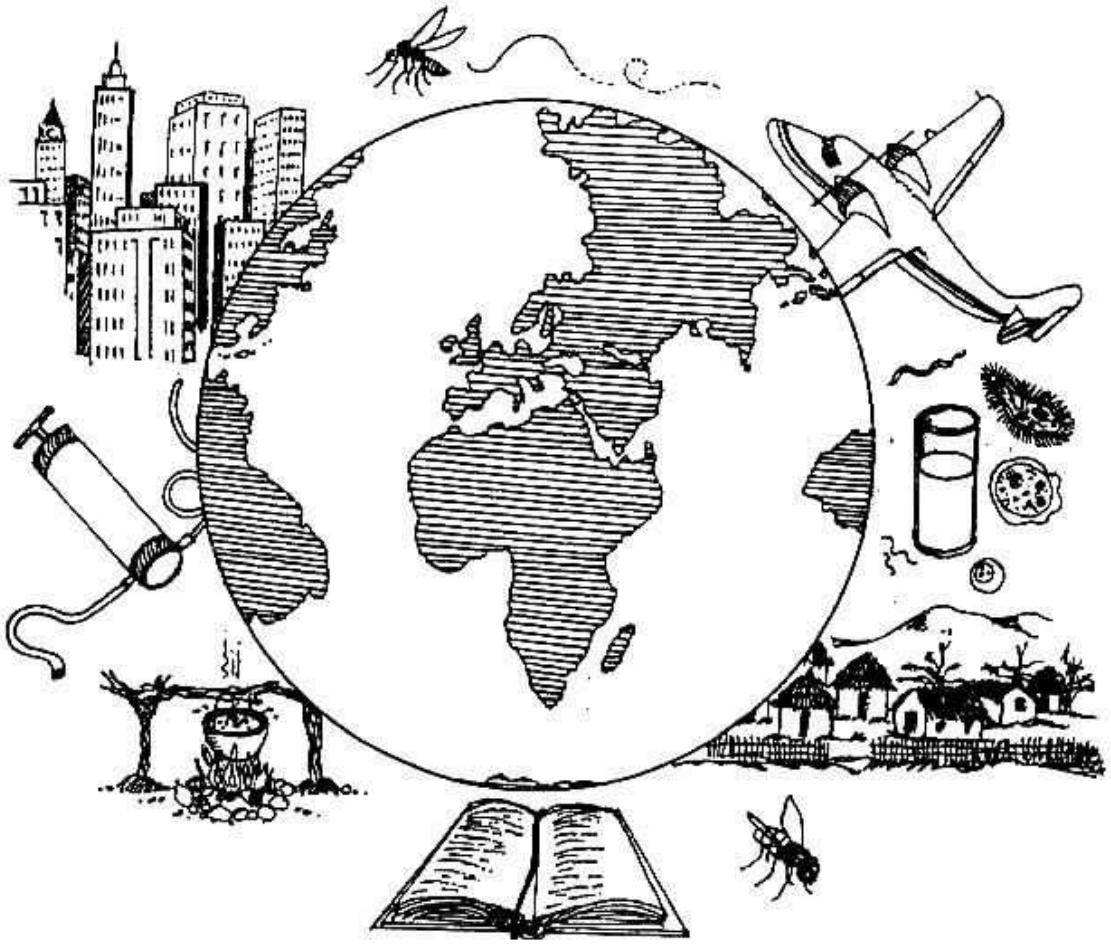
Water Purification

Appropriate Technology



Missionary Training Series

INSTRUCTIONS

This Training Pac has a text and a separate Workbook that contains the exercises for the text. Follow these steps:

1. Read through the entire text to obtain an overview of the text content.
2. Become familiar with the Objectives at the beginning of each section.
3. Then reread the text while completing the exercises in the Workbook.

Contents

Objectives

When you have successfully completed this Training Pac, you will be able:

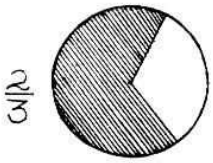
To learn the importance of clean, disease-free water
To locate some common sources of water
To recognize contaminated water and find its source
To learn how to purify water and make it safe to drink
To be prepared for an emergency
To be aware of “little foxes” that spoil the vines

I. IMPORTANCE OF CLEAN WATER

Clean water is necessary for life. It keeps our organs running smoothly, our bodies cool, and satisfies our thirst. It cleans us, and helps prepare our food. Every person needs clean water to live and to stay healthy and free from sickness and disease.

