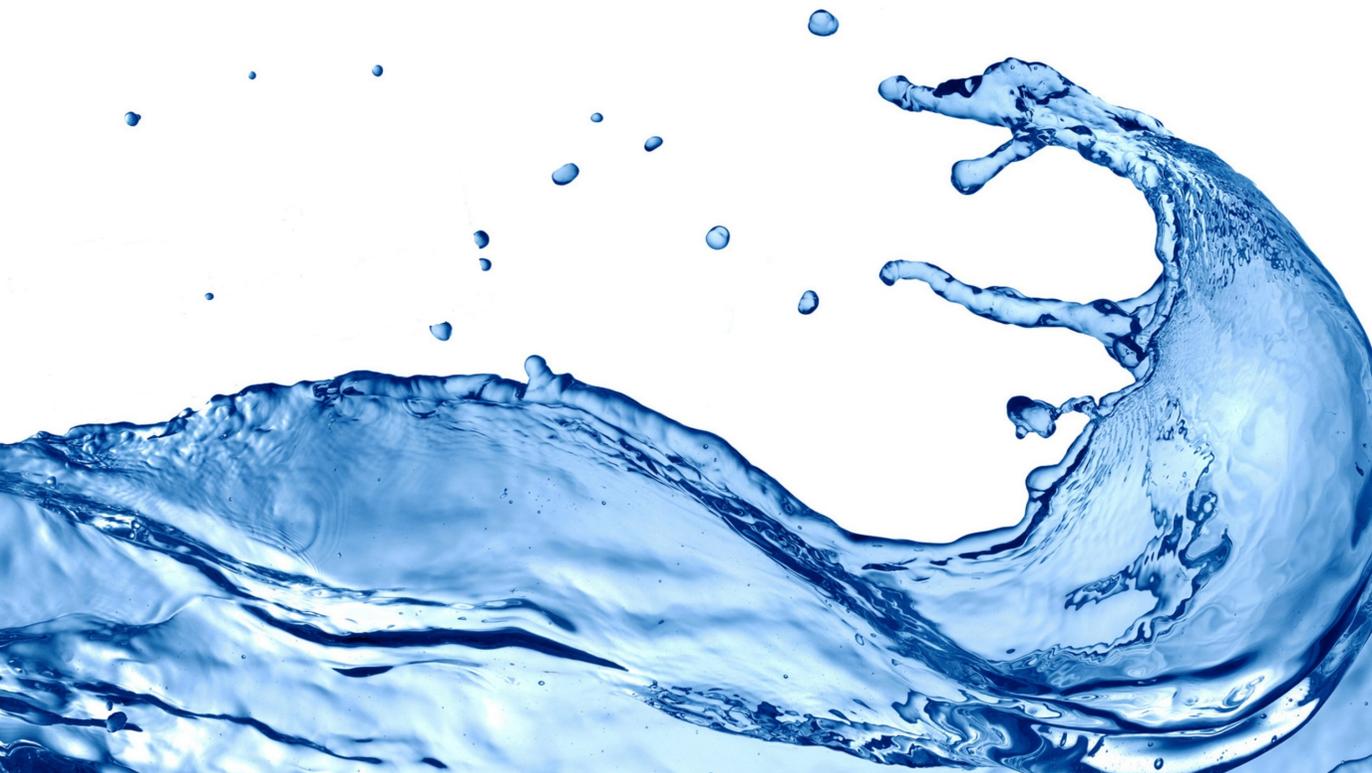




WATER EDUCATION

Teachers Guide



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1.0 INTRODUCTION



1.1 What is Water

Have you ever heard someone refer to water as H_2O ? Why do you suppose someone might call water by this name? What is water?

Water is a basic molecule made up of two hydrogen atoms and one oxygen atom. When these three atoms come together, they form a strong bond that is difficult to break. The strength of this bond keeps a water molecule together for millions and even billions of years.



Water is one of the most common substances on the Earth. Covering over 70% of the surface of the Earth as it is easy to find same goes to our body too.

Why it is important to us?

