



Lesson 6: Other Treatment Options

CURRICULUM CONNECTIONS:

Grade 6-8 Social Studies and Science

INSTRUCTIONAL METHODS:

- Jigsaw Instructional Strategy
- Research assignment

ESTIMATED TIME: 75-110+ minutes

KEY QUESTIONS/IDEAS:

- What other methods (than the BSF) can be used to treat water?
- What are the benefits and drawbacks of each one?
- How can organizations decide the best method to provide for a community?

NOTE TO TEACHER:

Since the Case Studies can be tricky for students to understand, we have included a special Note for Teachers at the end of the activity. This section is not intended for students but just for you, as the instructor, to guide their research and thinking through the problems.

MATERIALS

Computers, tablets or library time for re-search assignment,

Copies of Activity W11—Note-Taking Sheet for whole class,

6 Copies of Activity W12 – Information Sheets for Other Water Treatment Options,

Copies of Activity W13 – Diverse Solutions for whole class,

Copies of Activity W14 – Case Studies for whole class.

Part A: Water Treatment Options for Developing Countries

1. JIGSAW ACTIVITY (45 MIN)

Give students Activity W11 – Note-taking Sheet.

Divide students into 6 groups (of approximately equal number)

Give each group one information page from Activity W12– Water Treatment Information Sheets about a type of water treatment

Allow students time (10-15 minutes) to read through their page and make specific notes about their type of water treatment. Make sure that the students know that they will be the experts on this type of treatment. They will need to teach others about it.

When expert groups are finished, create new groups with an expert from each water treatment type in each (should have 6 people in each group).

Students in the groups take turns teaching the others in their group about their water treatment (allow for 20-30 minutes if needed).

In the end of the activity, all students should have detailed notes (and drawings) about all of the different water treatment types.

Teaching Strategy:

Jigsaw - In this instructional strategy students are split into groups (as many as there are topics) and learn about one specific topic. The students in each group become experts on their topic first. Then, new groups are formed – with one student from each of the expert groups. The students then teach their groups about their topic, ensuring that all students learn about all topics.

2. CLASS DISCUSSION (10 MIN)

What was your favorite water treatment method and why?

Which methods are easiest to implement? Hardest?

Part B: Example of the need for Diverse Solutions to water treatment

1. GIVE ALL STUDENTS A COPY OF ACTIVITY W13 (10 MIN)

This is an explanation of the need for diverse solutions in different areas of a country due to land formation and specific needs of communities. Students may read this over in partners and then have a discussion.

2. DISCUSSIONS QUESTIONS (10 MIN):

Why does Samaritan's Purse need to use two different solutions for water treatment in these two areas of Kenya?

What should be considered when an organization enters a new area to try and offer water treatment?

Part C: Problem Solving and Research Assignment

(for homework or allow for 30-45 min in class depending on how many case studies you ask each student to complete)

Students work in pairs or small groups to solve one or more of the case studies available in Activity W14– Case Studies for Water Treatment using their knowledge of water treatment. Most of these case studies will also require students to do some research about the availability of water treatment options in the given country.

MINISTRY MOMENT:

Read together Proverbs 2.

QUESTIONS:

What is real wisdom?

Why is wisdom important?

What situations in your life prompt you to ask God for wisdom? What other situations, looking back, should you have asked for wisdom?

Have students fill out this chart and then discuss. So often we rely on our own knowledge and abilities when we should be asking God for help and guidance. When Samaritan's Purse Staff enter a new village or district to help people have access to clean water, they need to ask God for wisdom in deciding how to approach the community, what treatment system to use, what community members to hire as health and hygiene promoters, where to set up the meeting place, and many other things. God should be consulted when making any decisions, no matter how seemingly small or insignificant.

Decision	Did you ask God for wisdom (yes or no)	Explain why or why not
What to wear to school		
Who to make friends with		
What to buy at the mall		
What sports or extracurricular activities you should do		
What movies to watch		
What games to play		

ACTIVITY W11 – NOTE-TAKING SHEET

Boiling Water	Solar Disinfection (SODIS)
Chlorination	PUR Water Packet
Ceramic Filters	Rainwater Harvesting

ACTIVITY W12 – INFORMATION SHEETS ON TYPES OF WATER TREATMENT (FOR JIGSAW)

SOLAR DISINFECTION (SODIS)

Solar disinfection (SODIS) was developed in the 1980s to inexpensively disinfect water used for oral re-hydration solutions to treat diarrhea. In 1991, the Swiss Federal Institute for Environmental Science and Technology began to investigate and implement SODIS as a household water treatment option to prevent diarrhea in developing countries.

