critical components of water, sanitation, and hygiene (WASH) policies, strategies, and programs. As WASH takes center stage in India like other developing countries in the pursuit of achieving SDG targets, these are crucial toward enhancing the quality of capacity-building efforts targeting important stakeholders who are closer to the site of implementation, and bring about positive changes in orientation and motivating the communities. S M Sehgal Foundation is working to fill the large gap of capacity building for promoting sustainable WASH practices that address the actual requirements of the communities and reduce women's drudgery. This manual is a guidebook for training of trainers promoting better WASH behaviors.

I hope this training manual finds wide acceptance and proves useful in bringing positive changes in people's lives. This manual remains freely available for all those who are interested in capacity building.

Let's together work for building safer WASH practices for all.

Anjali Makhija
Chief Executive Officer, S M Sehgal Foundation

Foreword

Safe drinking water is a basic human need and in spite of tremendous advances in science and technology, 884 million worldwide, and 91 million in India, do not have access to safe drinking water. In order to meet this need, the World Health Organization (WHO) and Centre for Disease Control (CDC) consider household water treatment and safe storage (HWTS) to be an effective intervention to provide safe water to households.

S M Sehgal Foundation have been both early adopters and champions for household water treatment in India by promoting and sharing knowledge on different household water treatment products and technologies including the biosand and ceramic pot filters. This momentum has continued to grow through the establishment of the household water treatment and safe storage network in India in 2020, which is being coordinated by Sehgal Foundation is a significant milestone in spreading knowledge of safe water in India.

CAWST's vision is a world where people have the opportunity to succeed because their basic water and sanitation needs have been met. CAWST works with likeminded organizations to build the capacity of water, sanitation and hygiene (WASH) implementers around the world and in India. We are pleased to partner with the S M Sehgal Foundation since 2016 and through this partnership, together we have trained more than 1350 participants from 343 organizations.

CAWST and the S M Sehgal Foundation began their partnership by delivering in-person workshops on household water treatment and safe storage and drinking water quality testing. Most recently, S M Sehgal Foundation has been delivering a series of online workshops in these fields, created by CAWST, and the team is doing an excellent job of delivering these online trainings for both Indian and international audiences.

Based on lessons learned, we hope this manual supports grassroots organizations to initiate, strengthen, and scale up their water programs. Congratulations to the entire S M Sehgal Foundation team for all the great work they are doing on safe water issues. I wish the S M Sehgal Foundation team all the best in their endeavours to make this world a better place.

Tal Woolsey
Vice President, CAWST

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Chapter 1

How Water gets Contaminated

Purpose:

Inform the participants about "how water gets contaminated."

Materials Required:

Colorful scenario cards, transparent glass, clean drinking water.

Session Introduction Activity:

Fill a transparent glass with fresh water from a hand pump or water bottle, show the glass to the participants, and ask if can you drink this glass of water, everyone's answer will be yes. Then in front of them, dip a leaf in the glass of water, after that, again ask who would like to drink this glass of water, then no one will answer.

Session Introduction Discussion:

- What happened to this water after dipping leaf that you do not want to drink this water?
- What can happen by drinking this water?
- Leaf can come in contact with human or animal feces, if not directly, through flies taking bacteria from feces to leaves.

Session Details:

- We will discuss how water becomes dirty. We will show through a scenario card how water gets contaminated by human activities such as defecating on the banks of the river, cleaning dirty clothes in the river, throwing garbage in the river, bathing cattle, etc.
- We will also discuss how water can be contaminated from the dirt and puddles around the hand pump.
- Open defecation means that nearby water is impure whether from human or animal feces; this point will also be discussed.
- Human or animal feces (1 gram) can contain about one million bacteria, which is enough to make us sick.

Key Points for Discussion:

Show a colorful scenario card with a river and a colorful scenario card with a hand pump and asks them what's objectionable and why?

- Organic impurities are very dangerous because that can make us sick immediately.
- Cleanliness around the house is done loudly around festivals and why do not we pay attention to cleanliness always?
- Apart from this also discuss other reasons which can contaminate water.

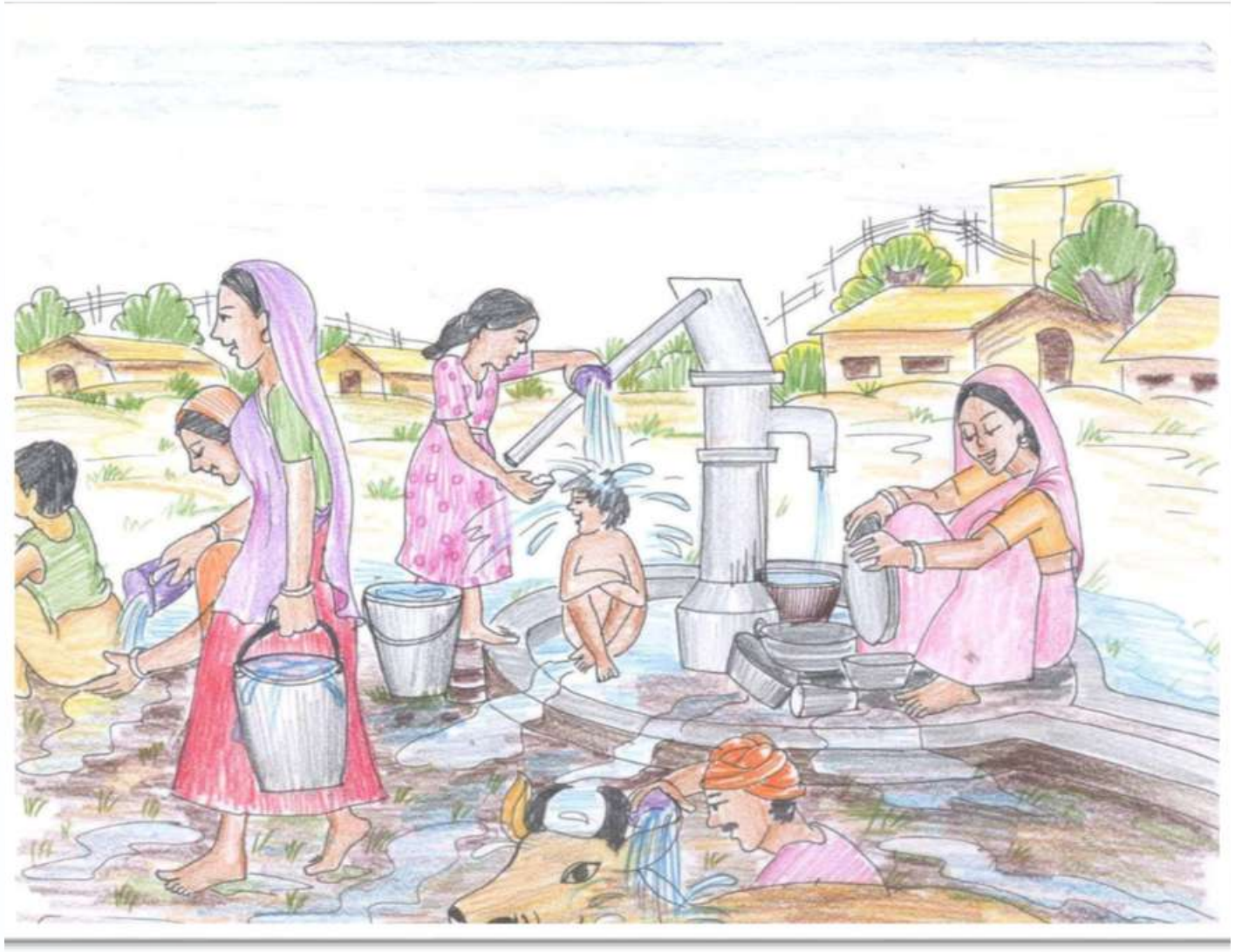
Review:

- Ask participants what new thing they learned today?
- Is it safe to consume groundwater direct from the source in an area where people openly defecate?

Scenario Cards

Water Contamination: River

Water Contamination: Household



Water Contamination: Community Handpump

Chapter 2

Consuming Unsafe Water can make us Sick

Purpose:

To build awareness about: water can contain microbial contamination, and use of contaminated water can make us sick.

Materials Required:

Scenario card, poverty cycle, a transparent glass, bottle of water.

Session Introduction Activity:

Show the scenario cards and a glass full of water and ask the participants following questions:

- What do you observe in this card?
- What can you notice in this water?
- What is present in this water that is not visible?
- What will happen to you if you drink contaminated water?
- What disease can we get when we drink contaminated water?

Session Introduction Discussion:

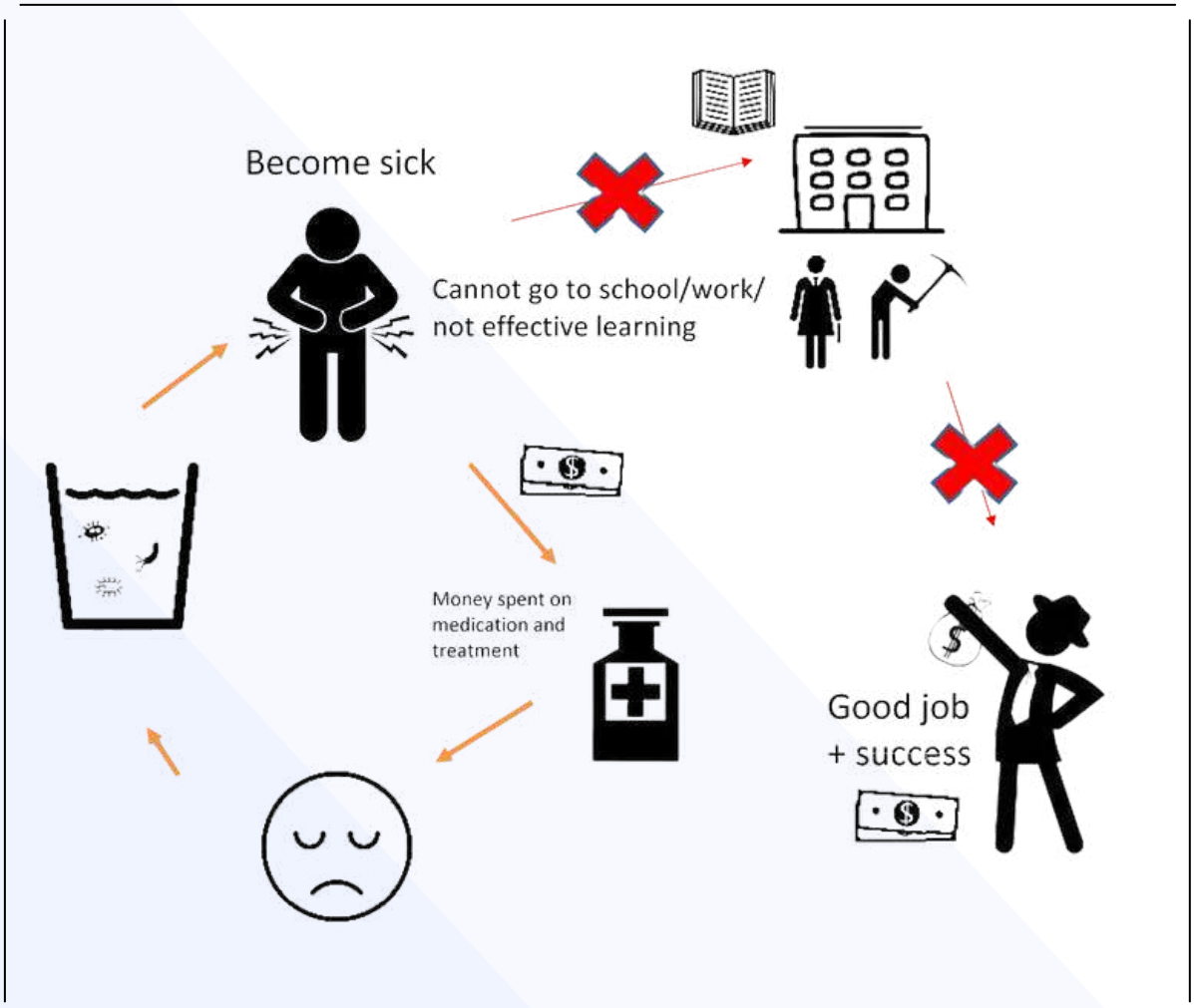
We will discuss the points mentioned above and tell them that if appearance of water is dirty, we know that it can be contaminated. When we see clean water, we often think that it is clean. But this is not always true. There may be pathogens present which appears to be clean water, which can only be visible through a microscope. Consuming contaminated water may cause illnesses such as vomiting, abdominal pain, diarrhea, fever, cholera, jaundice, gas problems in the stomach, constipation, sour belching, skin diseases.

Poverty Cycle:

If we get sick, we may have to go to the doctor or even be admitted in the hospital. We may have to miss school or work. Getting treatment for an illness can be costly also. Our household economy is affected by spending all the savings on the treatment while earnings are stopped due to disease, and we can be trapped in a poverty cycle.

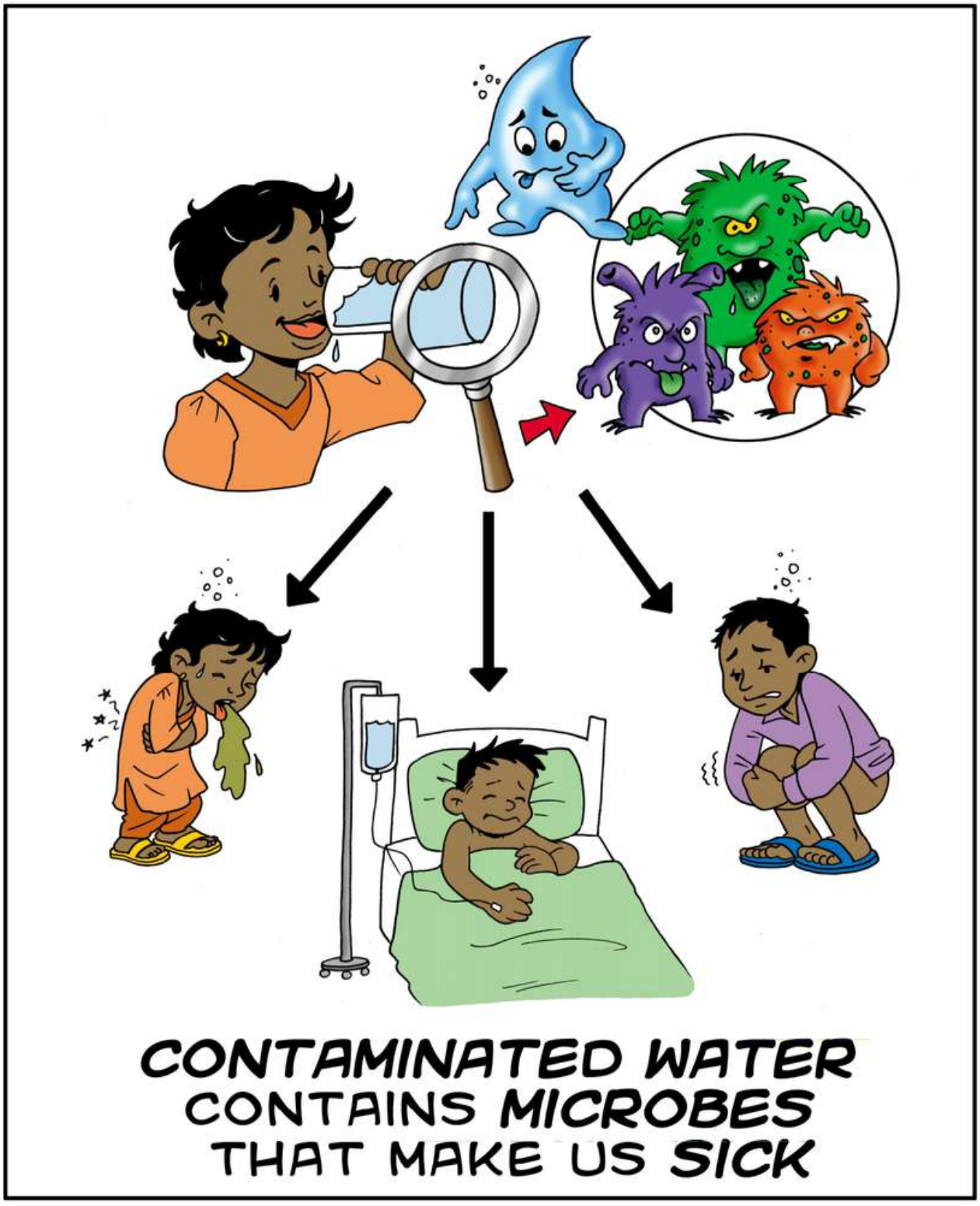
Review:

- Have you been sick recently?
- Do you know the reason of your sickness?
- Have you been sick from drinking contaminated water?
- Were you able to continue your work during the illness?
- Has the illness had any impact on your financial situation?
- If water has a clear appearance, can we assume it is clean/contains no pathogens?