"My people are destroyed for lack of knowledge..." Hosea 4:6

Water Around the World



Two-thirds of the earth's water supply is contaminated (unsafe to drink). Many people suffer serious health problems and even die because of unsafe drinking water. Some people who are sick do not know it is because of the water they drink. They do not know you can purify water and make it safe. In some countries, the people go to the bathroom, bathe, and wash clothes in their main drinking water supply. They must be taught about good water sanitation and hygiene rules. Village water supplies can easily contaminate (made dirty) by rain water running through livestock areas and washing waste into the clean water supply.

Many international travelers and overseas missionaries have suffered needless sickness and disease because of contaminated water sources. Through the simple methods we will learn about in this Training Pac, all of this can be avoided. This will make your travel more enjoyable and productive. A well missionary is a useful missionary.

Some Myths and Facts About Clean Water

Myth	Fact
Water is safe to drink when it is clear.	Most harmful bacteria in water are invisible, even clear water can be extremely unsafe.
If the water is very cold germs cannot live in it.	The colder the water the more difficult it may be to purify thoroughly. Cold water bacteria can survive some purification methods.
A deep well is always safe.	Deep wells can be contaminated by outside sources. For example, too close to animal areas or sanitation areas.
Tap water is safe to drink.	Tap water from a contaminated source is unsafe to drink.

II. WATER AND DISEASE

Unsafe water can be a breeding ground for bacteria, germs, and harmful disease organisms. Many illnesses enter the body through unclean water. These can cause fever, diarrhea, cramps, vomiting and sometimes death. These diseases are called water-borne illnesses. All are preventable through proper water purification and sanitation practices.

Cholera

A disease that often comes in epidemics. It is a dangerous disease causing severe diarrhea and sometimes vomiting.

Infectious Hepatitis

The hepatitis virus from water contaminated with stool of a person with the disease. In some places it is called 'the fever'. It damages the liver.

Typhoid Fever

Typhoid is an infection of the gut that affects the whole body. It is spread from feces to mouth in contaminated food or water and often comes in epidemics (many people sick at once). Typhoid is one of the most dangerous infections.

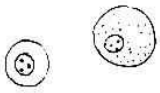
Amoebas

Amoebas are tiny animals – or parasites – that can be seen only with a microscope. They are transmitted into drinking water or food through poor sanitation. Amoebas are a common cause of severe diarrhea or dysentery (diarrhea with blood).

Giardia

Like the Amoeba it is a very small parasite transmitted into the body through contaminated drinking water. Giardia can cause intestinal cramps, severe diarrhea, and dehydration.

Cysts



Cysts are small sacs containing baby tapeworms. Through improper sanitation these cysts get into drinking water and go into a person's brain.

Disease Prevention

All the diseases mentioned above can be avoided by following proper sanitation guidelines in your house and community and most importantly through clean drinking water. By keeping outdoor toilets and sanitation areas far away from water supplies many of these problems can be avoided. Clean water supplies make a village or community a healthy place to live. We must learn how to take care of our water and then teach others how important clean water is to all of us. An ounce of prevention is worth a pound of cure.

III. WATER SOURCES

A WATER SOURCE IS A PLACE WATER COMES FROM. When checking water sources ask ourselves these three important questions:

Where does the water come from?
What is the source of contamination?
How can I correct the problem?

? ? ?

Some common water sources are:

Streams	oceans	underground rivers
Rivers	lakes	rain
Springs	underground wells	snow

Know the Source

When we come to a place (or before we go if possible). We must first determine where the water originates from and whether or not it is contaminated (unsafe to drink). If it is contaminated we must find the source of contamination and correct the problem before the water is used.

Well Water

Deep wells (wells more than 100 feet deep) can be considered safe if there is a cement top to keep any outside water from coming in. It may also be safe if water comes directly from the well into a clean container and no toilet is nearby (at least 35 meters away). Before use all well water should be tested for harmful bacteria or Amoebas.

Public Sources

Some chlorinated public water supplies in cities are considered safe to drink but even these places treated water sources are variably chlorinated and unreliable.

Bottled Water

In regions where bottled non-chlorinated water is available, this may be considered as an alternative to purifying your own water. Please be careful! Health agencies currently recommend that bottled, non-carbonated ("still") water be avoided in areas of poor sanitation. Always be certain the water you will use is free from contamination and disease.