SODIS users fill one-liter or two-liter plastic soda bottles with low-turbidity water, shake them to oxygenate, and place the bottles on a roof or rack for six hours (if sunny) or two days (if cloudy). The combined effects of UV-induced DNA alteration, thermal inactivation, and photo-oxidative destruction wipe out disease-causing organisms.

In the laboratory, SODIS has been proven to inactivate the viruses, bacteria, and protozoa that cause diarrheal diseases. Field data have also shown reductions of bacteria in developing countries' waters treated with SODIS. In four trials, SODIS reduced the amount of diarrhea in users between nine and 86 per cent.

WHERE IS IT USED?

More than two million people in 28 developing countries use SODIS for daily drinking water treatment.

Important partners are community-based organizations such as women's clubs, youth associations or self-help groups, well-established non-governmental organizations working on community development projects, institutional organizations (such as health posts, hospitals, and teacher training centers), and government programs.

THE BENEFITS OF SODIS ARE:

- Proven reduction of viruses, bacteria, and protozoa in water
- Proven reduction of diarrheal disease incidence in users
- Easy to use, so little resistance by potential beneficiaries
- No cost to the user after obtaining the plastic bottles
- Minimal change in water taste
- Recontamination can easily be kept to a minimum by serving the water directly from the small, narrow-necked bottles (with caps) in which it is treated



THE DRAWBACKS OF SODIS ARE:

- The need for pre-treatment (filtration or flocculation) of silty, muddy waters
- User acceptability concerns because of the limited amount of water that can be treated at once and the length of time required to treat it
- The large supply of intact, clean, clear, colorless plastic bottles required
- It does not change the chemical quality of water, so it's ineffective against chemical pollutants
- Extensive education is needed to help beneficiaries understand how and why the system works
- Bottles can crack, and even if they don't they will still need replacing eventually

Sources: Centers for Disease Control

"The Safe Water System," Centers for Disease Control and Prevention, 2012, Swiss Federal Institute of Aquatic Science and Technology