Poverty Cycle

Scenario Card



Consumption of Contaminated Water

Chapter 3

Transmission of Disease-Causing Pathogens

Purpose:

To build awareness about the transmission of diseases causing pathogens from feces to face and mouth.

Materials Required:

White and yellow cards.

Session Introduction Activity:

Show white and yellow cards and ask the following questions:

- What do you observe in these cards?
- Through what means can the pathogen enter the mouth and body from feces?
- How do flies spread pathogens?
- How do pathogens spread through water?
- Ask participants to arrange cards to show the transmission of pathogens.

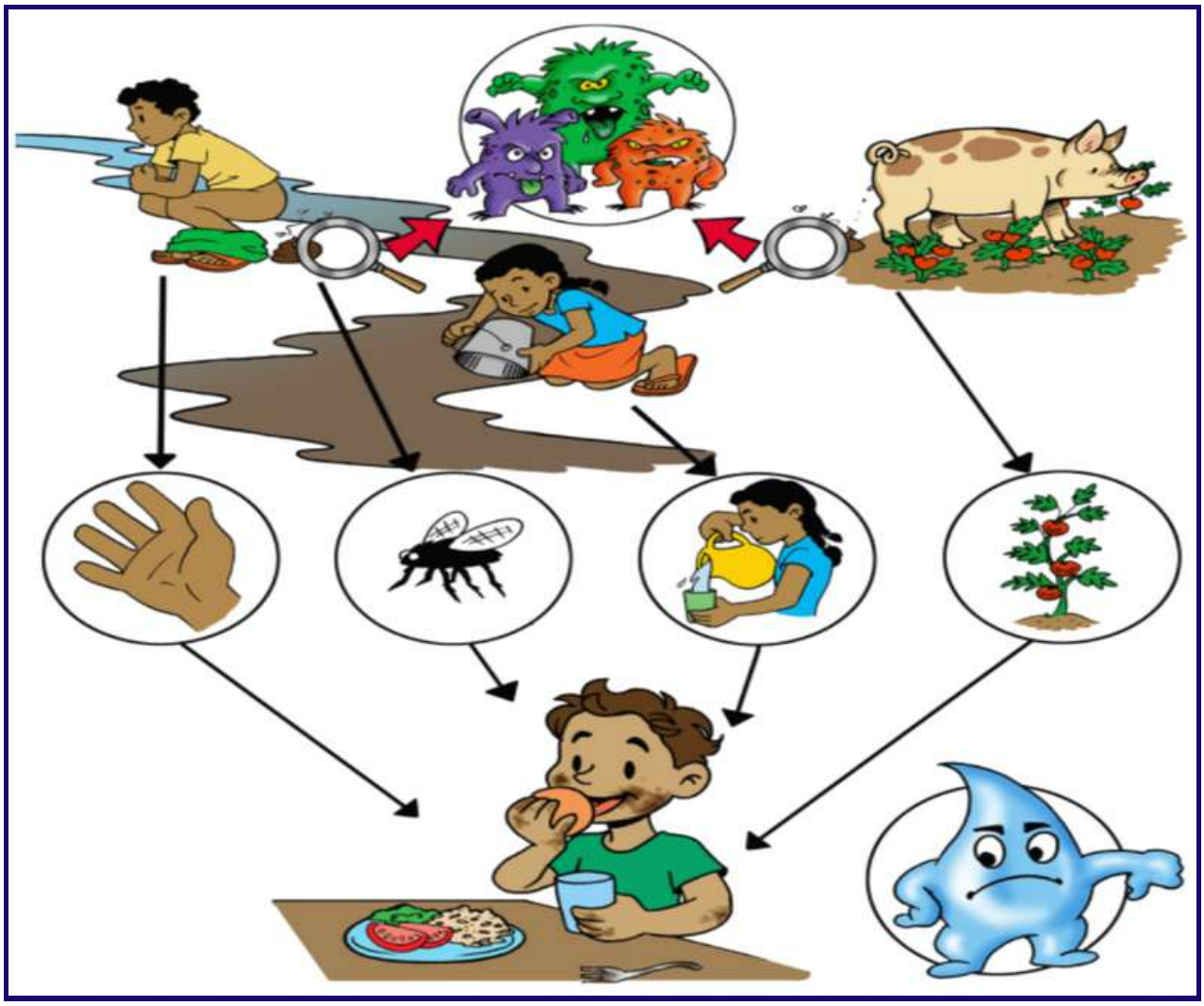
Session Introduction Discussion:

- As shown in the picture card, pathogens enter the mouth and stomach from feces through our hands and fingers.
- Whenever we touch the feces of an animal or human, the pathogens present there stick to our hands. If we do not wash hands before eating or cooking, the pathogens may go to the mouth and stomach, causing illness such as stomach pain, diarrhea, etc.
- In the open defecation area flies will sit on the feces; from there, pathogens sticks to the feet of the flies. After that, if the fly sits on uncovered food, it leaves the pathogens there, thereby spreading the pathogens and diseases when you eat the food.
- Flies can spread the pathogens and thereby diseases by sitting on our mouth or hands.
- The pathogens can also come in contact with our hands or feet from the feces lying on the roadside.
- Fruits and vegetables can also carry pathogens, which can enter the body via mouth if eaten without washing.

Review:

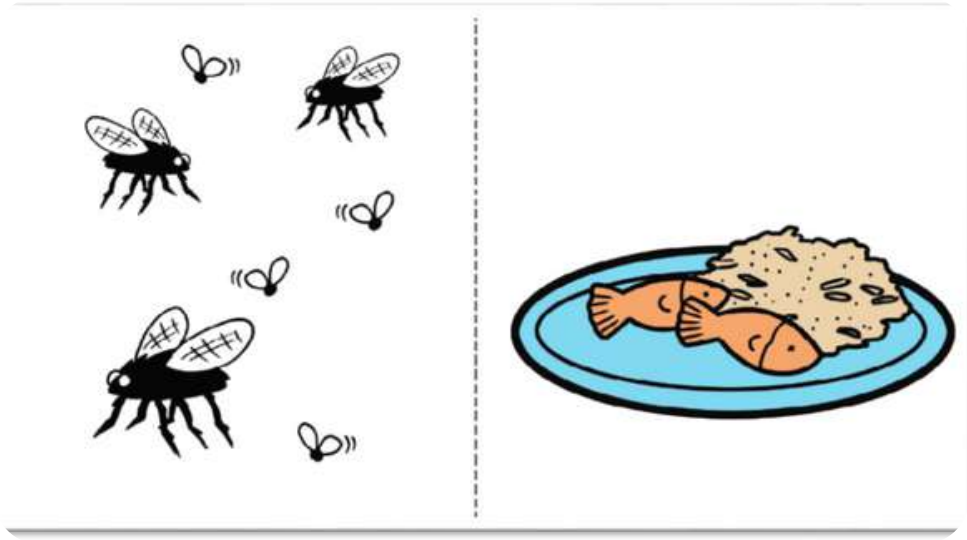
- How can flies spread germs?
- How do germs spread from the road or farm?
- How do germs spread through our hands and fingers?
- True or False: Pathogens can enter food through external sources if food is left uncovered/unwashed.
- Can pathogens enter the household through open defecation?

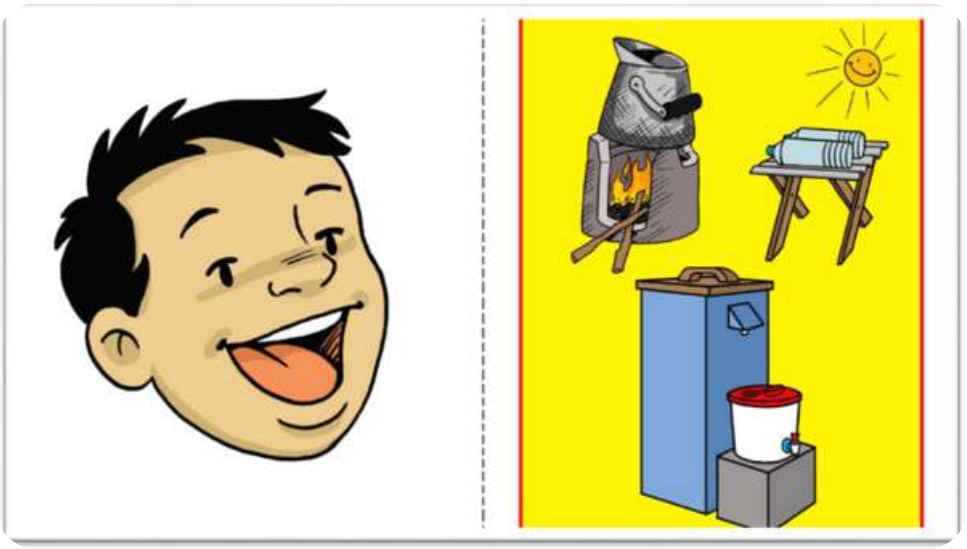
Scenario Card

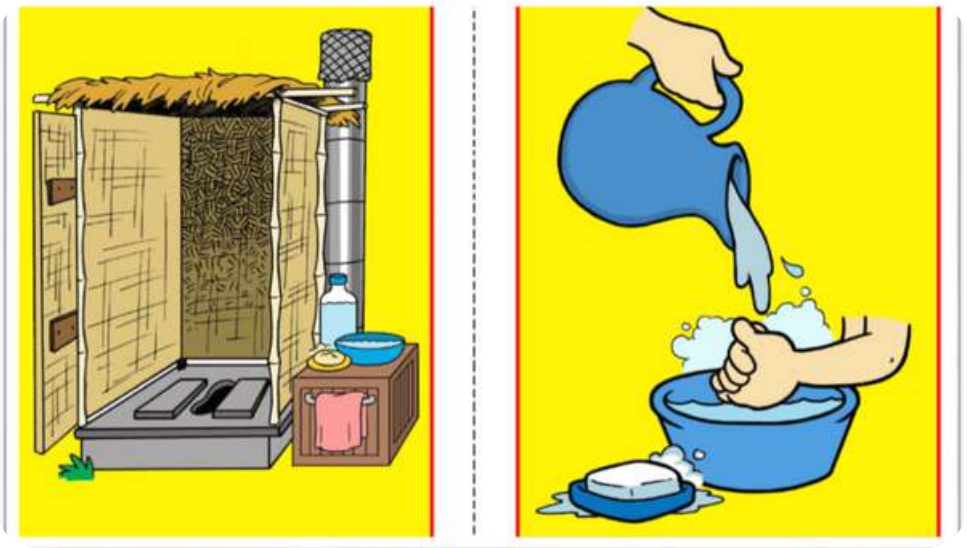


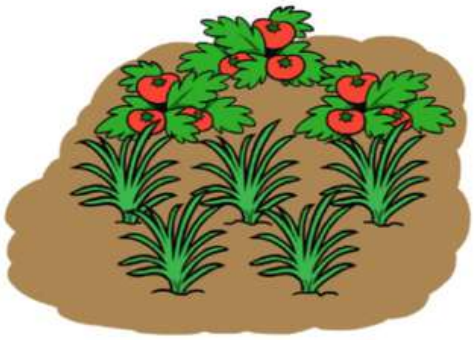
Disease Transmission

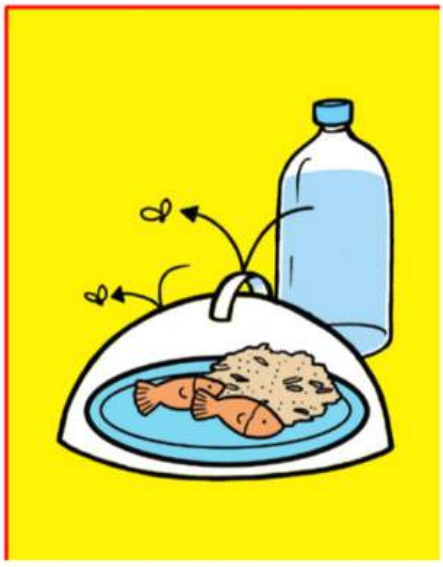
White and Yellow Activity Cards











Chapter 4

Importance of Handwashing

Purpose:

Build awareness about importance and correct process of handwashing.

Materials Required:

Makeup powder or turmeric, a picture of steps to wash hands, etc.

Introductory Activities Shiny Handshake:

Ask two participants to apply turmeric or powder to their palms, which can easily be spread onto the other person's palm while handshaking. Shake hands in a way that other person won't notice the powder. Then ask people to see their hands.

This is the same way the pathogen transmission takes place from one to another.

Session Introduction:

Handwashing is an important barrier for prevention of transmission of waterborne diseases. Proper handwashing can reduce the spread of pathogens, thereby preventing harmful infections like diarrhea and vomiting, and must be performed properly.

When should one wash hands?

- After defecation
- Before cooking or eating or serving
- Before touching eyes, nose, and mouth
- After coming from the market
- Before worshiping
- Before feeding/ children

Session Introduction Discussion:

How did turmeric or powder spread in everyone's hands?

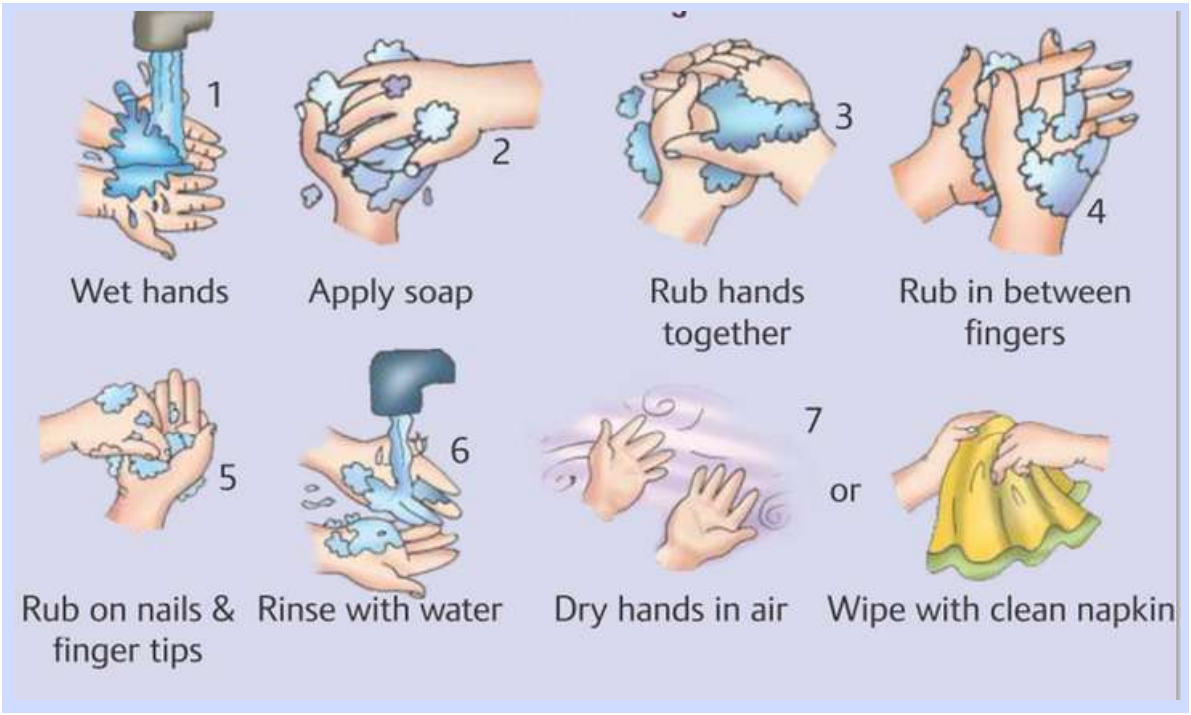
Why it is important to wash hands:

- Throughout the day, many activities are done with our hands. There is a possibility of fingers and palms getting dirty. Pathogens are so small that they are not visible to the naked eyes.
- Diseases such as diarrhea, cholera, typhoid, jaundice, etc., can be caused by not practicing handwashing.

Correct Handwashing Procedure:

- First apply soap on both wet hands and rub them well. Do this for 10 seconds.
- After this, turn the palms and wash the back side for 5 seconds.
- Now alternately rub the space between the fingers with fingers of other hand.
- Similarly, clean the back surface of the fingers.
- Now rub the surface of the thumb and clean it thoroughly.
- Clean the nail by rubbing.
- Finally wash hands thoroughly with water.
- After that, the hands should be wiped dry with a clean towel.

Steps of Handwashing



Handwashing Cleaning Agent:

Handwashing must be practiced with:

- Soap + water
- Ash + water in absence of soap

However, it is better to use soap.

Review:

- Why should we wash hands?
- When should we wash hands?
- What materials can be used to wash hands?
- Can germs still spread from person to person even if their physical appearance is clean?

Chapter 5

Importance of Handwashing Station

Purpose:

Understanding the importance of handwashing station to reduce transmission of diseases.

Materials Required:

Flash cards.

Session Introduction Activity:

Show the flash cards to the participants and ask the following:

- What do you observe in these cards?
- How is the handwashing practice different in each flash card?