Why the water is being so important in our life? It all has to do with the unique properties that water exhibits. Firstly, it is the only substance on Earth that is in liquid form at the temperatures commonly found on the Surface of our planet. Secondly, it is a superb solvent, meaning that other substances regularly and easily dissolve into it. This allows water to carry nutrients to cells and carry waste away from them.

In addition, water has the unique property of expanding as it freezes. Because water expands becoming less dense, frozen water, more commonly known as ice, floats. This is very important because it protects the water underneath, insulating it from freezing.



Sustainable Development (SD)

SD refers to an unending quest to improve the quality of people's lives and surroundings, and to prosper without destroying the life-supporting systems on which current and future generations of humans depend (New Zealand Parliamentary Commission for the Environment, 2004). SD is a continuous process to improve human's life in ecosystem including biotic and abiotic factors to ensure the well-being of the future generations. Abiotic factors refer to non-living physical and chemical such as water, air, soil, rocks, sunlight etc. While biotic factors refer to living organisms such as animals, plants, fungi, etc. Both factors are interdependent to each other to ensure ecosystem equilibrium.

Sustainable Development Goal (SDG)

In 2012, Sustainable Development Goals (SDGs) was born at United Nations Conference on SD in Rio de Janeiro. SDGs were developed to succeed the MDGs which ended in 2015. MDGs has eight goals which are:

1. To eradicate extreme poverty and hunger
2. To achieve universal primary education
3. To promote gender equality and empower women
4. To reduce child mortality
5. To improve maternal health
6. To combat HIV/AIDS, malaria, and other diseases
7. To ensure environmental sustainability
8. To develop a global partnership for development

While SDGs have 17 goals:

1. No Poverty – End poverty in all its forms everywhere
2. Zero Hunger – End hunger, achieve food security and improved nutrition and promote sustainable agriculture
3. Good Health and Well-Being – Ensure healthy lives and promote well-being for all at all ages
4. Quality Education – Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
5. Gender Equality – Achieve gender equality and empower all women and girls
6. Clean Water and Sanitation – Ensure availability and sustainable management of water and sanitation for all
7. Affordable and Clean Energy – Ensure access to affordable, reliable, sustainable and clean energy for all
8. Decent Work and Economic Growth – Promote sustained,

11. Sustainable Cities and Communities – Make cities and human settlements inclusive, safe, resilient and sustainable
12. Responsible Consumption and Production – Ensure sustainable consumption and production patterns
13. Climate Action – Take urgent action to combat climate change and its impacts
14. Life below Water – Conserve and sustainably use the oceans, seas and marine resources for sustainable development
15. Life on Land – Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
16. Peace, Justice and Strong Institutions – Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
17. Partnerships for the Goals – Strengthen the means of implementation and revitalize the global partnership for sustainable development

All goals are interrelated in order to improve life for future well-being.

Education for Sustainable Development (ESD)

ESD is a process of transforming SD concept through teaching and learning. ESD does not integrate content of SDGs but create interactive teaching and learning in producing life-long learners. It can be done formal and informal learning. Through ESD, citizens for future generations will have knowledge and skills about sustainability. It is a hope that ESD would be able to change the society's perception to be more affectionate and appreciate the nature – ecosystem in ensuring well-being life.

1.3 SDG 6 – Clean water and sanitation

In SDG 6, is to ensure availability and sustainable management of water and sanitation for all. This is due to scarcity global freshwater problems. Fresh water ecosystem is vital for human healthy living, environmental sustainability and economic prosperity.

Healthy living refers to good physical and mental health. Every human needs a balance diet as well as sufficient water in ensuring digestive system is functioning properly. In addition, toxic from digestive system byproducts can be flush out.

Environmental sustainability refers to the ability to maintain qualities that are valued in the physical environment (Sutton, 2004). For example, in order to have a healthy life, human need clean water, unpolluted air and environment. We must make sure that our natural environment did not decline in quality.

Economic prosperity refers to the quality of life.



1.4 Water Values

Water is very much used in our daily life, including among Muslims. In Islam, water is considered an important and valuable resource not only because of its usage in sustaining life but also due to its necessity in performing the act of worship (*ibadah*). In Islam, a person is supposed to use water to cleanse body and to perform wudhu' before he could pray. Thus, matters related to sustainability of water is given much emphasis in Islam.