Part A: The Filter

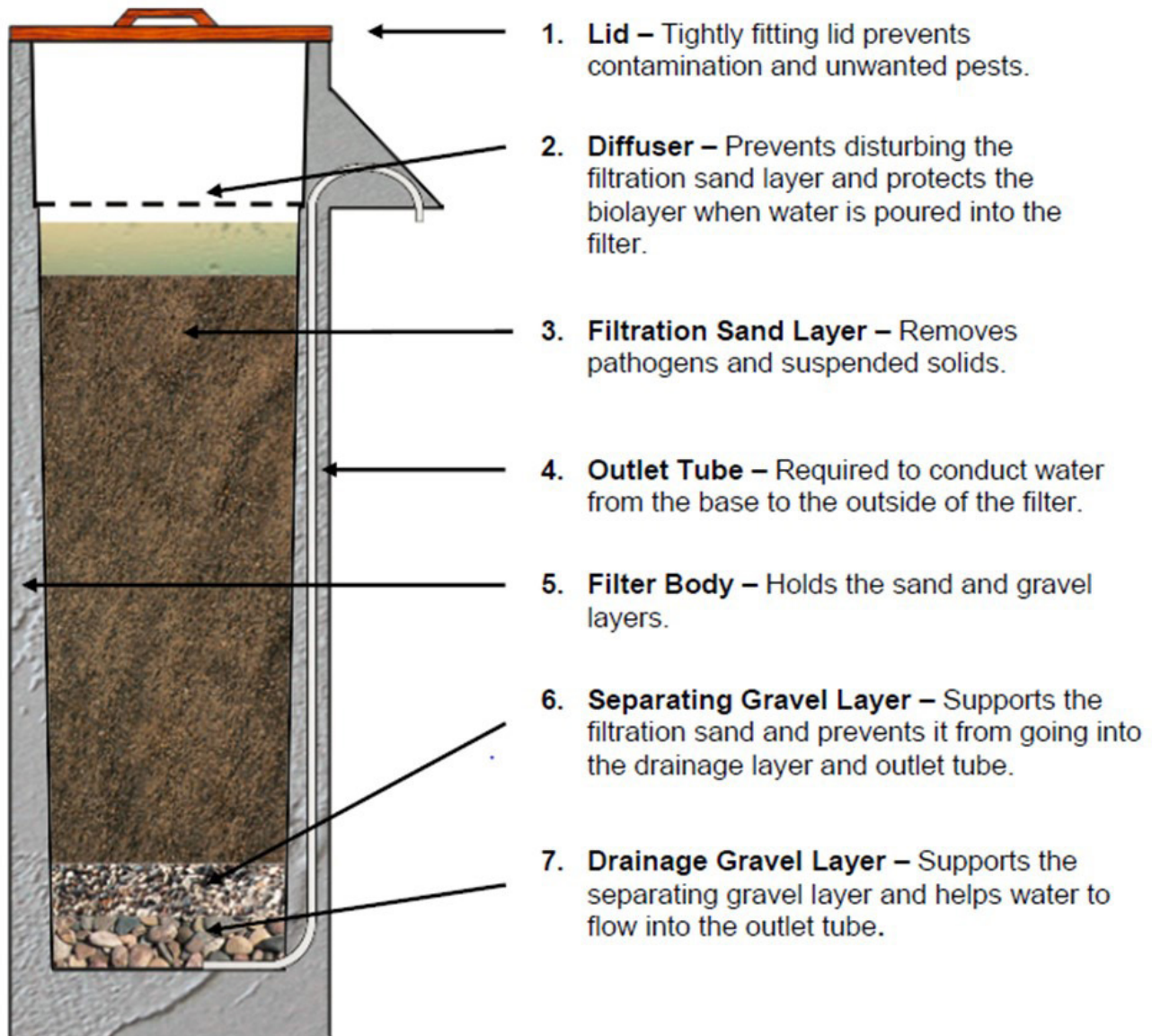
1. GETTING TO KNOW THE BIOSAND FILTER:

Give each student a copy of Activity W8 – The Biosand Filter.

2. STUDENTS LABELING:

Students label the parts of the filter and answer questions using information from the video:

[‘The Parts and Function of the BioSand Filter’](#)



Part B: Learn about the BSF using videos

WATCH VIDEOS:

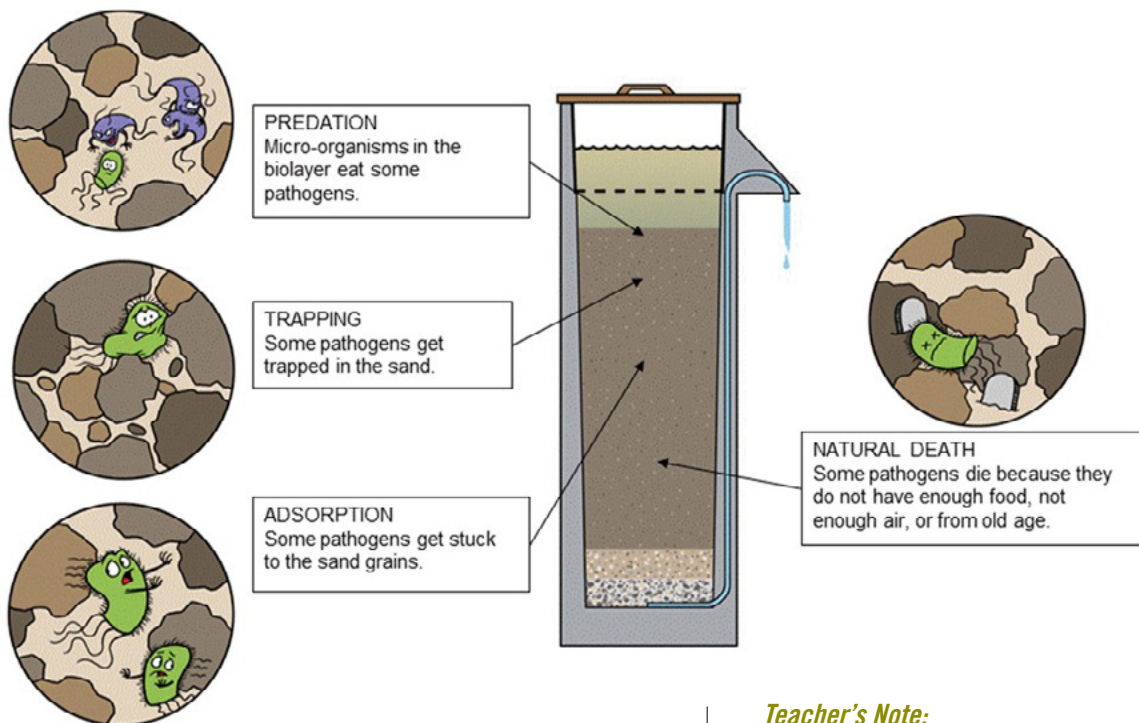
Watch videos used by CAWST (Centre for Affordable Water and Sanitation Technology) to teach owners of BSFs about the technology. Students answer questions on Activity W8—The BioSand Filter while watching videos.