Session Introduction Discussion:

Why it is important to wash hands-

- Throughout the day, many activities are done with our hands. There is a possibility of fingers and palms getting dirty and infected with pathogens. Pathogens are so small that they are not visible to the naked eyes.
- Diseases such as diarrhea, cholera, typhoid, jaundice, etc., can be caused by not practicing safe handwashing.
- Hand washing is important but how to do it?

Activity Discussion:

- Explain the different scenarios presented in each cards.

1. *Card 1: Washing hands in a basin and with a soap, a good practice, Why?*
2. *Card 2: Washing hands into the container, not a good practice, Why?*
3. *Card 3: Washing hands with the help of another person, can be a good practice, but need another person to help.*
4. *Card 4: Washing hands from a tippy-tap handwashing station, a good practice, Why?*

- Explain to the participants that using the same source (say a hand pump) for washing hands after defecation and fetching water for household purposes can spread the pathogen among the community members and can make them sick.

- Explain to the participants the importance of handwashing stations.
  - It is convenient to practice handwashing station.
  - Use of handwashing station can stop the spread of pathogens.
  - Handwashing station helps behavioral change towards safe handwashing practice at the required time.
  - Handwashing station must be built suiting to affordability.

Handwashing Station Components:

Water dispenser (having tap) and soap

Review:

- Do you understand the importance of washing hands at a handwashing station?
- Is it safer to use a hand pump or a tap for handwashing?
- True or false: Sicknesses will be prevented if handwashing is stopped.

Flash Cards

Handwashing

Tippy-Tap Handwashing Station

Handwashing Station

Wash Basin

Chapter 6

Building a Handwashing Station

Purpose:

To motivate people to adopt handwashing practices and use of hand washing stations.

Materials Required:

Colored picture of tippy-tap, local materials to build a tippy-tap station.

Session Introduction Discussion:

Why handwashing should be practiced-

- Washing hands kills germs.
- If food is eaten with dirty hands, germs might enter into the body and the person can fall ill.
- Not washing hands properly can lead to spreading of diseases such as meningitis, influenza, Hepatitis A, coronavirus, and diarrhea.

Session Discussion:

Why should we use a separate handwashing station for washing hands and not use a hand pump for washing hands?

- To prevent transmission of pathogens from one to many.

Activity Discussion:

Why is a handwashing station important?

- Ease of use.
- Easy access to soap and water.
- Prevention of wastage of water.
- Avoid touching the tap or handle of the hand pump.

To make your own tipi tap, we use the following ingredients:

- 2 meter stick × 2
- 1 meter straight stick × 1
- Shovel for digging holes
- Water container
- Soap, rope, iron fort, gravel, candle, match, etc.

Following are the steps to make Tippy-Tap Handwashing Station —

1. Dig two holes 12 inches deep and about 2 feet apart.
2. Place the sticks, ensure they are level.
3. Fill holes with soil and rocks and pack tightly.
4. Hit the nail and make holes in the water container as shown in the figure.
5. Make a hole in the soap and put thread string.
6. Hang container and soap and fill with water.
7. Attached 2-meter string to water container, a second stick is tied at its end, which is used to run with the foot.
8. Now the container should be filled with water.
9. Grass, brick, or gravel should be used as a filler in the soak pit made to capture the waste water.

Review:

- Ask the participants the importance of handwashing station.

Handwashing Station

Chapter 7

Know about Ceramic Pot Filter

Purpose:

To build awareness about Ceramic Pot Filter (CPF).

Materials Required:

A ceramic pot filter and receptacle (safe storage container), "Ceramic Pot Filter Maintenance" user pamphlet, flipchart paper and markers.

Introductory Activity:

- Ask participants about incidence of waterborne diseases, causes, and solutions.

Session Introduction Discussion:

- Ask the participants to have a close look of CPF and discuss with a partner: "What do you know about a ceramic pot filter?" If they don't know what it is, ask them to discuss what they think it could be.
- Ask the larger group: "What can you tell me about a ceramic pot filter?"

CPF is used as one of the form of household water treatment in many parts of the world. These filters are both locally and industrially produced. It is a low cost water treatment technology which is capable to remove microbial contamination, turbidity and improves water quality at household level.

- Discuss with the participants: How a CPF is manufactured, what are the materials used in the making of a CPF, and about the application of colloidal silver.
- Discuss how CPF works and role of silver impregnation

The raw water is poured into the ceramic pot filter. The water slowly passes down through the micro channels and pores; and filtered water is collected in the receptacle. The tap at the receptacle is usually preferred for fetching treated water. The CPFs are capable to remove iron, microbial contamination, and turbidity. CPF also reduces TDS to some extent.

The larger pathogens and suspended particles are removed through physical processes like mechanical trapping and adsorption. Colloidal silver acts as an anti-microbial shield, breaking the cell wall of the microbe and ultimately causing the death.

- Ask participants: "Can someone describe to me how to use this filter?"
- Demonstrate and explain how to use the filter:
  - Prepare the filter: make sure that you have a storage container that is very clean and has a tap.
  - Place the ceramic pot on top of the open safe storage container.
  - Pour water into the ceramic pot (up to an inch below the brim).
  - Explain to participants that a ceramic pot filter has very small holes to filter out the pathogens very effectively. Silver as part of the ceramic Filter help in eliminating pathogens including viruses from the water.
  - Explain to participants that the ceramic pot filter can filter 1-3 liters per hour.
  - Explain to participants that although the filter is very effective, it is not 100 percent effective. It is always better to add chlorine to the safe storage container to make sure the water is fully safe to drink.
  - Use the tap on the safe storage container for filtered water.

Benefits and Limitations of a CPF:

- Participants after knowing the details of CPF must know about the benefits of using CPF.
  - Simple and easy to use
  - Low price
  - Easy maintenance
  - Water always available at point of use
  - No consumption
  - Eliminates bacteria for years
  - Locally produced
  - Good taste without chlorine

- With the coming benefits, it also has some limitations:
  - Fragile
  - Easily gets cracked due to mishandling
  - Undetectable cracks

- Flow rate

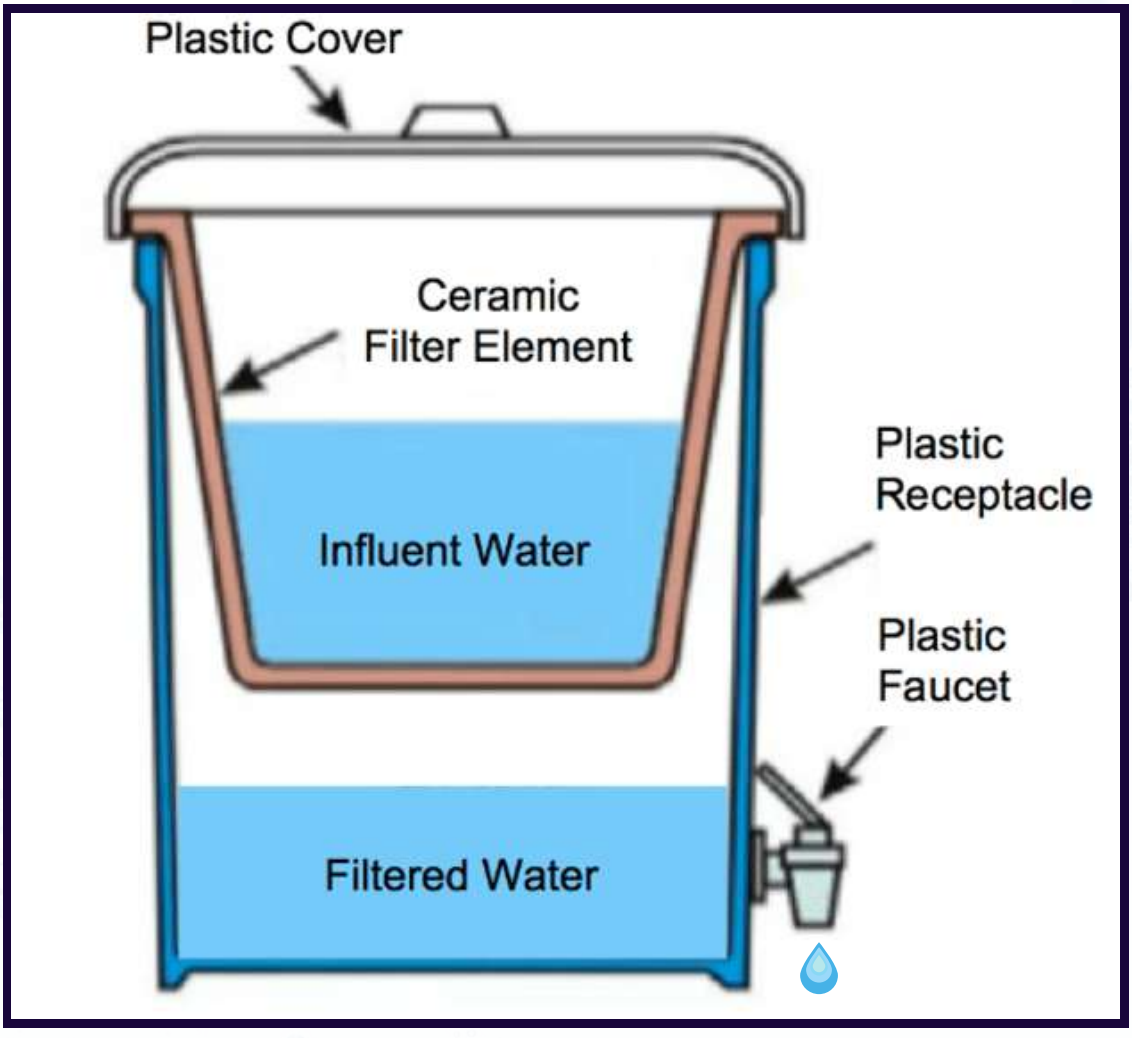
When the pot filter is full, flow rate is highest. With the regular use of filter and accumulation of contaminants within the filter pores it might reduce the flow rate. The flow rate, volume and supply are provided in the below table.

Flow Rate	Batch Volume	Daily Water Supply
1-3 Liters/hour	*9 Liters*	*20-30 Litres*

- *Estimated lifespan*
  - Up to 5 years, generally 1 year
  - Filter needs to be replaced if there are visible cracks or silver application after 3 years

Review:

1. What are the materials used for making CPF?
2. What is the role of silver?
3. What quality improvement CPF does to water for drinking?
4. How does a ceramic pot filter help reduce the transmission of microbial contaminants?



Ceramic Pot Filter

Maintenance of Ceramic Pot Filter (CPF)

अपने फिल्टर का रखरखाव कैसे करें

ध्यान रखें:

- फिल्टर को साफ करने से पहले हाथ ठीक तरह से साबुन से धोएं।
- सफाई के दौरान माटीकल्प फिल्टर की बाहरी सतह को गंदे हाथ या किसी गन्दी वस्तु से नहीं छूना चाहिए।

क्या आपका फिल्टर साफ है?

जब फिल्टर से पानी कम आने लगे तो यह एक संकेत है कि मिट्टी के फिल्टर के छिद्र बंद होने लगे हैं।

फिल्टर कैसे धोएं?

- मिट्टी के फिल्टर को तब न उठाएं जब यह पानी से भरा हो। मिट्टी के फिल्टर के खाली होने तक प्रतीक्षा करें।
- अपने हाथ साबुन से धोएं।
- भंडारण से मिट्टी के फिल्टर को निकालें और इसे एक साफ प्लेट या फिल्टर के ढक्कन पर रखें जिसे फिल्टर हुए पानी से धोया गया हो।
- फिल्टर किए गए पानी को फिल्टर में वापस डालें।
- फिल्टर में जमे हुए कणों को हटाने के लिए कपड़े धोने के मुलायम ब्रश के साथ फिल्टर को अंदर और बाहर से साफ करें। बेहतर है अगर आप फिल्टर साफ करने के लिए अलग ब्रश का इस्तेमाल करें
- अगर मिट्टी में से कुछ निकलता है तो घबराएं नहीं। इसका मतलब है कि आप अच्छी तरह से साफ कर रहे हैं, लेकिन बहुत अधिक न रगड़ें।
- फिल्टर को फिल्टर किए हुए पानी से खंगालें।
- हर महीने क्लोरीन युक्त पानी के साथ या साबुन के साथ भंडारण को साफ करें।
- सफाई की प्रक्रिया समाप्त होने के बाद फिल्टर को प्लास्टिक के भंडारण में पहले की तरह रख दें।

सावधान! फिल्टर को धोने के लिए क्लोरीन युक्त पानी या साबुन का उपयोग न करें।

CAWST Centre for Affordable Water and Sanitation Technology

SEHGAL FOUNDATION

Chapter 8

Know about JalKalp Biosand Water Filter

Purpose:

To build awareness around JalKalp water filter.

Materials Required:

Action cards representing JalKalp Processes, A JalKalp water filter and safe storage container, JalKalp puzzle game.

Introductory Activity:

Show the Action cards and discuss what actions are shown in the cards and briefly talk about these actions.

Session Introduction Discussion:

Ask participants about incidence of waterborne diseases, cause and solutions.

Session Discussion:

- Ask the participants to have a close look of JalKalp diagram and discuss with a partner: "What do you know about a JalKalp biosand filter?" If they don't know what it is, ask them to discuss what they think it could be.
- Ask the larger group: "What can you tell me about a JalKalp biosand water filter?"

- A JalKalp biosand filter is a water filter that makes dirty water safe to drink. It can be used in houses or buildings like schools. It is made of stainless steel. It is filled with layers of sand and gravel that are carefully prepared to go inside the filter. Pathogens, iron and turbidity are removed by physical and biological processes in the filtration sand.

- Discuss with the participants: How JalKalp is installed, what materials are used in installing JalKalp, and the application of copper foil.

- Discuss how JalKalp works and role of copper foil

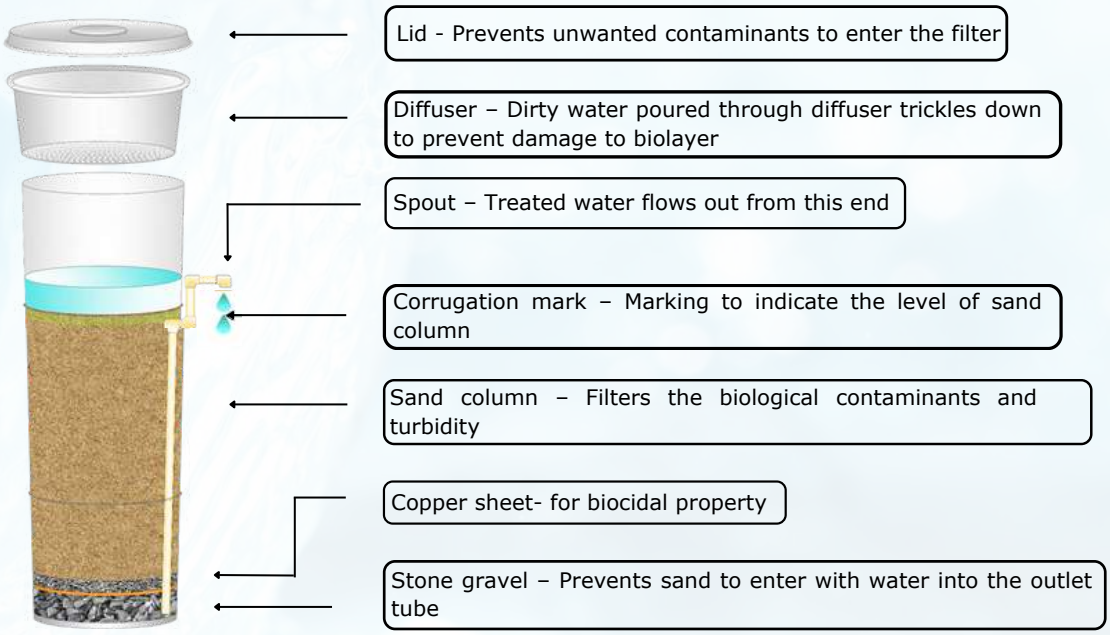
- The raw water is poured into the filter through a diffuser that travels through sand and stone gravels. Microbes adhere to the surfaces of specially

prepared sand (Adsorption).

- The biolayer that forms on top of the sand layer contains microbes, kills one another (Predation).
- Inside the filter, water trickles down through tiny pores (spaces) between sand particles. Fine grain sand particles prevent the passage of pathogens (Mechanical trapping).
- Ask participants: "Can someone describe to me how to use this filter?"
- Demonstrate and explain how to use the filter:

- If the water is very cloudy, settle the dirt before pouring it into the filter. It's important to use the clearest water available.
- Be sure to get from the same source every time.
- Use one container for collecting water and a different one for the filtered water.
- Never put anything in the reservoir except water.
- Always pour water through the diffuser.
- The reservoir at the top will hold liters of raw water. That's about 1 bucket.
- Always place the lid back to keep out flies, dust, and other unwanted objects.
- You'll see the water start to flow out of the outlet. Make sure the storage container is always clean.
- The flow rate of the filter should be around 0.65 liters per minute.
- Take about one hour for the water to flow through the filter.
- You'll need to let the JalKalp rest for before pouring in bucket of water.
- Be sure to pour at least once in the filter every day. Otherwise, the biolayer could die! If the biolayer dies the JalKalp will not work.