"When in doubt ... Don't"

IV. SOURCES OF CONTAMINATION

There are many sources of water contamination and our list is not conclusive. Water suppliers can also be contaminated at large water source upstream from the contaminated water supply. Here are some common sources of contamination.

Chemicals	sitting (stagnant) water	animal waste
Oils	acid rain	trash
Toxins	human waste	community bathing sites

These sources can be divided into two basic groups:

Chemical Sources

These contaminants (things that make water dirty) may not be easily stopped. You may need to move your water supply or find a completely new source of water. You may need to contact the source if it is a company or industry polluting the water. Other methods of action (maybe even legal) may need to be taken.

Biological Sources

These sources can usually be traced to poor sanitation and low health standards. Latrines (toilets) may need to be built. Bathing areas, animals and latrines must be kept at least 35 meters from water supplies. A positive course of action must be taken to raise health standards near water supplies.

After locating the source of contamination we are making good progress. A solution to correct the problem can now be found.

V. CORRECTING THE PROBLEM

There are several safe methods that can be effectively used for water purification. Some are expensive and other cost little. Depending on where you are and what your need is you must choose a method that will work for you. The goal is pure, safe water.

Be Prepared

As a general rule, water cannot be trusted anywhere you go. Be prepared to purify your water at all times. When you travel in other countries or cultures, it is very important not to offend the people. Implying (suggesting) that their water is not clean can be insulting to them. You can prevent unnecessary problems by simply being discreet when treating your water. You may want to explain that any difference in water can upset a person's system. They may also experience some discomfort if they travel outside their country or area. Some people think that water purification is a "westernized" way. The truth is it is "God's" way for us to live clean, healthy and productive lives.

VI. METHODS OF PURIFICATION

Boiling

1. If water is polluted, strain through paper towels, paper coffee filters, or several layers of clean white cloth into a container to remove sediment or floating matter.

2. In a clean covered pot, boil water vigorously over stove, camp stove, or fire for 20 minutes. (This will kill harmful bacteria).

3. Let water cool and pour into clean airtight containers. Always keep clean water covered. Use within 48 hours (2 days).

Warning! *The boiling method alone does not kill all waterborne diseases, viruses, and bacteria. In some areas conditional purification methods may be required.*

Chemicals

The most common method is using bleach (chlorine) or tincture of iodine.

1. If water is polluted, strain through paper towels, paper coffee filters, or several layers of clean white cloth into a container to remove sediment or floating matter.

2. Use liquid chlorine (household) bleach or tincture of iodine. (Follow measurements on chart below). Using an eyedropper, drop the required amount of bleach / iodine directly into the water.

Warning! *Do not use granulated forms of household bleach... they are poisonous.*

3. Mix thoroughly by stirring or shaking water in container and let stand for 30 minutes. A light chlorine (or bleach) smell should be in the water. If there is no smell found, repeat dosage and wait another 20 minutes before using.

Bleach / Iodine Purification Chart

Amount of Water	Amount of chlorine bleach to add to:		Amount of tincture of iodine 2% to add to:	
	Clear Water	Cloudy Water	Clear Water	Cloudy Water
1 quart	3 drops	6 drops	5 drops	10 drops
1 gallon	12 drops	24 drops	(1 / 4 tsp.) 20 drops	(1 / 2 tsp.) 40 drops
5 gallons	(3 / 4 tsp.) 60 drops	(1 ½ tsp.) 120 drops	(1 ¼ tsp.) 100 drops	(2 ½ tsp.) 200 drops

Another method of chemical purification is using water purification tablets. Halizone or Globaline are the most common. Some contain iodine or chlorine. They can be purchased at some drugstores and sporting good stores that carry outdoor sporting supplies. When travelling, some government health departments make these available to overseas health workers or volunteers in rural or contaminated areas. Check with local health departments for more information on water conditions and purification supplies.

Important

Bleach loses its strength over time. Keep a fresh supply on hand. When bleach is one year old, double your dosage. Bleach that is two years old should be thrown out.