- [How the BioSand Filter works](#)
- [How to use the BioSand Filter](#)
- [Source: Video by CAWST is licensed under CC BY-SA 4.0 / Adaptation](#)



Part C: The Biolayer

The Biolayer is a very important part of the BioSand Filter. The bacteria and organisms living in this layer are a large part of the filtration system. There are 4 main ways that the Biolayer kills pathogens. Introduce this to students by showing them this image or by explaining in words on the board.



PATHOGEN GAME: (ON ACTIVITY W9—{PATHOGEN GAME})

Have students play this game to review the parts and function of the BioSand Filter, as well as how the pathogens are killed in the filter.

Teacher's Note:

You will need 5-8 copies of the Pathogen Game (depending on your number of students). Each student should have a pawn and each group needs a die. The question cards will need to be cut out before class starts.

Part D: Advantages and Disadvantages of the BioSand Filter

1. Divide class into small groups of 3-4 people. Give each group one of the stories from Africa in Activity W10: Stories from Africa. Have students read the stories and take notes on what are the benefits of the BioSand Filter for the children in Africa.
2. Class Discussion: Start by brainstorming with the class what they think are the best parts (benefits) of a BSF in a developing country (from prior knowledge and reading stories). As the class comes up with ideas, write on the board. Then share the other benefits listed below.

BENEFITS OF THE BIOSAND FILTER:

- Because the water is treated at the point of use, there is less risk of contamination during transport.
- Easy to use. Simply pour water in the top and it pushes out water that has passed through the sand layers. There's almost no waiting, no moving parts, no energy required, and nothing for the user to do but make sure a clean container is available for the improved water.
- There are no additional operating costs, so people are able to use it every time they need water.
- After filtering, the water tastes better, has less sedimentation, and cools as it passes through the sand. No other technology has these three quality improvements, and this is often stated by users as one of the finest attributes of the filter.
- Reduces incidents of diarrhea by up to 40 per cent.

THE DRAWBACKS OF BIOSAND FILTERS ARE:

- Very heavy, so putting them in place to operate takes a lot of effort.
- Not designed to be moved, so inappropriate for nomadic people.
- Do not filter out every pathogen.

Brainstorm:

Ask students what they think are the disadvantages or drawbacks of a BioSand Filter (from what they've learned today). Again brainstorm and write on the board. Ensure that all students have this information written down as they will use it for the next lesson.

Optional assignment or discussion:

Design a comparison study to discover the similarities between how wetlands and BioSand Filters improve contaminated water.



At A Glance:

Location: La Paz, El Salvador

Partner: Agua Viva (Living Water) – Since 2004

Project Budget (CDN):
 \$191,000 Annual

Project Impact:

Rural villages have access
 to life-saving safe water
 through household BSFs and
 Samaritan Filters

700 homes with BSFs with
 6,500 beneficiaries

2 schools with the Samaritan
 Filter, 550 students

Ken has been the Project Manager with Agua Viva since 2009 where he leads a team of seven men to serve rural El Salvadorans. He's respectfully and affectionately called 'Capitan' or "Captain" by his team. Quite an appropriate title because he once was the captain of a United States helicopter carrier with 3,000 personnel!