- Once you are finished filtering the water it's time to disinfect it to make sure it's totally safe to drink. There are different ways to disinfect your water such as chlorine, SODIS and boiling.



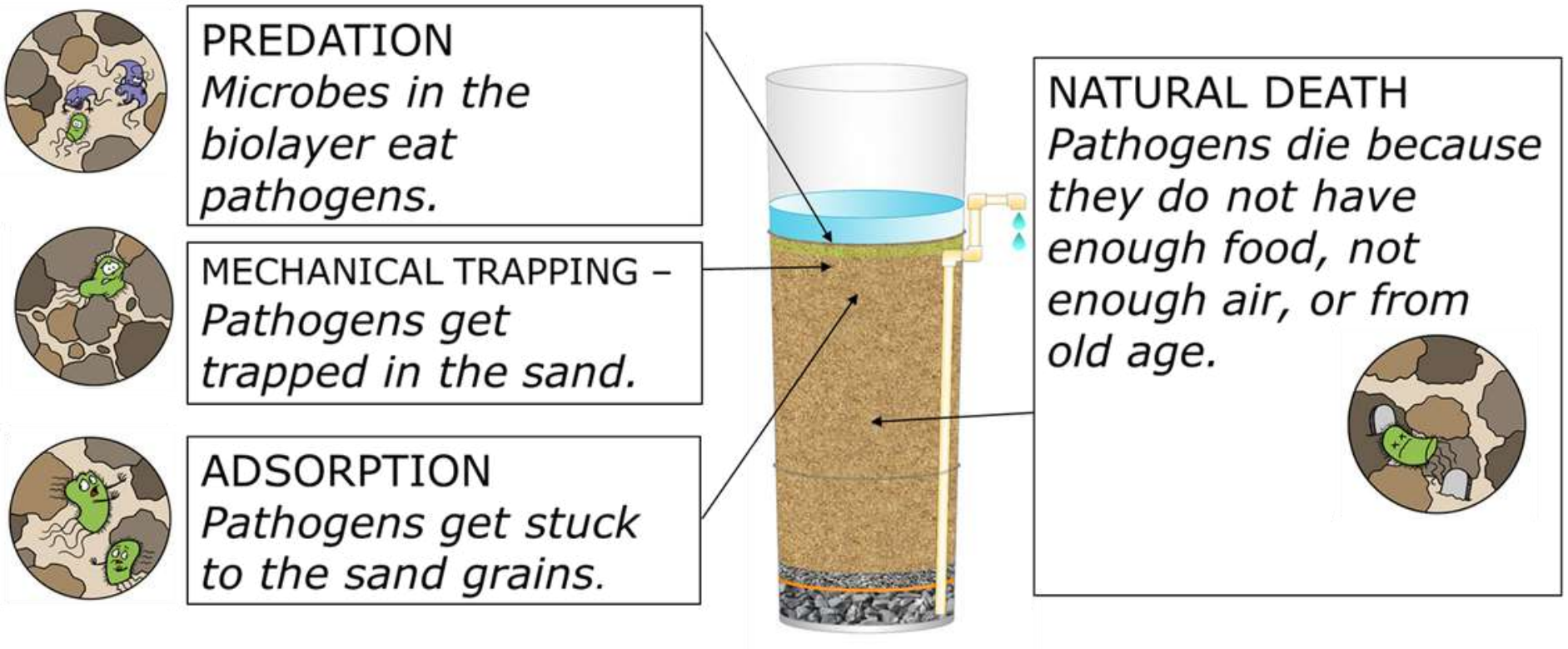
Session Activity:

- Choose a JalKalp picture and cut its pieces into parts to make it.
- Distribute the pieces to the participants and ask them to arrange to make a JalKalp filter (This way, participants will learn the parts of the JalKalp along with the working of the filter).

Review:

- What are the filtration processes involved in removal of pathogens?
- What is the role of copper foil?
- What quality improvement CPF does to water for drinking?
- How is a JalKalp biosand filter installed?
- How can a JalKalp filter improve health?

JalKalp Biosand Water Filter



Different Processes of Pathogen Removal

Chapter 9

Multi-Barrier Approach to make Water Safe

Purpose:

To improve drinking water quality by creating multiple barriers through a multi-barrier approach and to reduce the health hazards caused by drinking unsafe water. This approach requires creating some obstacles in preventing the path of pathogens in the water reaching us.

Materials Required:

Transparent glass, paper ball, water bottle, card board pieces, scenario card, etc.

Session Introduction Activity:

Take a glass full of water and asked the participants to throw some small paper balls at the glass and see if the paper ball comes in contact with the glass easily. After that, cover the sides of the glass one by one with the help of card board pieces. Covering the glass with each card board will the paper ball out of the reach of the glass, creating a hindrance.

Session Introduction Discussion:

Discuss with the participants what was observed about the relationship between the number of obstacles used and the difficulty in reaching the glass.

Barriers designed to protect water from pathogens are in the following steps:

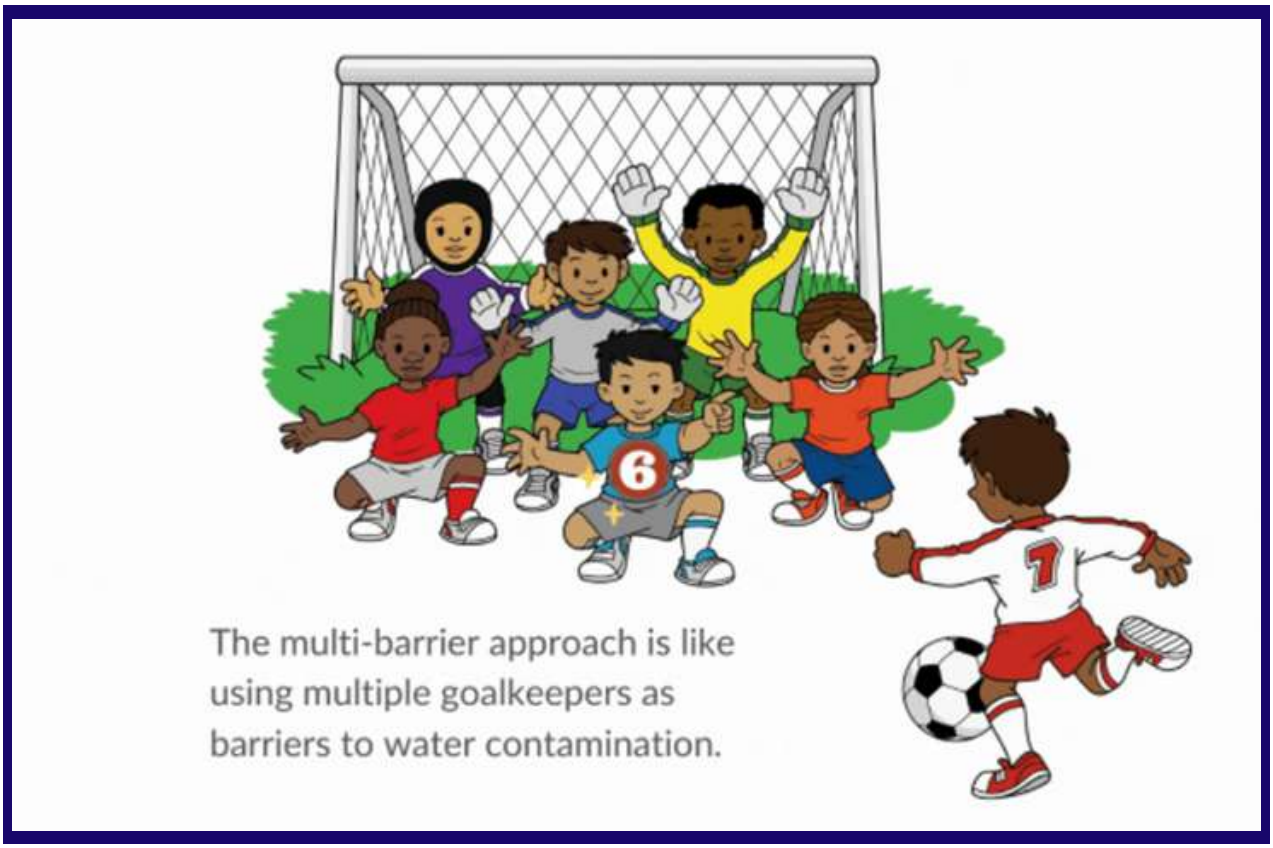
1. Protecting Your Water Source
2. Safe Transportation
3. Water Treatment
   a. Ceramic pot Filter
   b. JalKalp Biosand Filter
   c. Any other effective water filter
4. Store your treated water safely

Session Discussion:

Why are two obstacles better than one? Or are three obstacles better than two? Or the use of all obstacles is optimal?
We will end the session with the example of "There is power in unity " story.

Review:

- Why it is important to treat your water?
- What are the barriers used in treating water?
- List two of the barriers used to make water safe for drinking?
- What is the power in unity in relation to the multi-barrier approach?



Chapter 10

Safe Storage Container

Purpose:

To provide information on adoption of safe storage to avoid recontamination of treated water.

Materials Required:

Scenario cards, bucket full of water without lid, safe storage container pictures, powder, etc.

Session Introduction Discussion:

Why is safe storage important?

- To prevent recontamination of treated water
- To protect against breeding of mosquitoes, dust mites, flies
- To protect from children and animals
- For cleanliness, hygiene and health

Discuss with participants how their clean drinking water can become recontaminated:

- If we store treated water in the same vessel from which we bring water from the source
- If we use a dirty mug to the water
- If our container does not have a lid
- Through children, animals, and flies
- By not cleaning the storage container

Session Activity:

Place a bucket full of water in front of participants and ask one of them to draw the water by dipping their hands and then discuss with them how the water gets contaminated. After this, apply powder on the bottom of a glass or mug, ask them to draw water from the filled bucket, and then discuss that if the mug or glass is kept in a dirty place, then there is dirt on its bottom by which our treated water can be recontaminated.

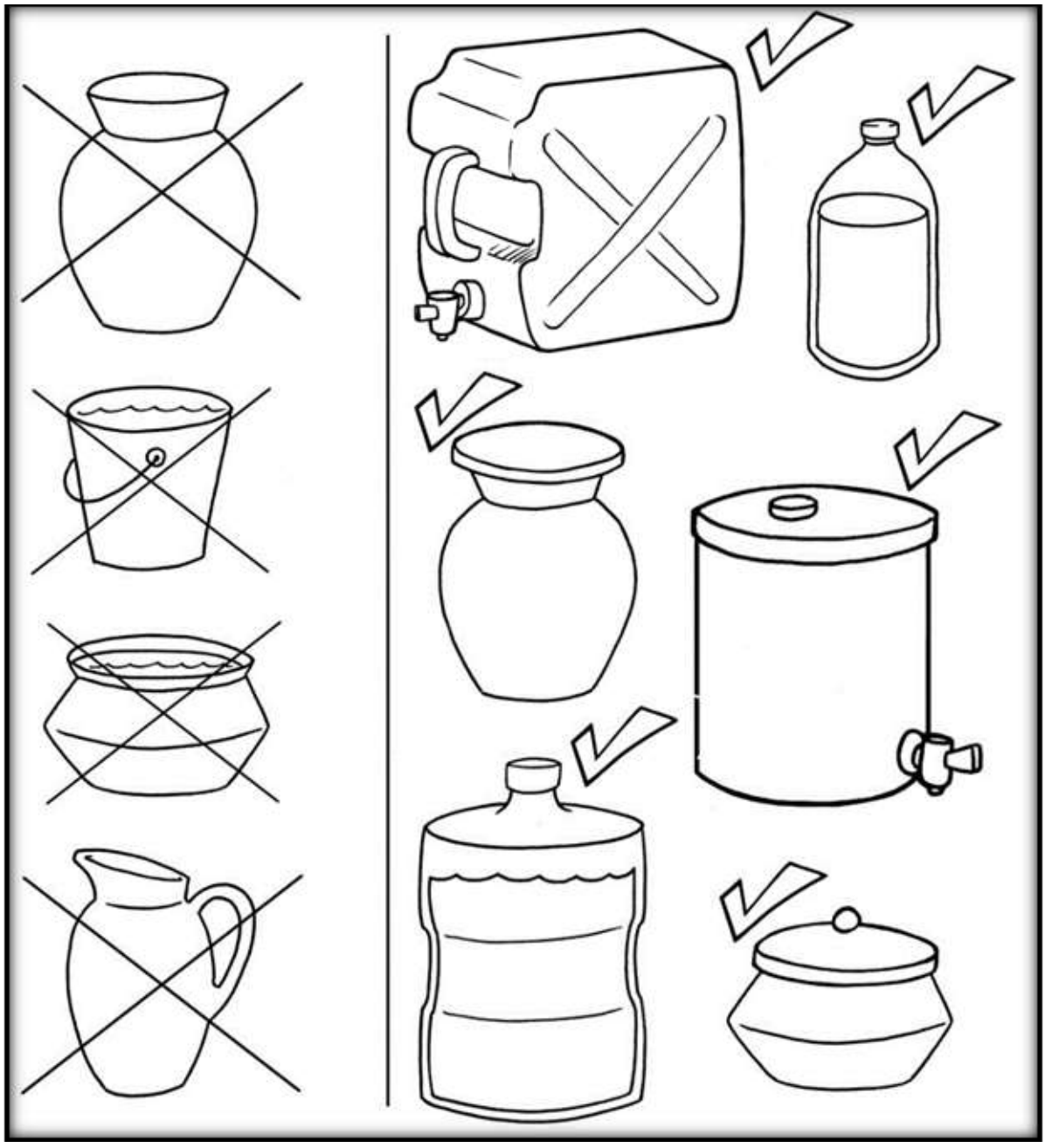
Discuss with Pictures: The types of safe storage containers available in the market

A good quality safe water storage container must have the following properties:

- The container should have a small lid or tap to the water.
- The lid should fit tightly.
- The base of the container should be strong.
- The weight of the vessel should not be too much so that we can easily move the vessel from one place to another.
- Container should be of steel/plastic (food grade).
- Should be easy to clean.
- Should not be transparent.

Review:

- How treated water can be recontaminated?
- What are the qualities of a good storage container?
- Is it safe to store food in the same container in which another food item had been stored without cleaning? (Same way it happens in water storage container)



Safe Storage Container

Chapter 11

Safe Water Handling

Purpose:

To provide information about safe handling of treated drinking water and its safe storage container.

Session Introduction Discussion:

How to use treated drinking water and where it should be placed?

- Safe storage container should be placed in the shade above the ground.
- Separate storage containers should only be used to store treated water and not for untreated water.
- It is important to protect your treated water and prevent it from recontamination.
- Putting cups and mugs on a table or the ground or touching them with your hands can be dirty. Pathogens will pass through the cup or mug into the water. On drinking this water, it can make you sick.
- Use treated water as much as possible.
- Containers with taps should be used.
- Safe storage containers should be kept out of reach of children and animals.
- After collecting the water from the tap, the tap should be closed properly.
- Try to use treated water within a day.
- Safe storage containers should be cleaned regularly.
- The tap should be used to draw water from container instead of scooping or dipping mug or tilting.

Safe Storage Cleaning Method:

- Use clean water, soap, a clean cloth, and the brush to clean the container from the outside.
- Safe storage container and its cover should be kept in a clean place to air dry or can be dried with a clean dry cloth.
- The safe storage and lid with treated water before storing.

- Then the safe storage should be filled with treated water and use for drinking or cooking.
- If chlorine is available, the chlorine (tablet or liquid) in an appropriate amount and leave for 30 minutes.

Review:

- Where should a storage container be placed to prevent pathogen transmission?
- What materials are needed to properly clean storage containers?

Chapter 12

Waterborne Diseases

Purpose:

To explain the health impact of waterborne diseases during monsoon.

Materials Required:

Flash cards, flip chart, and marker.

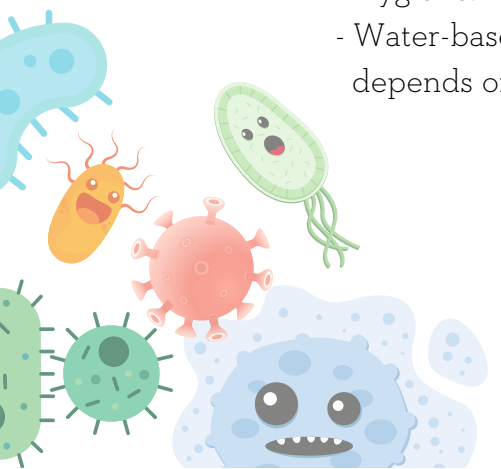
Session Introduction Activity:

Show the flash card to the participants and ask the following:

- What can be observed in this card?
- What diseases do you think are linked with cleanliness and water?
- Have you ever experienced any sickness from drinking water?
- Does the pattern of falling sick increases in monsoon?