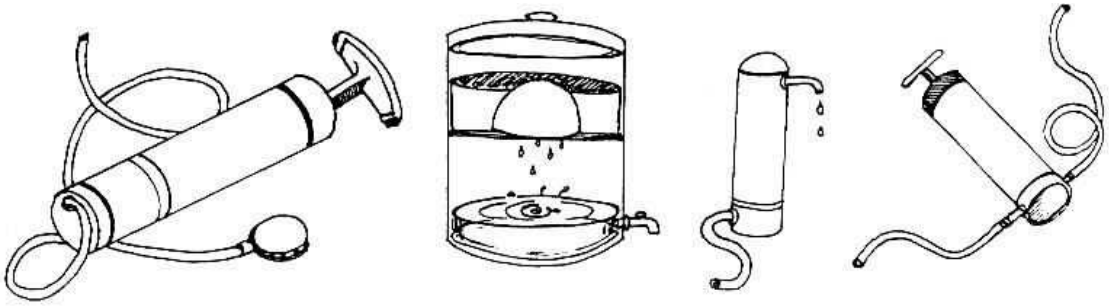
Purification tablets are only good for two years. Check expiration dates. Do not risk using expired tablets. Discard all expired tablets.

Warning! *Purification methods using iodine (liquid, tablet, and some filters) are very dangerous for diabetics and children. Pregnant women or thyroid patients must consult a doctor before using iodine. Using too much bleach can cause serious gastric disturbances. Follow dosage instructions carefully.*

Water Purifiers

There is a variety of water filters, pumps and devices available on the market for purifying water. We suggest one that removes harmful microbes, Giardia, cysts, tapeworms, amoebas etc.. Most filters only remove chemicals from the water. We advise that you read all labels and discuss the actions of each device with a knowledgeable sales representative. Or reliable source.

Some filters require the water to be boiled for twenty minutes before running it through the filter. Icy water from mountain streams is more difficult to purify. It may need to pass through some filters twice to kill all microbes. Water filters are more expensive than boiling or chemical methods. Also, future replacement cartridges may be needed for some pump-type filters. Replacement tubing and lubricating compounds are possible additional expenses to be considered. If you are traveling outside the U.S.A., finding these replacement parts may be difficult or impossible.



Selecting a Filter

Filters vary in size and output. You do not want to use a personal size purifier for a family of five. Ask your salesman which size is right for you. Some are easier to operate than others. If buying a pump-type filter, test the pumping action in the store before you buy and make sure it is not too difficult for your needs. Some filters need to be hooked up to a faucet. Other filters use a slow drip process.

Remember: Your life depend on this device. A wise decision is a must.

Using the Filter

Follow all instructions carefully. Read every detail and use according to directions given. DO NOT use filter on soda pop, juices, or any beverage (these will destroy the filter). Use for water only.

Care of the Filter

Follow all maintenance and cleaning instructions carefully and exactly. Any short-cuts taken in care or cleaning could result in contamination of your water. When the filter is clogged and difficult to pump either clean or replace immediately.

Water filters can be a reliable way to purify water. Beware! There are many gadgets and devices on the market such as filter straws or bacteriostatic filters which DO NOT purify contaminated water. These may improve the taste of your water, but will not make it safe to drink.

VII. USE AND STORAGE OF PURIFIED WATER

After water is purified and stored in proper containers, it is ready for use. The following is a list of some common uses for purified water.

Drinking	cooking	washing wounds
Brushing teeth	washing fruits/vegetables	mixing medicines
Ice	washing dishes	
Powdered beverages	baby's juice drinks	

It is very important to remember when to use purified water. If we fail to remember even one time we could become seriously ill and even die! The following are some common mistakes that are made in our daily tasks:

- Brushing teeth with unpurified water
- Allowing water to get into your mouth while showering/bathing
- Not drying your dishes completely
- Adding unclean ice to your beverage
- Not washing hands (especially under fingernails)
- Splashed water from mud puddles, rivers, etc. entering your mouth
- Trusting someone's word about the water

All your effort in purifying the water will be in vain if you make one of these common mistakes.

Remember: It's little foxes that spoil the vine. (Song of Solomon 2:15)

Storage for Immediate Use

After the water is purified, it must be stored in properly sanitized containers. Thus is a very important step and you must follow the exact the directions. First, choose the containers in which you are going to store your water. Keep in mind the amount of people who will be using the water. You may want to have containers of varying sizes depending on the needs of those using it. Heavy opaque plastic containers with screw on caps are your best choice. If you are hiking or traveling, you may want to store your water in a canteen.