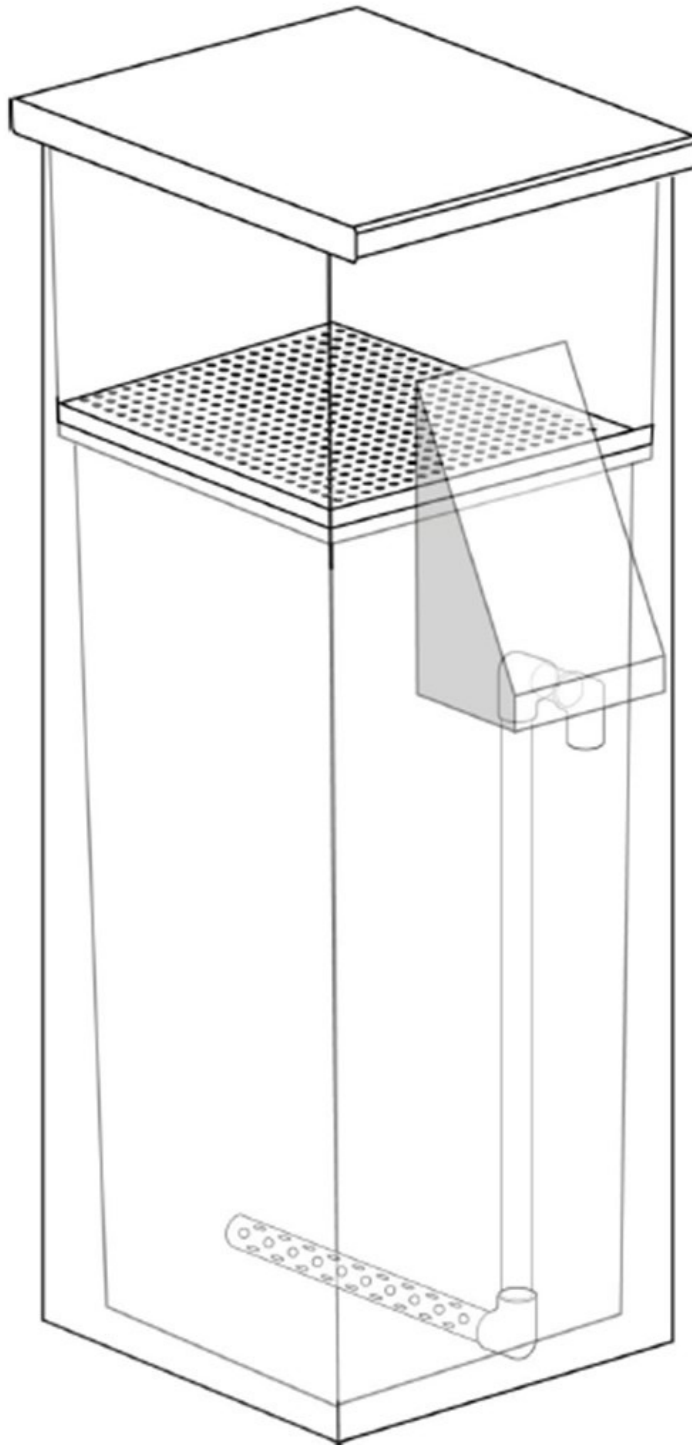
While stationed in El Salvador, Ken once received an SP Calendar with a picture of a young girl with a BioSand water Filter (BSF). He was glad to know that Samaritan's Purse was actively working in El Salvador and helping the poor. In his free time, he visited the project site and was convinced about the impact of the BSF. As he neared retirement, he and his wife Pamela asked the Lord to lead them. God kept them exactly where they were-El Salvador! Nearly 8 years later, Ken still says, "Every day is a joy to be here, I don't consider it work but rather a service."

During work week, Ken starts his day very early. At 3:30 am he makes coffee and spends time praying, reading, and memorizing God's Word. It's how the living water of God flows through him. Ken loves sharing God's Word and discipling people in Christ.

Once a week he takes a team of young adults to the local school where the team is installing a Samaritan Filter to conduct discipleship classes. In one school 420 students have a great time playing games, singing, learning and applying God's word in their lives. El Salvador is known as the murder capital of Latin America. Rampant gang activity is claiming the futures of many youth. Ken says, "I want the children and families to know that Life is much better, even now in Christ." He and the team press on, rain or shine, every day to serve and to share in the Name of Jesus.