Session Introduction Activity Discussion:

- Explain how the monsoon changes the plot of sickness.
  - Change in temperature and humidity
  - More growth and survival of germs
  - More chances of contamination
  - Transmission of all germs through food, air, water, hands, and flies increases.
- Explain the difference between waterborne diseases, water-based insect vector diseases, and water-washed diseases.
  - Waterborne diseases: infections spread through contaminated drinking water.
  - Water-washed diseases: diseases due to lack of proper sanitation and hygiene.
  - Water-based vector borne diseases: diseases transmitted by insects that depends on water for their propagation.



Session Discussion:

Place the flip chart paper, and write down the discussion details. Question the participants who all experienced water borne diseases during the monsoon season and select three representatives for recording their responses on flip chart on the following questions.

- What kind of sickness you experienced? (kind of diseases)
- For how long did you experience sickness? (how many days)
- How much money did you spend on paying medical bills?
- How much money did you spend on transportation (on visiting distant doctors)?
- How much money did you spend on buying medicines?
- Other extra expenditures occurred due to sickness (fruits, leafy green vegetables, immunity syrups, etc.)?
- Did your livelihood related work affected due to sickness?
- What is the wage loss you incurred due to sickness?

Table of Statement of Losses

List	Participant 1	Participant 2	Participant 3
Kind of diseases			
Sick for how many days			
Consultation charges			
Transportation charges			
Medicines bills			
Other expenditure			
Loss of wages due to sickness			
Total			

Session End Discussion:

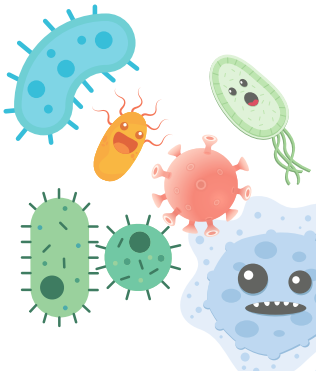
- Explain some of the ways they can do to stay safe during monsoons.
  - Always drink treated water.
  - Wash fruits and vegetables thoroughly before consumption.
  - Keep your foods covered at all times and avoid consumption of unhygienic food.
  - Ensure personal and environmental hygiene is maintained at all times (wash your hands often).
  - Ensure open drains and potholes in your locality are covered.
  - Don't allow water to stagnate or collect anywhere in and around the house to breeding of flies and mosquitos.
  - Do not practice open defecation and keep your toilet clean.
  - Wash your hands with water and soap using toilet, handling feces of child and before cooking and eating food.
- Explain the do's and don'ts (pictures below) to maintain and how this practice can make you fall sick easily.

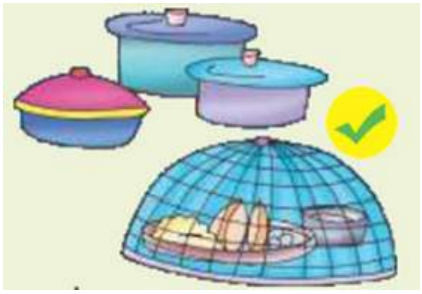
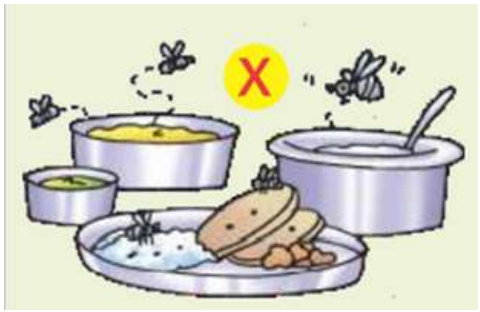
Review:

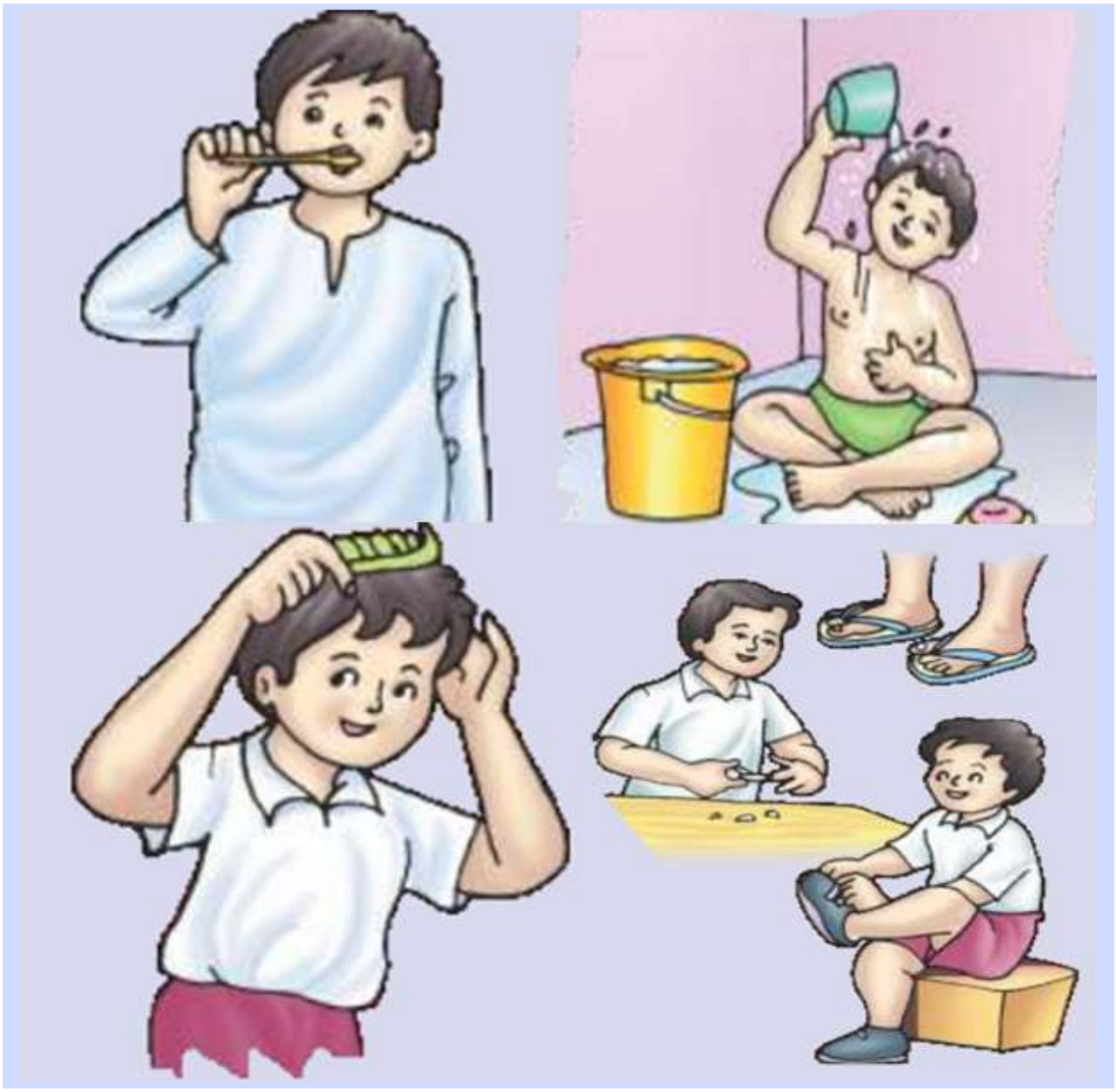
- Do you understand the reasons for falling sick?
- Will you practice proper WASH behavior to avoid getting sick?

Flash Cards

Effects of Consuming Contaminated Water



Do's	Dont's
	
	
	



Personal Hygiene

Chapter 13

Solid Waste Management

Purpose:

To inform about the solid waste management. They should know about reuse and recycling the waste, composting, burning and burial of materials.

Materials Required:

Scenario cards (littered and neat and tidy surroundings), Activity color card (waste type), trash bag and scenario card, etc.

Introductory Activity:

Show two scenario cards (littered and neat and tidy surroundings) (Scenario Cards to be developed)

Ask the participants-

a. what difference they see in the scenario Cards
b. what are the objectionable things they see and why these are not good

Session Introduction Discussion:

What is the meaning of solid waste?

Things which are used in our homes, industries, offices, schools, etc., are simply thrown after a single use. There are thousands of such products, such as glass, plastic items, electronic items, medical series, and medicine vials, etc., remains same after a single use.

Vegetables, fruits, leaves, cow dung, etc., used in our homes turn into manure after some time. While there is no proper disposal of some solid waste. Due to this, they not only make the land barren but also increase the pollution in water and air.

Discussion: Why is it important to have proper waste management?

- Disease can be prevented by preventing breeding of snakes, mosquitoes, insects, rats, animals, and flies.
- The environment and water resources will be protected.
- Garbage can block drainage such as rivers and streams, causing floods.
- Rotting of garbage causes air pollution which injurious to health.
- A pile of garbage destroys the scenic beauty.
- Manufacturing of new products generates more waste requires which is very harmful for the environment.

Discussion: Show the activity color cards to the participants and explain the types of waste.

The types of waste are divided into five parts on the basis of its nature:

- Solid waste: Solid waste includes hard made objects which are mainly used in homes, industries, and hospitals.
- Liquid waste: This type of waste includes contaminated or dirty water, the wastewater coming out of the house and the polluted effluent from the industries.
- Dry waste: In dry waste, the amount of liquid in it is absolutely negligible. This includes recyclable and nonrecyclable items.
- Biodegradable waste: Biodegradable waste is any product that can be easily broken down naturally by water, oxygen, the sun's rays, radiation, or microorganisms. In the process, organic forms of matter are broken down into simpler units. The matter is decomposed and will eventually return to the soil.
- Non-biodegradable waste: A nonbiodegradable material can be defined as a type of material which cannot be broken down by natural organisms and serve as a source of pollution

Ask the following questions from the participants-

- What can we do in our daily lives that can help reduce the amount of waste we generate?
  - Reuse plastic bags/plastic bottles, try to fix or repair things when they break.
- Is there any item that can be reused for the same or for a different purpose?
- What is recycling and what are the benefits of recycling?

- Recycling is the process of converting waste materials into new materials and objects.
- Garbage, paper, plastic, glass, etc., can be recycled.

Session End Discussion:

1. What is meant by composting?

Compost is a type of manure which is obtained from the decomposition and recycling of organic matter. It is the main component of organic farming. The easiest way to make compost is to make a pile of moist organic matter like leaves, leftover food, cow dung, etc. and wait for some time so that it decomposes.

2. What items can be used to make manure?

Fruits, vegetables, paper, husk, grass, leaves, cow dung, etc.

3. Benefits of making a compost

- Creates a valuable resource for agriculture including home gardens.
- Can be done easily at home.
- Retains soil and water better.
- Very low cost to start and nothing to operate.
- Increases the effectiveness of fertilizers.
- Reduces the amount of waste that has to be collected and transported.

4. What are the dangers of burning garbage at home?

- Fear of spreading fire.
- Smoke from burning causes damage to human lungs, eyes, nose and throat and can cause diseases like cancer.

5. Discuss any hazardous waste materials (e.g. batteries, syringes) and their disposal options.

- Do not burn hazardous waste.
- Minimize use of hazardous materials.
- Do not throw hazardous waste into water sources or the ground.
- Containers containing hazardous materials must not be reused.
- Hazardous waste should be kept separate from normal household waste.

Review:

- What did you understand by solid waste management?
- Will you segregate the waste?
- Will you reuse and recycle the products?

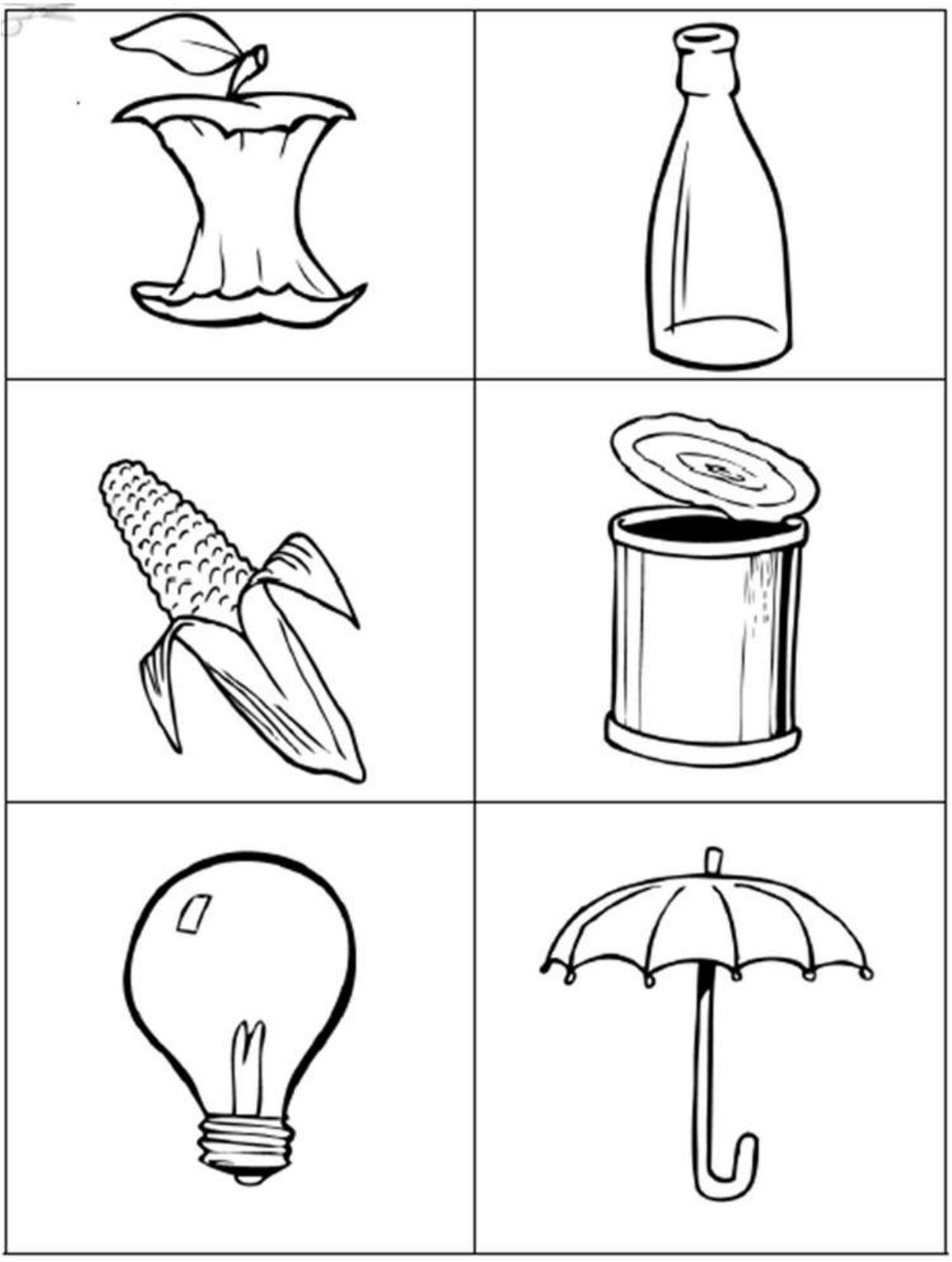
Flash Cards

Littered Surrounding

Flash Card

Neat and Tidy Surrounding

Activity: Bag of Garbage

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Chapter 14

Kitchen Hygiene

Purpose:

Explaining the importance of maintaining kitchen hygiene.

Materials Required:

Flash cards, flip chart and marker.

Session Introduction Activity:

Show the flash cards to the participants and ask the following:

- What can be observed in this card?
- Why is cleanliness/hygiene important?
- What are the key principles to maintain hygiene especially in kitchen?

Session Introduction Discussion:

- Explain why it is necessary to maintain hygiene especially in kitchen.
  - Kitchen is the heart of the household.
  - Matter of pride for household members.
  - Cleanliness avoids foodborne diseases (stomach infection, food poisoning).
  - Clean surfaces ensure non-transferring of pathogens.
- Explain how we can maintain good kitchen hygiene?
  - Wash your hands.
  - Cook meals thoroughly.
  - Ensure proper storage of food items, utensils, drinking water, etc., above the ground to keep out of reach of children and animals.
  - Use dustbins.
  - Avoid cross contamination through separating different items like cooked and raw.
  - Keep the kitchen clean.
  - Maintain proper ventilation or lighting.

Session Discussion: Place the flip chart and question the participants the following questions.

- Ask about the physical setting of their kitchen in their homes.
  - If there is no separate room for setting up kitchen, then demark the area and define a designated place within the commonly used single room.
  - Ask what to do proper ventilation for the fumes and why.
  - Ask why should they have a separate area for keeping clean and used utensils .
- Ask how many of them follows the steps given below:
  - Heating the stale food before eating.
  - Wipe down surfaces and counters.
  - Not reusing dirty utensils and plates.
  - Clean drain or sinks.
  - Clean kitchen cloth after used for wiping.
  - Clean utensils and surface immediately after use.