Sterilizing Containers

After choosing your containers they must be properly sanitized for use. The following steps must be done carefully.

1. All containers must be washed with soapy water and rinsed thoroughly.

2. Using clear running water, tap water or purified water, fill the container ¾ full and add ¼ cup liquid bleach for each 1 quart of water. (This water is not for drinking, it is for sterilizing.)

3. Shake the container well, remembering to turn it upside down 2 or 3 times to sterilize the stopper.

4. Let it stand for 2-3 minutes and then pour the water into the next container. The bleach water can be used for up to 10 containers.

Fill the container with purified water and close it tightly. We advice that you label and date your containers. This water should only be kept for up to 48 hours (2 days). After 48 hours (2 days), use this water for hygienic purposes only. New water must then be purified for drinking.

VIII. EMERGENCY WATER RESOURCES

In an emergency such as an earthquake, flood, fire, or volcanic eruption, water supplies to homes, communities and sometimes even large cities can be cut off or polluted because of damaged pipes. This means we must be prepared by having a water supply ready to meet an emergency.

During a Disaster

Shut off the main water supply to your home. Don't risk using tap water that is not clear or that has an unusual smell. During a disaster NO WATER CAN BE PRESUMED SAFE, ALL WATER FOR DRINKING AND COOKING MUST BE PURIFIED.

How Much Drinking Water Is Needed

A minimum of 2 quarts per person per day (up to 1 gallon). Note: Pets may also need water. A family of four people would need 28 gallons of safe water for a 2 week supply. Use this water carefully for:

1. Drinking
2. Food preparation
3. Brushing teeth
4. Washing wounds

Emergency Sources of Water

1. Hot water heater*
2. Water that remains in plumbing (water pipes)*
3. Water from flush tank of toilet (not bowl)
   (Do not use if 'blue' water form chemical)*
4. Water from swimming pool (hygiene purposes only)
5. Melted ice cubes*
6. Juice or liquid from canned goods
7. Factory bottled drinking water

*Water from these sources must be purified if used for human consumption.

Preparing a Water Supply

Containers made of heavy plastic are best if you are going to bottle your own water. Empty household bleach bottles are good if the water is changed every 6 months. Label these bottles carefully and cover or remove old bleach labels. Children may accidentally drink bleach if you are not careful.

Plastic containers that held juice or milk are not a good choice. They can be used but may crack or leak sooner. Whatever container you choose must be sterilized properly (see sterilizing containers on page 9 of your Unit Training Pac.)

Purifying water for Long-term Storage

You can purify water for long term storage by carefully following instructions on page 6 for chemical (bleach / iodine) purification. Using the chart on this page for your measurements.

Storing Emergency Water

Emergency water supplies must be kept free from contamination in sterilized containers and tightly sealed. If you buy sealed factory bottled water in heavy duty plastic containers (usually in 5 gallon sizes) it will last 5 – 10 years. Lighter and smaller containers of factory bottled water may crack or leak in a short time.

Label and date the outside of each bottle

Place lightweight plastic and clear containers of water in clean black plastic trash bags and seal (You may also want to put in a box). This protects it from sunlight and permeable odors. Sometimes stored water can develop an unpleasant appearance, taste, or odor, this is not harmful. Check your water supply every 6 months. If any of these signs are present, replace the water and re-label with current date.

Important: Some containers are permeable. Keep all containers away from gasoline, kerosene, pesticides, and other chemical substances. Do not drink water stored in vinyl plastic containers. This plastic may release chemicals into the water making it unsafe to drink.

IX. CONCLUSION

There are other ways to purify water for large scale needs such as villages, communities, towns, and cities. In this Training Pac, we have covered basic water purification techniques used for missionaries, travelers, families, small groups, and households.

Having clean water is necessary for life. We can improve the standards of our world by practicing and teaching others these simple methods of water purification and storage.

A clean water source means healthy living.

For future information regarding health information for world travel, contact World Health Organization, Atlanta, Georgia. They have information regarding disease outbreaks and immunization.

Sources of Information

Where There Is No Doctor – David Werner
Earthquake Disaster Plan – Lafferty & Associates
Health Handbook for International Travel – State of Ohio D.O.H.
World Travel Information – Hotline, Atlanta, GA
Sommer Haven International Ministries Overseas Training Seminars on Water Purification and Health/Hygiene for World travel... under the direction of Agnes I. Numer