ACTIVITY W8 - THE BIOSAND FILTER – COLOURING PAGE

Watch Video “The Parts and Functions of The BioSand Filter”. Colour and label the parts of the filter.



WHILE WATCHING “THE PARTS AND FUNCTION OF THE BIOSAND FILTER” VIDEO, ANSWER THE FOLLOWING QUESTIONS:

1. What does the lid protect the filter from?
2. What is the diffuser and why is it important?
3. What is the standing water at the top of the filter called and how high should it be?
4. What does the sand of the filter do?
5. Why does the filter need gravel at the bottom?

ANSWER THE FOLLOWING QUESTIONS WHILE WATCHING THE VIDEO “HOW THE BIOSAND FILTER WORKS”.

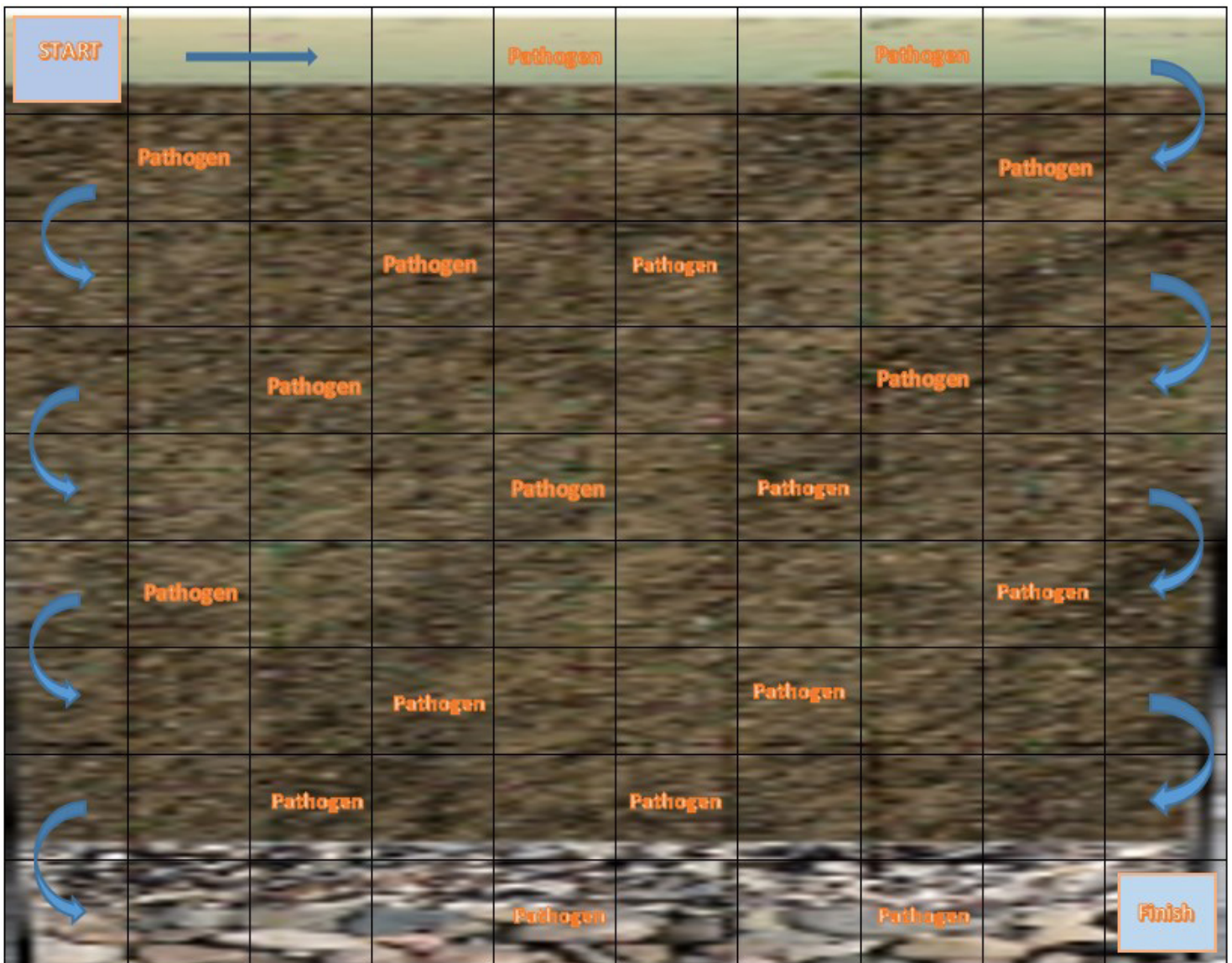
6. What are three different ways that the BioSand Filter cleans pathogens from water?
7. How long does it take for the BioSand Filter to start working optimally?