Session End Discussion:

- Explain about the cross contamination.
  - It occurs when harmful bacteria are unintentionally transferred from one surface to another causing a high risk of foodborne diseases.
- Explain about the five key food hygiene behavior (through picture card).
  - Cleanliness of serving utensils using soap/ash.
  - Handwashing with soap before feeding (mother) and before eating (child).
  - Proper storage of cooked food.
  - Thorough reheating of leftover/ stored food.
  - Consuming treated water.
- Explain the pictures (given below) to maintain hygiene.

Review:

- Do you understand the reason of maintain hygiene in kitchen?
- What steps will you follow proper hygiene protocol to avoid getting sick?

Flash Cards

Cleanliness to Maintain Hygiene

Chapter 15

Financial Literacy

Day 1

Purpose:
Motivate the community members about common household savings.

Materials Required:
Flip chart paper, colorful marker, transparent jar, big pebbles, small pebbles, sand

Time duration: 1 Hour

Session Introduction Activity:
To start, the trainer discuss: in case of some emergency situation or you need money for something new you want to do/purchase. How will you arrange money (HH savings, what savings plans will involve, challenges and achievements)? Spending all the earnings without saving for the future is not a good practice.

Session Introduction Discussion:
The trainer ask questions to the participants in the group and trainer will record the answer on flipchart. The trainer discusses how and how much participants get and use money, for themselves or for their family. This aims understanding the cash flow.

Activity: Common HH Savings
To formulate a cash flow of an arbitrary HH the trainer will ask the group:

1. What ways participants earn money and how much? Trainer will ask about ways like farming, daily wages, govt. job, private job or any other ways.
2. What ways do participants spend money (broad expenditure heads)?
3. Who you currently owe money to?
4. Who currently owes you money?

In this process trainer will record different ways participants earn money, and a list of how participants spend money. This activity shows that there are many opportunities to make money and also many ways to spend. It is important to understand that money flows (income and expenditure). It is important to consistently save little by little to see your money growing. If you save, they will add up to a large amount.

Here you can touch upon ways income is earned and how can people save depending on the categories below.

- Seasonal like farming or order based work (in case of seasonal they should save one portion in bank and the other portion for HH expenses or needs)
- Daily wages (small savings but regular)
- Fixed income (plan budget for daily needs and save regularly)

It is important to touch these points as the way people save or may save will vary for all three.

Activity:

Trainer will touch upon ways income is earned and how can people save.

Ways income is earned	Savings	Expenditure
Seasonal, i.e. farming or order-based work	Save one portion in bank	Other portion for HH expenses/ needs
Daily wages	Regular small savings	Rest amount for consumption
Fixed income	Regular savings	Plan budget for daily needs

Messages:

How long does it take you to earn money compared to how long it takes you to spend? Money should not control us; we should be controlling the money.

In case you are not able to work for some time/ seasonal job how will you manage your HH expenditure?

This question will give them clarity about importance of savings.

Session Details:

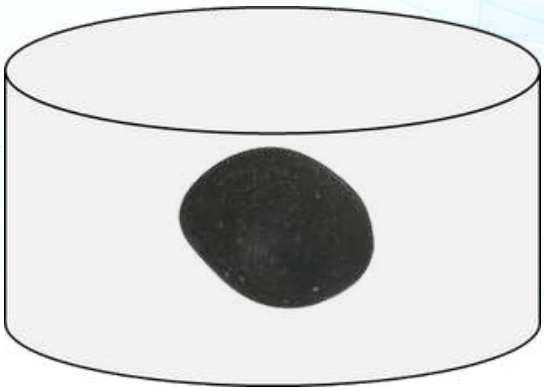
Trainer will discuss about what need is and what they want most important thing versus less important things (explain with local examples).

Activity:

Take a transparent big jar. Add big pebbles/stones into it. Ask the participants if the jar is full or not. They response can be either yes or no. Then add small pebbles which fills the space in the jar. Ask further if there is any space left now. Further, add sand in the jar and again repeat the question. Tell participants there is still space for water (do not pour water though).

Explain them big pebbles are the important things that they need to spend on. Draw big pebbles on flip chart and ask them to write important things such as child's education. Small pebbles are less important things. Ask them to share these and write on flip chart, sand is least important. Ask them what they consider least important. And write on the flip chart. Ask and see where HWTS fits in. Big pebbles, small, or sand?

Also discuss what if you would have filled the jar with sand completely, would there be any space left for small pebbles and big pebbles/stone. This activity tells them about prioritization.



1. Trainer will ask a probing question. "What all might you lose for not having enough money or savings? (Hint: education, health expenditure, clothes, food, etc.)
2. Trainer will discuss about savings to avoid loans and make them understand that taking loans make them financially weak and they will be trapped in vicious cycle.

3. Trainer will also discuss about savings for WASH related things (HWTS and HWS). How small spending on WASH can save them from big health related expenditures and wage losses.

Trainer will carry out an exercise of having some cash to spend and list of expenditure to incur cash availability (e.g. if they have earned INR 500 and they have expenditure of INR 600 then they should have think about wise spending on other things).

Participants discuss the outcomes of this exercise. The goal of the activity is to make participants think about what they need to spend money on, and identify those things that participants can reconsider before buying. This activity is very important for participants to understand that they have limited money and to use their small earnings wisely, and to prioritize what are important items for the limited money they have.

Messages:

Think and ask yourself before you buy things. Some things can wait until you have enough money to buy them. Self-control and discipline are very important.

Why it is important to have money for WASH?

(Hints: For good health, avoid water borne diseases, avoid missing school for children, avoid missing work and discuss about poverty cycle)

Day 2: How to Save Money?

Purpose:

To motivate the community members about Common Household savings.

Materials Required:

Flip chart paper, colorful marker.

Time duration: 1 Hour

Session Introduction Activity:

Goal Setting

The trainer will discuss how to set a goal, like an aim or target (HWTS and HWS), to help manage money. Explain goals are important so we can stay focused. This give us a target (HWTS and HWS) to work to and help us save money. To set your goal, be specific, and list the benefits of your goal. Trainer will ask them questions on following topics:

1. Goal: Remain healthy via controlling health related expenditure.
2. Specific goal: Cut down health risk by adopting HWTS and HWS.
3. Benefits of goal: Why it is important to save money for HWTS and HWS?
4. Priorities: HWTS or HWS?

Session Introduction Discussion:

Set a Goal

Trainer will discuss why timeframes are important to achieve goals (Hints: Ask about how much they earn per day and what are the expenditure per day and how much they will save to achieve their goal.). The trainer asks participant to set a goal for most important thing that you want to purchase for your family to avoid water borne disease with specific time frame.

Note: If they have a goal, they need to know the estimated price of the item they want to buy, for how long they would save, and how much in a week, month or year to save for achieving that goal.

Depending upon the saving capabilities of individuals, they can save.

Examples:

For HWTS:

Goal	Estimated Amount	Day / Time	Time/Month	Amount to save per day	Amount to save per month	Goal type
Buy HWTS	INR 600	30	4	INR 5	INR 150	Short term
Buy HWTS	INR 600	30	2	INR 10	INR 300	Short term

Here you can ask the participants and discuss how can they save INR 5 or INR 10, e.g. the responses can be:

- Spend less on tobacco
- Develop a habit of putting money in a gullak

The idea of this discussion is to trigger the thought that INR 5 can be saved and that can help them meet their goals.

So you can call this as POWER OF 5

For HWTS:

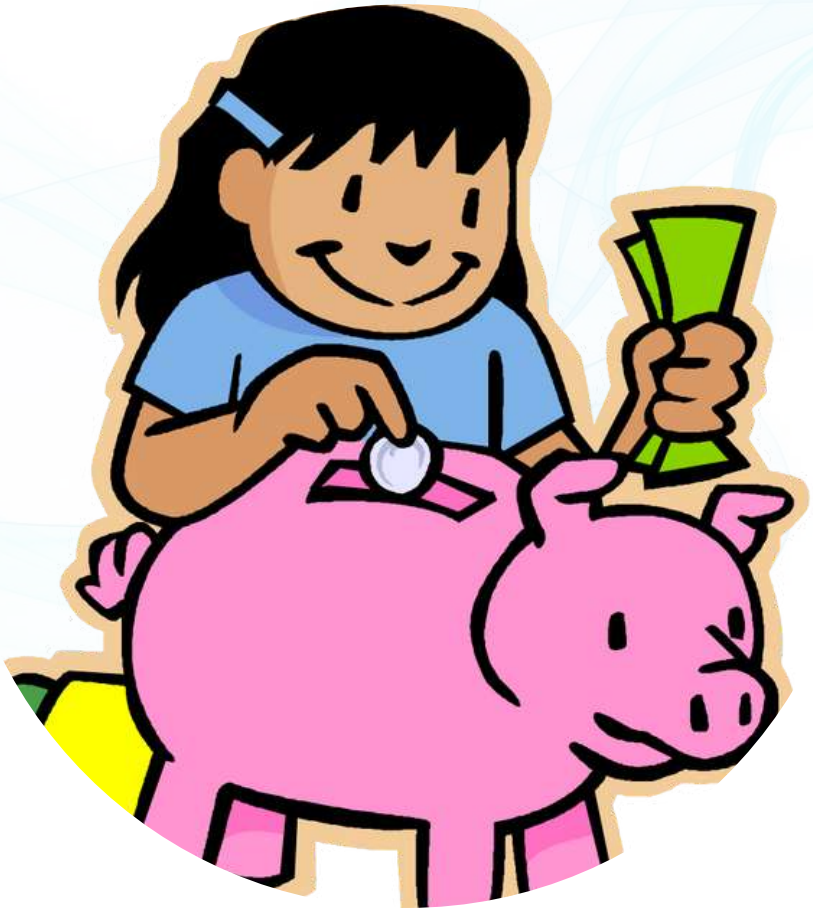
Goal	Estimated Amount	Day / Time	Time/Month	Amount to save per day	Amount to save per month	Goal type
Buy HWTS	INR 2000	30	3.5	INR 20	INR 600	Short term
Buy HWTS	INR 2000	30	1.5	INR 45	INR 1350	Short term

Timeframes:

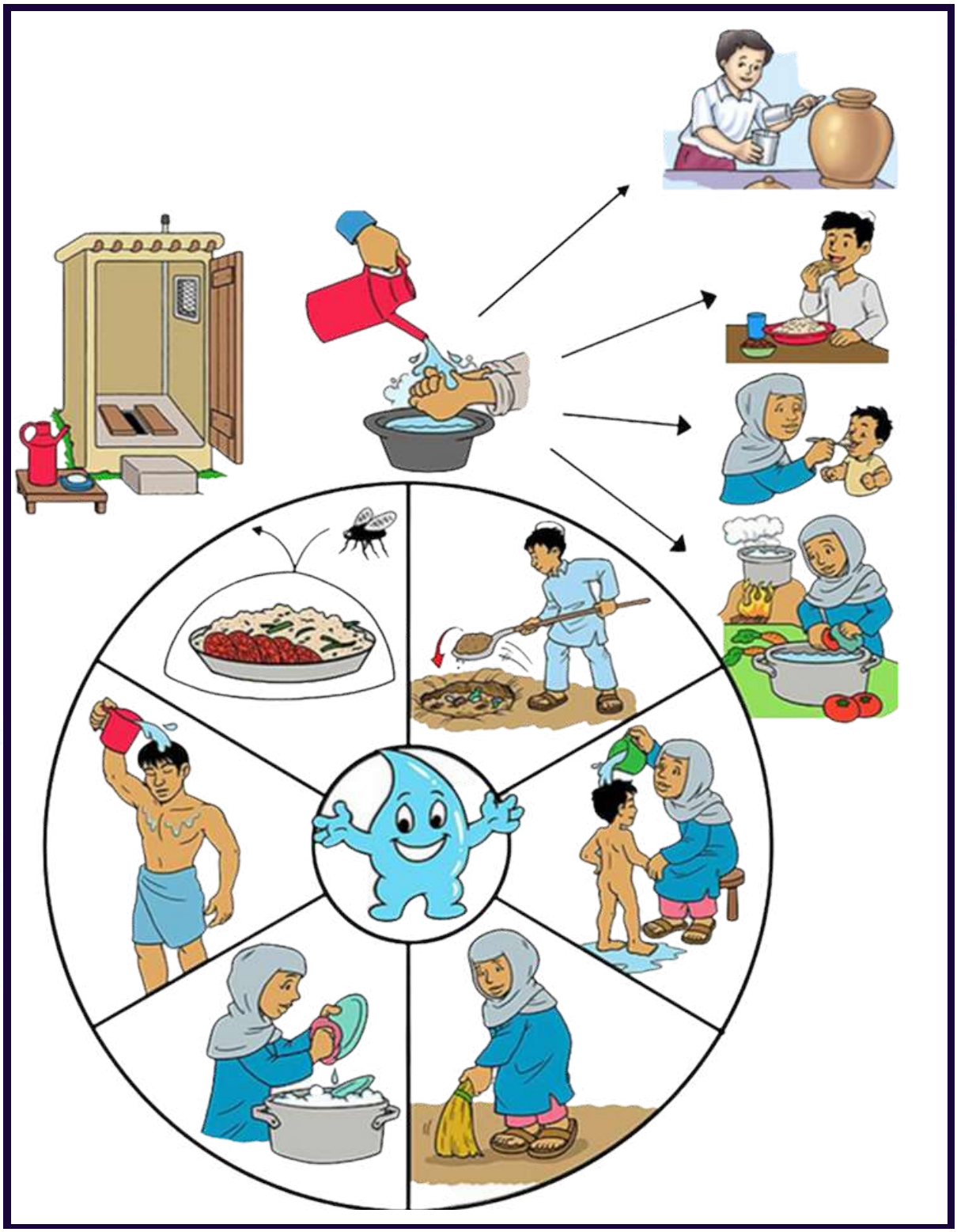
- Short Term = 0-3 months
- Medium Term = 4-6 months
- Long Term = 6 months +

Main Message:

Keep saving, and don't set more than one goal at one time. If you fail, don't worry. Encourage them in the end to save in the bank esp. when amount is big as they can earn interest, its more safe and they will not be tempted to spend on things of less importance. The sooner they start saving, the better.



Flash Cards



Importance of Maintaining Hygiene

Five Key Food Hygiene Behavior

Technical Brief

Ceramic Pot Filter (CPF)

One of the principal risks to public health is the lack of access to safe drinking water. The establishment of Millennium Development Goals by World Health Organization (WHO) with the target of halving the proportion of people without access to safe drinking water (WHO, 2005). The Sustainable Development Goal 6 ensures access to affordable safe drinking water and sanitation to all. 2.3 million annual deaths among children attribute to diarrheal diseases (WHO, 2019) in India as a result of unsafe drinking water, poor sanitation, and bad hygiene.

The ideal solution to cut out waterborne diseases are to build access to safe, pathogen free drinking water at the point of use. Household Water Treatment and Safe Storage (HWTS) is an effective and affordable means of providing safe drinking water at home. HWTS practices such as sedimentation, filtration, and disinfection are solutions that are easy and sustainable for making water safe for drinking. Some studies have shown that HWTS practices have yielded considerable deduction in diarrheal diseases. Ceramic Pot Filter (CPF) is one of such point-of-use water filter.

What is Ceramic Pot Filter and how is it manufactured?

CPF is used as one of the form of household water treatment in many parts of the world. These filters are both locally and industrially produced. It is a low-cost water treatment technology that is capable to remove microbial contamination and turbidity, iron and manganese improves water quality at the household level.

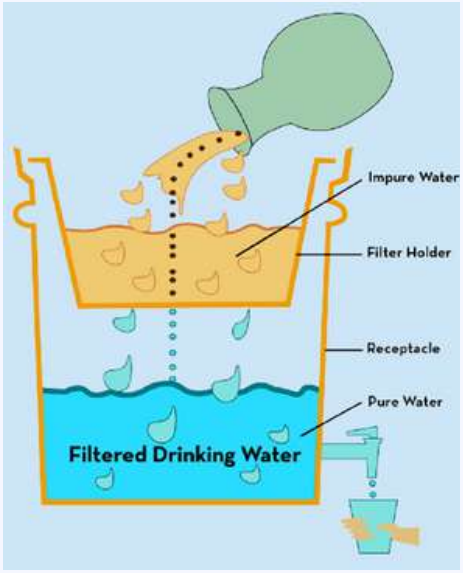
CPFs are manufactured by mixing clay with combustible material. Currently they are fashioned in two variations with flat bottoms and round bottoms. To make the ceramic filter, the clay and combustible material are mixed together with water until they form a homogenous mixture. The mixture is pressed into shape using a mold looking like a pot. Molded pot is then dried in

shade for three to four days, and then in the sun. The dried pots are then fired in a kiln. In the firing process, the combustible material burns out, leaving a network of interconnected micro pores. Water can flow through these micro pores. After the filters are fired and cooled, several quality tests, like a flow rate test, are performed. A flow rate test is the most verified test to ensure the flow rate must be between one to three L/hr. This is required to ensure that enough water is provided to the family and adequate contact time of water is maintained with the filter body.