ANSWER THE FOLLOWING QUESTIONS WHILE WATCHING VIDEO “HOW TO USE THE BIOSAND FILTER”.

8. How much water does the reservoir hold?
9. Never put _____ into the reservoir.
10. It is very important that the container that the water filters into is _____.
11. How many times a day should a filter be used (should one pour water in)?

ACTIVITY W9: THE PATHOGEN GAME:

To play this game you will need a die, a pawn for each player, a small cube or chip for each pathogen square and a set of question/answer cards (included in handout). The game starts with a player rolling the die. Starting at the START square, the player moves his/her pawn (following the arrows) the number of squares indicated by the die. If a pawn lands on a Pathogen, the person must answer a question from the question cards. If they answer correctly, the pathogen is killed and the person gets to keep that pathogen. The object of the game is to kill as many pathogens as possible.



<p>Question: What is it called when micro-organisms in the biolayer eat pathogens?</p> <p>Answer: Predation</p>	<p>Fill in the blank: Some pathogens get killed by getting _____ in the sand.</p> <p>Answer: Trapped</p>	<p>Question: What is it called when pathogens get stuck to the sand grains?</p> <p>Answer: Adsorption</p>
<p>Question: What is it called when pathogens die because they do not have enough food, or air or from old age</p> <p>Answer: Natural Death</p>	<p>Question: What is the name of the part of the BSF that kills the pathogens?</p> <p>Answer: The Biolayer</p>	<p>Question: Why does the BSF need a lid?</p> <p>Answer: To keep out contamination and pests</p>
<p>Question: What is the diffuser used for?</p> <p>Answer: Prevents sand and biolayer from being disturbed when water is poured into filter</p>	<p>Question: What is the filter body made of?</p> <p>Answer: Usually concrete, but some are also made of plastic</p>	<p>Question: How high should the standing water at the top of the BSF be?</p> <p>Answer: 5 cm</p>
<p>Question: What is the function of the separating gravel layer?</p> <p>Answer: To support the filtration sand and keep it from getting to the intake tube.</p>	<p>Question: What are the two types of gravel called?</p> <p>Answer: Separating gravel layer and Drainage gravel layer</p>	<p>Question: How many days does it take for a new BSF to grow its biolayer?</p> <p>Answer: 30 Days</p>
<p>Fill in the Blank: Water from the same _____ must be used each time the BSF is filled.</p> <p>Answer: Source</p>	<p>Question: How long must the BSF rest between filtering a bucket of water?</p> <p>Answer: Several Hours</p>	<p>Question: What are three ways to disinfect the water after it has been filtered by the BSF?</p> <p>Answer: Chlorine, SODIS and Boiling</p>
<p>Fill in the Blanks: It is important to filter the water into a _____.</p> <p>Answer: clean storage container</p>	<p>Question: What are two ways that the BSF makes water cleaner?</p> <p>Answer: filters pathogens like protozoa, bacteria and worms, takes away cloudiness or silt, makes water taste better</p>	<p>Question: What are two ways that the BSF makes water cleaner?</p> <p>Answer: filters pathogens like protozoa, bacteria and worms, takes away cloudiness or silt, makes water taste better</p>

ACTIVITY W10: STORIES FROM AFRICA

These stories are fictionalized accounts based on the real lives of children in the developing world.

Ethiopia

Who: Ayana (aah-yana), 10 year-old girl

Where: Amhara region, Ethiopia

My older sister and I put our buckets into the river. I can hardly wait for them to fill so we can walk to school. I wasn't at school for long time, even though I love school. I was sick again – my belly hurt really bad. I couldn't do anything or stand up. I just lay on my mat on the floor with sweat dripping off me.

My sister would sometimes help me out of our hut to get some fresh air. "Ayana," she would say, "you must get better. Be strong."

Thankfully, I am better now, so I can go to school, but my mother is worried about my baby brother, Zeke. He has been sick for a long time. He lies on his mat like I did. He makes noises like a small kitten. Someone in our family is always sick. When my mother is sick, she can't work on the farm. If my mother can't work on the farm, we have no food to eat. Mostly, we kids are sick. I know why our bellies hurt so much. The river water we drink makes us sick. It's brown and smells like cows. The mud taste makes me want to spit it out. But it's the only water we have.

My friend Miriam lives in another village down the river. People from Samaritan's Purse helped the village build tall cement boxes called "water filters." Miriam's father helped build a filter for her family. When Miriam pours the river water into the top of the filter, it comes out safe and clear – like rain on your tongue.

Samaritan's Purse taught Miriam and her family ways to not get sick – to only drink water that has been poured through the filter, not going to the bathroom in the bushes and always washing their hands. They also taught Miriam's family about Jesus.

Miriam's family changed after getting the water filter. Miriam doesn't get sick or miss school. Her father and mother are strong and work in the fields every day. Her baby brother is not sick. I want a filter for my family. I hope Samaritan's Purse comes to my village, too.

ACTIVITY W10: STORIES FROM AFRICA

These stories are fictionalized accounts based on the real lives of children in the developing world.

Liberia

Who: Famata (fah-mata), seven-year-old girl

Where: Bopolu county, Liberia

I haven't lived in my village for very long. We used to live in a big, noisy city, but one day we began a long trip into the jungle. My mama told me we were going to our old home, a village very far away. I had never been there before because of the war in our country. "Now the fighting is over and it's safe for us, Famata," said mama. "We can go back to our real home."

Bad men had burned down our old house, so my father built us a new one out of trees, mud and cow dung. We covered the roof with branches and leaves. Now, my job is to help carry water and feed the goats. I like our village; lots of families have come back and all the kids I play with feel safe, too.

The best part is our water filters. People called Samaritan's Purse came to the village and helped us build tall cement boxes filled with sand and rocks. When mama pours the water from the creek inside, it comes out the spout tasting good. We had never tasted water so good.

The people from Samaritan's Purse told us to always pour our water through the filter, and put clean buckets under the spout, and it would help stop our runny stomachs. Before, most everyone had runny stomachs and sometimes the kids in the village were so sick their parents would have to take them in a wheelbarrow to the hospital far away, because we have no cars.

Even my father carries filter water to the field each day, so he doesn't have to drink straight from the creek. Because of the water filters, I never get a runny stomach and no more kids have to go to the hospital in a wheelbarrow.

The water filter makes us feel very fine – we are so happy to have it.

ACTIVITY W10: STORIES FROM AFRICA

These stories are fictionalized accounts based on the real lives of children in the developing world.

Niger

Who: Miriamma, 10-year-old girl

Where: Firgoune, Niger

Miriamma is making changes in her family and her village and she is helping them live healthier. Miriamma lives in Firgoune, which is on an island in a river. She goes to school and spends most of her spare time helping out at home. Her mother and father are often busy working in the fields, trying to grow enough food for the family to eat.

Miriamma cooks meals, looks after her younger brothers and sisters, and hauls water from the river to her home in a big bucket on her head. Young girls like Miriamma are hard workers and have very important roles in their families.

Besides these duties, Miriamma volunteers every week to attend health and hygiene classes at school. In these classes, she learns how to fight bad germs by washing her hands with soap, how to use a toilet dug in the ground, why it's important to drink and clean herself with safe water, why she should cover food to keep flies away, and the importance of sleeping under a mosquito net to keep away insects that could bite and give her malaria.

Many children die from diarrhea and malaria, so these classes are important for saving lives. In Firgoune, the only source of water is the river, which is polluted and can cause diarrhea.

Miriamma also learned about Oral Re-hydration Solution. This mixture of water, sugar, and salt is easy to make at home and is very important for people who are sick with diarrhea. Drinking the solution helps you from getting too dehydrated when you have diarrhea and it can save people's lives.

Miriamma was able to share those lessons with her family. She knew having safe water wasn't enough to make her family as healthy as possible. So those lessons were very useful when the family began using a BioSand Filter in 2007. It was their first source of safe water and it is still helping to reduce sickness in her family.

As a result of her courage and excitement about what she was learning, Miriamma's one small voice was able to help improve the health of her family.