The moment flow rate test is performed and passed, the filters are air dried and impregnated with colloidal silver before distributing to customers. Silver is known as antimicrobial, that has been used to kill bacteria, fungi and viruses. Silver as an additive is used to enhance microbial disinfection. Research shows that bacterial efficacy of CPF is increased with silver impregnation.

Operation

The raw water is poured into the ceramic pot filter. The water slowly passes down through the fine pores and is collected in the receptacle. The treated water is stored in the container until needed and is protected from recontamination. The tap at the receptacle is usually preferred for fetching treated water. The CPFs are capable to remove iron, microbial contamination, and turbidity. CPF also reduces TDS to some extent.



The filter should be regularly cleaned with a soft scrub to remove any accumulated material. During the scrubbing, filter element retains the flow rate by removing the deposited particles from the pores. Any visible cracks or leaks must be checked over time to ensure the effectiveness.

Contamination Removal (Treatment)

The pathogens and suspended particles are removed through physical processes like mechanical trapping, adsorption. Small size combustible material used in the mixture is used to ensure that pore size is small enough to prevent contaminants from passing directly through the filter. Colloidal silver acts as an antimicrobial shield, breaking the cell wall of the microbe and ultimately causing the death.

Treatment Efficiency

Goal	Bacteria	Viruses	Protozoa	Helminths	Turbidity	Iron
Laboratory	> 98%[1] - 100%[4]	19%[1] - > 99%[6,7]	> 100%[8]	> 100%[8]	83%[1] – 99%[5]	Not available
Field	88%[2] to > 95.1%[3]	Not available	> 100%[8]	> 100%[8]	< 5 NTU[2]	> 90%[5]

1. Lantagne (2001)
2. Smith (2004)
3. Brown and Sobsey (2006)
4. Vinka (2007)
5. Low (2002)
6. Van Halem (2006)
7. Some additives to the clay may increase virus removal
8. Not researched, however helminths and protozoa are too large to pass between the 0.6-3 μmpores. Therefore, up to 100% removal efficiency can be assumed.

Operating Criteria

When the pot filter is full, flow rate is highest. With the regular use of filter and accumulation of contaminants within the filter pores it might reduce the flow rate. The flow rate, volume and supply are provided in the below table.

Flow Rate	Batch Volume	Daily Water Supply
1-3 liters per hour	9 liters	20-30 liters

Estimated Life Span

- Up to 5 years, generally 1–3 years.
- Filter needs to be replaced if there are visible cracks.

Maintenance

- Filters are cleaned by lightly scrubbing the surface when the flow rate is reduced.
- Soap and chlorine should not be used to clean the filter.
- Receptacle container, tap and lid should be cleaned on a regular basis.

Cost

The estimate cost of CPFs is about 450 to 750 INR.

JalKalp Biosand Water Filter

The JalKalp water filter removes:

- Biological impurities
- Arsenic contamination (with adaptation)
- Iron contamination
- Turbidity

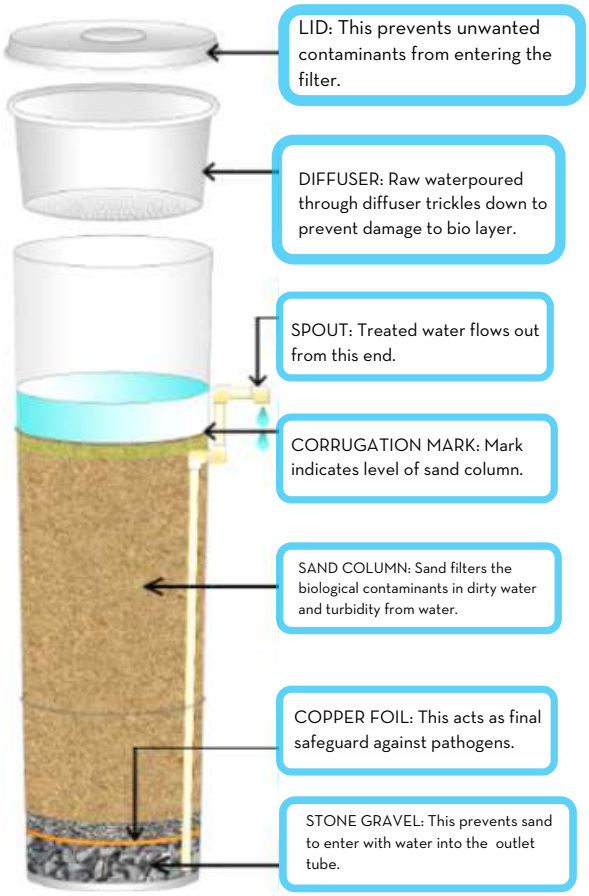
WORKING PROCESS

Biological and physical processes combine to filter and treat water. Water poured through a diffuser in the filter travels through sand and stone gravel. Inside the filter, water trickles through, through tiny pores (spaces) between sand particles. Impurities pathogens, and turbidity larger than pores are trapped by the sand and removed, Up to 0.7 liters of water is filtered each minute.

Treatment Mechanism

- **Adsorption:** Microbes adhere to the surfaces of specially prepared sand, which has a slight electrostatic charge, and some die there.
- **Predation:** The biolayer that forms on top of the sand layer contains microbes: stronger ones kill weaker pathogens.
- **Mechanical Filtration:** Fine grain sand prevents the passage of bacteria, parasites, and worms.
- **Natural Death:** The lack of oxygen and light further down in the filter causes more microbes to die off, and some pathogens die off naturally.
- **Germicidal Copper:** Passage of filtered water through a copper foil at the base of the container acts as final safeguard against any pathogens escaped from above.
- **Oxidation:** This removes iron contamination.
- **Zero Valet Iron Techmology:** This removes arsenic contamination.

PARTS & USAGE



TIPS AND GUIDELINES TO USE

- Use the filter daily for most effective results.
- Using water from a single source is preferable in the filter.
- Wait 7 days after installation before using treated water for drinking.
- After installation, do not move the filter from its position.
- Always pour water through the diffuser. When water from the spout is stopped, make sure there is 4 to 5 cm of standing water above the sand top surface.
- Do not store food items inside the filter.
- Use separate containers for storage and for pouring water into the filter.
- To prevent re-contamination, wash the storage container with filtered water before collecting water from the filter, and cover the container with a lid after collecting water from the filter.
- Wash the lid and diffuser weekly, and wipe the outer body of the filter with a clean cloth.

MAINTENANCE

1. Remove the filter lid.
2. If there is no water in the filter above the diffuser, pour water up to the bottom level of diffuser.
3. Remove diffuser and gently swirl the water without hand without disturbing the top surface of the sand column or the biolayer. Using a small cup, collect and dump the turbid water along with the accumulated slit and dust suspended within it.

4. Carefully dispose of this water because it contains harmful pathogens.
5. Repeat the process (steps 2 to 4) three or four times.
6. Put the diffuser back in place and fill filter with water.
7. Check if the flow rate has increased, if not repeat the process.
8. Wash the lid and diffuser with soapy water.
9. Wash your hands with soap.

The Multi-Barrier Approach to Safe Drinking Water

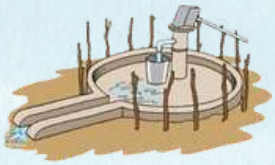
Introduction

Where does your drinking water come from, and how does it get from its source to your glass? In most communities, water goes through several steps to get from its source to a person's drinking glass. We call this combination of steps from source to sip the water supply system. Water supply systems range from very simple to complex (with technologies and infrastructure such as treatment systems, pumps, and piped distribution networks).

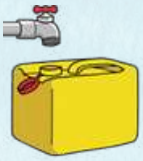
All water supply systems have multiple points at which contaminants could enter the water and make it unsafe. Using a multi-barrier approach is the best way to make sure water is safe when it reaches a user's glass. The multi-barrier approach uses a combination of behaviors and technologies to prevent and remove contaminants that could affect drinking water safety.

In this technical brief-

- We describe the multi-barrier approach to safe drinking water.
- We list the most common causes of drinking water contamination at the source, during transportation, and during storage.
- We describe actions you or the community you work with can take to improve drinking water safety. These include practices for source protection, safe water transportation, household water treatment, and safe water storage and handling.



Source Water Protection



Safe Water Transportation

Sedimentation

Filtration

Disinfection

Water Protection

Safe Water Storage

The Multi-Barrier Approach to Safe Drinking Water

The multi-barrier approach uses a combination of barriers (behaviors and technologies) to:

- Protect the water source from contaminants.
- Transport the water safely to the home and within the home.
- Treat the water to remove or inactivate contaminants.
- Store and handle the water safely to prevent contamination before and after treatment.

Sometimes, these barriers occur multiple times within a given water supply system. For example, treatment can occur at the point-of-distribution (before transportation to people's homes), and/or at the point-of-use (in a household or institution). As well, water transportation, handling, and storage may happen multiple times, before and after treatment. For each step of a water supply system, you should assess what could cause contaminants to get into the water, and use appropriate measures to keep your water safe. This process of assessing hazards and selecting appropriate barriers is also called water safety planning.

Source Water Protection

Source water protection involves finding the best possible water source for your household or the households you serve, and taking steps to protect it from contaminants.

1.1 Types of Water Sources

There are three types of drinking water sources: surface water, groundwater, and rainwater. Water sources are also often described as improved (sources that are designed to protect drinking water from fecal contamination) or unimproved. The following table describes and gives examples of these types of drinking water sources.

TABLE: Water Sources

Source Type	Description	Examples of Improved Sources	Examples of Unimproved Sources
	Surface water is any water taken directly from a stream, river, lake, pond, or similar source on the earth's surface. Surface water is often unsafe to drink without treatment because it is easily contaminated.	None–all surface water sources are unimproved	Rivers Streams Lakes Ponds
	Groundwater is the water that fills the spaces and cracks in rocks and soil beneath the earth's surface. Groundwater quality varies from place to place, but it is often safer than surface water because it moves very slowly and filters through rocks and soil.	Borehole Protected dug well Protected spring	Unprotected spring Unprotected dug well
	Rainwater is water that falls to earth as rain. Some people collect and store rainwater using a rooftop, ground surface, or rock catchment. The quality of rainwater collected from a rooftop is usually better than from a ground surface or rock catchment.	Rainwater (safely collected and stored)	Rainwater that runs into an open surface water source (lake, pond, reservoir)

Sometimes households collect drinking water from taps in their homes or communities, rather than directly from the source. All piped water supplies originate at a groundwater, surface water, or rainwater source. You cannot always assume that piped water is safe to drink; it depends on the quality of the source water, the level of treatment the water received before distribution (if any), and the condition of the piped network.

What is "Safely Managed" Drinking Water Supply?

Under the Millennium Development Goals (MDGs), access to safe drinking water was measured by counting the number of households with access to improved drinking water sources. However, people quickly recognized that this indicator did not address water safety. It is common for improved water sources to be contaminated by fecal pathogens, especially by the time water gets to people's homes.
Now under the Sustainable Development Goals (SDGs), access to drinking water is measured based on service level, using five categories (WHO & UNICEF, 2017):

- Surface water: drinking water collected directly from a river, dam, lake, pond, or canal.

- Unimproved: drinking water from an unprotected dug well or unprotected spring.

- Limited: drinking water from an improved source, where it takes people more than 30 minutes to collect water, including round-trip travel time and waiting in line.

- Basic: drinking water from an improved source, where it takes people less than 30 minutes to collect water, including round-trip travel time and waiting in line.

- Safely managed drinking water: drinking water from an improved water source that is located on premises, available when needed, and free from fecal and priority chemical contaminants.

SDG 6.1 aims to achieve "universal and equitable access to safe and affordable drinking water by 2030." Increasing access to safely managed drinking water will require a multi-barrier approach, including source protection, treatment, and safe transportation and storage.

1.2 Causes of Contamination at the Source

Different types of water sources have different contamination risks. In general, contaminants enter water sources because of:

Poor site selection: The water source is too close to a latrine, farm, household, industry, or other source of contamination.

Poor design or construction: The water source lacks a lining or cover (for wells), tank sealing (for reservoirs), or proper pipe connections (for piped supplies).

Deterioration or damage to structures: Cracks in pipes, tanks, platforms, and covers allow contaminants to enter the source.

Do not site a water source downhill from, or within 30 metres of, a latrine.

Poor hygiene and sanitation practices: People use dirty buckets to collect water, defecate near the water source, or wash dishes and laundry in the same place they collect drinking water.

Unsustainable land use: Land that drains into the water source is heavily used for mining, industry, or agriculture, making erosion and source contamination more likely to occur.

Risk Assessment at the Water Source

Refer to CAWST's Sanitary Inspection Forms (available at www.resources.cawst.org) for detailed checklists you can use to assess risks of contamination at a water source. Forms are available for: boreholes, dug wells, piped water, protected springs, and rainwater harvesting tanks.

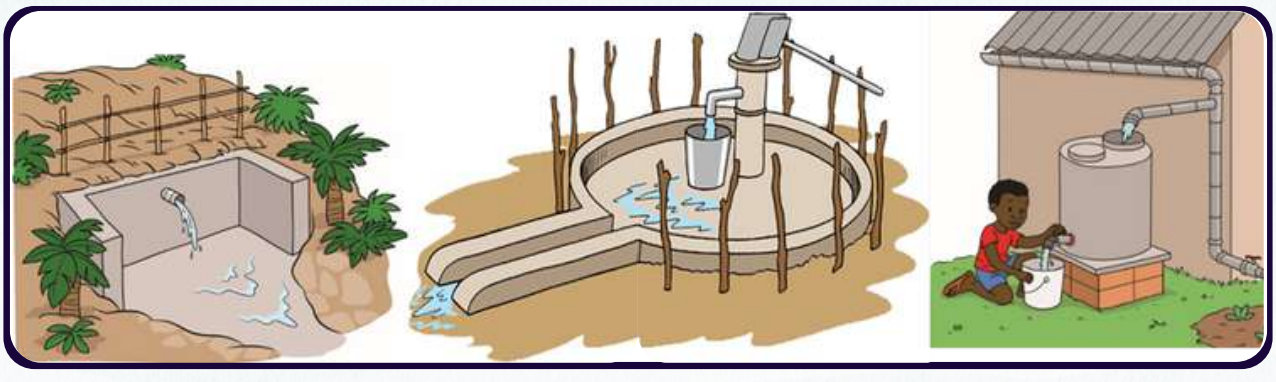
Examples of water sources at risk of contamination (from left to right): unprotected well; surface water near human activity and agriculture; borehole with cracked apron; container without lid.

1.3 Barriers to Contamination at the Source

Many different barriers can be used to protect a water source. These include changes to behaviors (such as stopping open defecation) and to infrastructure (such as installing well covers). The barriers you use should address the most critical risks identified during a sanitary inspection of the water source.

Steps you can take to protect a water source from contamination include:

- Locate latrines downhill and at least 30 meters away from the water source.
- Use fences and other physical barriers to keep animals away from the water source. Provide a place for animals to drink and bathe that is downhill from the source.
- Keep separate areas for washing clothes and watering animals. These should be downhill from where you collect water for drinking.
- Keep the area around the water source clean and free from excreta and garbage.
- Provide adequate drainage to prevent spilled water from pooling. Pools of water attract animals and allow insects to breed.
- Have a person or committee responsible as caretakers of the water source.
- Maintain and repair all constructed components (skirts, covers, drainage) to keep groundwater sources sealed from contaminated surface water.
- Monitor and keep careful records of activities around the water source and changes in drinking water quality.
- Constructing Improved Water Sources
- Whenever possible, eliminate or reduce contaminants from industry or agriculture that could threaten the water source.



Examples of improved water sources with barriers in place to reduce risks of contamination (from left to right): protected spring, protected borehole, and protected rainwater tank

Safe Transportation

Constructing Improved Water Sources

When constructing a new water source, you can add barriers to protect the water from contamination. Refer to the Water, Engineering and Development Centre (WEDC) Guides (available at: http://wedc.lboro.ac.uk/knowledge/index.html) for details about how to construct components such as spring boxes, well linings, and impermeable aprons.

Safe transportation describes any actions taken to ensure that water stays safe on its journey from the source to its point of use. Studies have found that bacteriological contamination of drinking water often occurs during transportation and storage (Wright, Gundry, & Conroy, 2004). Without safe transportation, water from safe sources can easily become unsafe by the time it reaches people's homes.

1.4 Methods of Water Transportation

Water moves from its source to point-of-use in many different ways. Most commonly, water is transported through networks of pipes or canals, or in containers carried by humans, animals, or vehicles. Sometimes, multiple methods are used to move water from the source to users' homes. For example, water sometimes begins its journey by traveling through pipes from a source to a communal tap stand, and then is carried in buckets from the tap stand to people's homes.

1.5 Causes of Contamination during Water Transportation

4.2.1 Causes of Contamination in Container

People often carry water from the source to their homes in containers. Sometimes they transport buckets of water by hand, and sometimes they use animals or vehicles. Along the way, contamination can occur when:

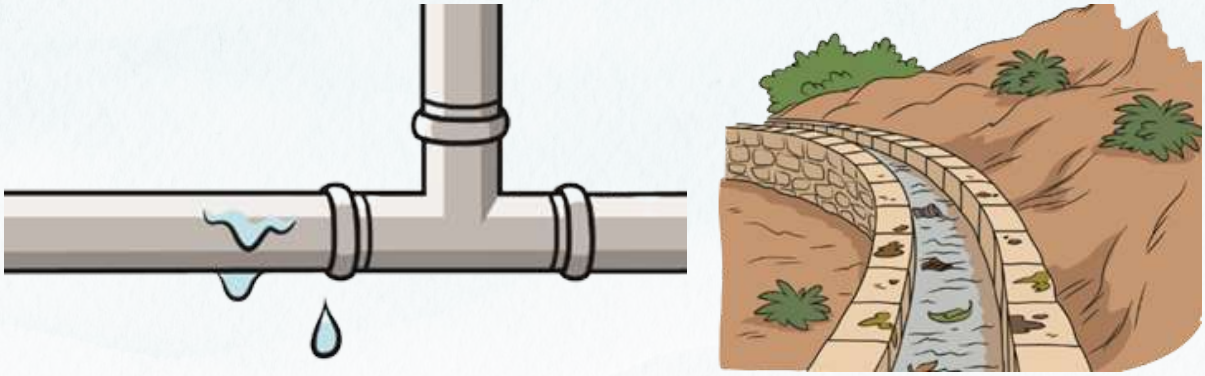
- People use dirty scoops or buckets to withdraw water from the source and pour it into their containers.
- Containers for transporting water have not been properly cleaned.
- Containers are left open during transportation, allowing contaminants to enter.
- People use dirty rags, leaves, or lids to cover their containers during transportation.
- Animals drink from the same containers used to transport human drinking water.

Using dirty containers or allowing animals to drink from containers can put water at risk during transportation.

4.2.1 Causes of Contamination in Pipes and Canals

Piped water systems have many advantages. They can reduce the amount of time people spend collecting water. If properly constructed and maintained, they can also protect water from contamination. However, contamination can occur in pipes and canals when :

- Chemicals or heavy metals leach from the pipes, joints, or soldering compounds.
- Contaminated water enters buried pipes because of low or variable water pressure in the pipes.
- Pipes develop leaks or holes that are not repaired quickly.
- People repair, replace, or install segments of pipe and introduce contamination.
- Pipes have dirty outlets or spouts, which contaminate water as people collect it.
- Canals are open to the environment, allowing garbage and contaminated surface water to get into the water



Leaky pipes and unprotected canals are two examples of water transportation systems that may introduce contaminants into the water as it moves.

1.6 Barriers to Contamination during Water Transportation

4.3.1 Barriers to Contamination During Transport by Container

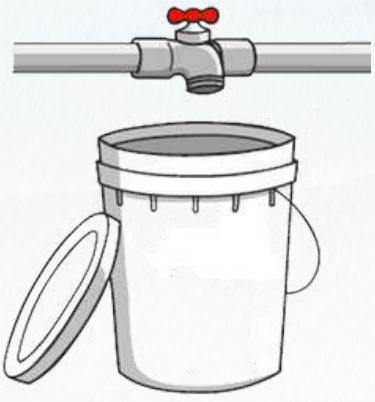
Actions to protect water during transport by vehicle, animal, or by hand include:

- Properly clean the container before filling it with water. Clean buckets regularly with soap or bleach to ensure they do not have microorganisms growing on them.
- If the water source does not have a tap or spout, use a clean scoop or bucket to withdraw water. If the source does have a tap or spout, make sure the spout is clean before using it to fill containers.
- Use clean lids to cover the buckets or vessels during transportation. Do not use any other materials (rags, leaves, etc.) to cover buckets.
- Do not allow animals to drink from water intended for humans. Use a separate container that is clearly marked for animal use.
- When not in use, store water transportation containers in a safe location out of reach of animals and small children.

4.3.2 Barriers to Contamination During Transport by Pipes and Canals

Actions to protect water in pipes and canals

- Clarify roles and responsibilities for everyone involved in monitoring, record keeping, maintenance, and repairs.
- Fix leaks immediately.
- Ensure that canals are closed and protected to prevent contaminants from entering them.
- If water is treated before distribution, monitor drinking water quality at the point of use to make sure contamination is not occurring during distribution.



- If water is treated with chlorine before distribution, monitor to make sure there is an appropriate level of free chlorine residual (chlorine available to react with pathogens that enter the water between the treatment plant and point of use).

Water Treatment

While source protection, safe transportation, and safe storage prevent contaminants from entering the water, water treatment removes or inactivates contaminants. In this section, we discuss how to remove or inactivate pathogens through different types of treatment.

Water treatment can occur at the point-of-distribution or at the point-of-use (household or institution). There are three types of water treatment barriers: sedimentation, filtration, and disinfection. Most large-scale water treatment plants combine these three barriers to achieve better removal rates for microbiological contaminants. In your household or the households you serve, you can also use an appropriate combination of water treatment barriers to make your HWTS system more effective.

Here we focus on household-level water treatment systems. In this section, we give a broad overview of some of the household methods you can use for sedimentation, filtration, and disinfection. For detailed information about any of the options described in this Technical Brief, refer to CAWST HWTS Knowledge Base (https://www.hwts.info/) and CAWST HWTS Fact Sheets. For information about how to select appropriate HWTS options, refer to CAWST Technical Brief: Selecting HWTS Options. Note that centralized water treatment systems may also be appropriate for the communities you work with; such systems follow the same processes of sedimentation, filtration and disinfection but are out of the scope of this document.

Safe Storage and Handling

Safe storage and handling describes any actions taken, before and after water treatment, to handle and store water safely. Contamination of drinking water during transportation and storage is a significant and common concern (Wright, et al., 2004). Using clean, well-designed containers helps to protect drinking water (Günther & Schipper, 2013; Wright et al., 2004).

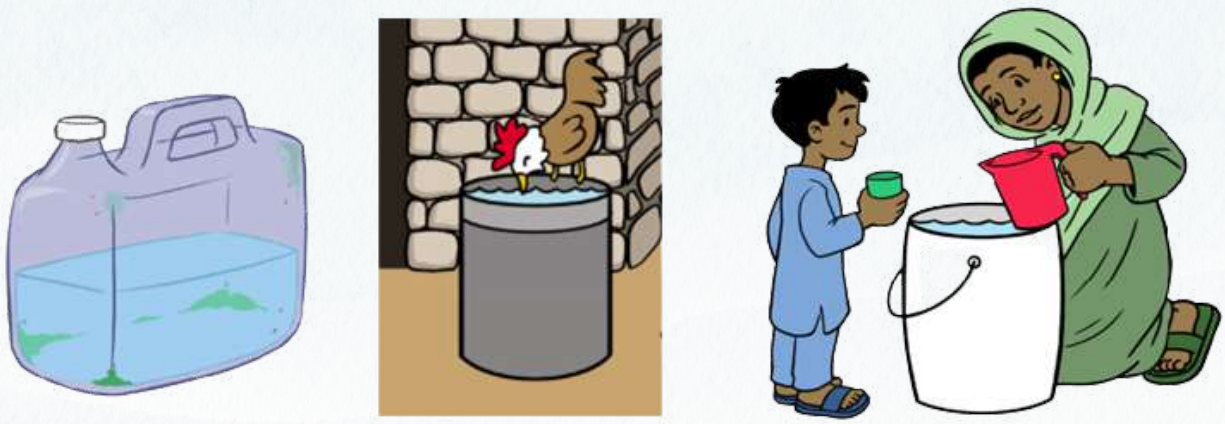
1.7 Methods of Drinking Water Storage

Drinking water is sometimes stored in large reservoirs or tanks that community members can access. Drinking water is also stored in people's homes, using buckets, pots, or jerry cans. Safe drinking water storage is particularly important after treatment, to avoid recontamination. Some household water filters, such as certain types of ceramic and membrane filters, include built-in safe storage reservoirs.

1.8 Causes of Contamination During Storage

In general, contaminants enter stored water because of:

- Improper Containers: The storage container or reservoir is open to the environment (allowing contaminants to enter), transparent (allowing algae and other organisms to grow), or difficult to clean
- Dirty Containers: The storage container or reservoir is not cleaned often enough
- Damaged Containers or Reservoirs: Cracks in tanks, containers, and covers allow contaminants to enter the stored water
- Poor Water Handling Practices: People use dirty hands or cups to scoop water from the container, allowing contaminants to get into the water. Or people use the same container to collect untreated water and to store treated water
- Unsafe Locations: stored water is placed where it is at risk of being bumped or contaminated by children and animals



Examples of unsafe water storage and handling practices (from left to right): transparent container that is difficult to clean, open vessel at risk of contamination by animals, dirty scoop used to take water from the storage container.

1.9 Barriers to Contamination during Storage

A safe storage container with a lid and tap protects drinking water.

Actions that can prevent contamination during water storage and handling include:

A safe storage container with a lid and tap protects drinking water

- Use a proper safe storage container. It should be durable and strong, non-transparent, and easy to clean. It should have a tight-sealing lid, and a tap for dispensing water.
- Pour drinking water out of the storage container instead of scooping it with a cup or ladle. Containers with taps make this much easier to do.
- Use different containers to store treated and untreated water.

- Use treated water within 1–2 days after treatment. A safe storage container with a lid and tap protects drinking water.
- Store treated water off the ground in a shaded place, away from animals and small children.
- Ensure that tanks and reservoirs are regularly monitored, repaired, and covered. Fix any leaks or cracks immediately.
- Clean storage containers or reservoirs regularly with soap or chlorine.
- Consider using a residual disinfectant that can protect against recontamination during storage. Common examples include chlorine, iodine, and silver.

Summary

All water supply systems have multiple points at which contaminants could enter the water. It is important to be aware of the potential risks to water safety and measures you can take to protect drinking water in your community or the communities you serve.

Using a multi-barrier approach is the best way to make sure water is safe when it reaches a user's glass. The multi-barrier approach uses a combination of behaviors and technologies to:

- *Protect the water source from contaminants.*
- *Transport the water safely to the home and within the home.*
- *Treat the water to remove or inactivate contaminants (using an appropriate combination of sedimentation, filtration, and disinfection).*
- *Store and handle the water safely to prevent contamination before and after treatment.*

Source water protection, safe transportation, and safe storage and handling are preventative barriers that keep contaminants from entering water. Sedimentation, filtration, and disinfection are treatment barriers that remove or inactivate contaminants. Using an appropriate combination of preventative and treatment barriers will protect drinking water quality and human health.

Definitions

Coagulant: Something (often a metal salt) added to water to cause suspended particles to clump together. Coagulants cause particles to settle from water more quickly.

Disinfection: A process that inactivates or kills pathogens in water. It is the last step of the household water treatment process, after sedimentation and filtration.

Erosion: Gradual destruction of soil or rock by natural forces such as water, wind or ice. Water sources near areas with high erosion may be more vulnerable to contamination.

Filtration: A physical process that involves passing water through filter media like sand, ceramic, cloth, or membrane. Filtration is commonly used after sedimentation to further reduce turbidity and remove pathogens. Water can pass through the pores of a filter, but particles get trapped by the filter media.

Free Chlorine Residual (FCR): Excess chlorine that is not consumed or combined and remains in drinking water after the contact time. FCR helps to prevent recontamination of the treated water, as it is available to kill new pathogens that enter the water.

Helminths: Also called worm or fluke. Large, multicellular organisms that are generally visible to the naked eye in their adult stages. Helminths can be either free-living or parasitic in nature. In their adult form, helminths cannot multiply in humans.

Improved Water Source: A type of water source that is likely to be protected from outside contamination, especially from feces. Examples of improved sources include boreholes, protected springs, and piped water supplies. This was an important definition for monitoring progress towards meeting the MDG target for water.

Millennium Development Goals (MDGs): Eight international development goals with specific targets for the year 2015. MDG 7 called for reducing by half the proportion of people without sustainable access to safe drinking water and basic sanitation. From 2016 onward, the Sustainable Development Goals (SDGs) have replaced the MDGs.

Multi-Barrier Approach: Adding as many barriers (control measures) as possible to reduce the likelihood of drinking unsafe water. Each barrier incrementally reduces health risks.

Point-of-distribution Water Treatment: Water treatment that occurs at a central location (for example, at a treatment plant) before the water is distributed—usually by a piped network—to people's homes or neighborhoods.

Point-of-use (POU) Water Treatment: Water treatment in the household or institution where the water will be used. Also called Household Water Treatment.

Protozoa: Microscopic, one-celled organisms that can be free-living or parasitic in nature. They are able to multiply in humans, which contributes to their survival and permits serious infections to develop from just a single organism.

Safely Managed Drinking Water: Under the Sustainable Development Goals, a safely managed drinking water service is defined as one that is located on premises, available when needed, and free of fecal and priority chemical contaminants.

Sedimentation: A physical water treatment process used to reduce turbidity of water. Sedimentation can be as simple as letting particles in water settle to the bottom of a bucket or tank. Sometimes coagulants are added to cause particles to clump together and settle more quickly.

Sustainable Development Goals (SDGs): Also known as the Global Goals, the SDGs build on the Millennium Development Goals, which ended in 2015. The SDGs are a series of 17 goals, each with specific targets to be reached by 2030. Goal 6 is to ensure the availability and sustainable management of water and sanitation for all.

Unimproved Water Source: One that does not meet the definition of an improved water. source. All surface water sources are unimproved.

Turbidity: The "cloudiness" or "dirtiness" of water. Turbidity is caused by suspended solids, such as sand, silt and clay, floating in water. Light reflects off these particles, which makes the water look cloudy or dirty. Turbidity is often measured in nephelometric turbidity units (NTU).

Water Safety Planning: A preventative, risk-based, system-wide approach to ensuring that water remains safe from the catchment (source) to the consumer (household member).

Water Supply System: The combination of practices used within a community for collection, transportation, treatment, and storage of drinking water. Water supply systems can be very diverse. Most communities have a variety of water sources, transportation practices, treatment measures, and storage practices.

Additional Information

CAWST HWTS Knowledge Base. *Available at www.hwts.info*

- A knowledge base for point-of-use water treatment solutions, from technology options to implementation best practices.

CAWST Education and Training Materials. *Available at https://resources.cawst.org*

- Technical briefs, lesson plans, presentations, posters, sanitary inspection forms, and other resources for learning and training about HWTS.

World Health Organization: Publications and Documents Related to Household Water Treatment and Safe Storage.
Available at: www.who.int/water_sanitation_health/water-quality/household/household-publications/en

- Resources related to national HWTS policies, the Scheme to Evaluate Household Water Treatment Technologies, water quality guidelines, water safety planning, and more.

World Health Organization and International Water Association:
Water Safety Portal. Available at: http://www.wsportal.org/

- An online network to support the implementation of water safety plans, including resources, news, and events.

References

Bruni, M., & Spuhler, D. (n.d.). Water Source Protection. Retrieved May 4, 2017,

from http://www.sswm.info/category/implementation-tools/water-sources/hardware/groundwater-sources/water-source-protection

Günther, I., & Schipper, Y. (2013). Pumps, germs and storage: the impact of improved water containers on water quality and health.

Health Economics, 22(7), 757–774. https://doi.org/10.1002/hec.2852

Rosa, G., & Clasen, T. (2010). Estimating the Scope of Household Water Treatment in Low- and Medium-Income Countries.

American Journal of Tropical Medicine and Hygiene, 82(2), 289–300. https://doi.org/10.4269/ajtmh.2010.09-0382

Sobsey, M. D. (2002). Managing Water in the Home: Accelerated Health Gains from Improved Water Supply. World Health Organization.

Retrieved from http://www.who.int/water_sanitation_health/dwq/WSH02.07.pdf

WHO, & UNICEF. (2017). Progress on Drinking Water, Sanitation and Hygiene: 2017 Update and SDG Baselines. Geneva.

Retrieved from https://data.unicef.org/wp-content/uploads/2017/07/JMP-2017-report-launch-version_0.pdf

World Health Organization. (2017). Safely managed drinking water - thematic report on drinking water 2017. Geneva, Switzerland:

World Health Organization. Retrieved from http://apps.who.int/iris/handle/10665/177752

Wright, J., Gundry, S., & Conroy, R. (2004). Household drinking water in developing countries: a systematic review of microbiological contamination between source and point-of-use.

Tropical Medicine & International Health, 9(1), 106–117. https://doi.org/10.1046/j.1365-3156.2003.01160.x

SEHGAL FOUNDATION

Plot No.34, Sector 44, Institutional Area
Gurugram, Haryana- 122003 INDIA
Website: smsfoundation.org
Email: smsf@smsfoundation.org