There is also a mineral water which popular among Muslims due to some spiritual and health reasons called the zam-zam water. The zam-zam water could only be found in the Holy Land of Mecca and is said to have unique components of molecules. It is also believed that mineral water, being read certain verses from the Holy Quran, could also act as a curing elements in alternative medicine.

Besides, there are also many stories related to water in the Holy Quran. Among stories related to water in the Holy Quran is the story of Prophet Moses and Pharoah, the story of Prophet Noah and his ark, the story of Prophet Yunus and the whale and the story of Prophet Ismail and the zam-zam water. Other than that, the Holy Quran also describes extensively the scenery in the Paradise which consists of various kinds of rivers including the river of milk, the river of wine and the river of honey.

1.5 Water Ethics

1.6 Framework

In this module, constructivism theory will be used. Through constructivism, teachers give children the opportunities to explore the activities in order to build their own understanding about certain concept. The activities should be hands-on as it allows children learn by doing. This situation would give a meaningful learning experience to children.

To implement constructivism approach in a classroom, certain strategies could be used such as inquiry or problem-based learning. Both strategies will use questions to stimulate children's curiosity.

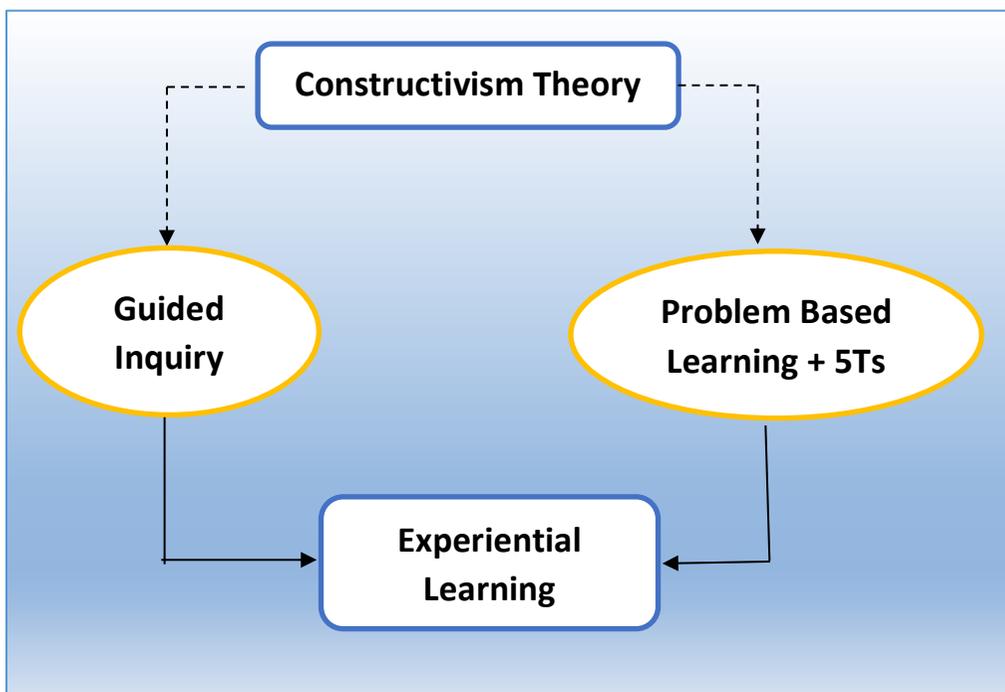


Figure 1. Framework for Teaching Strategies

Why Inquiry?

Inquiry is an interactive, question-driven, exploratory and explanatory approach (The Access Center, 2000) that makes children active in their learning process. The main aim of this approach is to develop children's understanding through the hands-on and minds-on activity. According to Hashimah and Nooraida (2012), hands-on activities are very important in inquiry approach because it give children to explore and experience the learning process. In addition, the inquiry approach is strongly encouraged as it is in line with the requirements of the National Pre-School Standard Document. In fact, this approach is able to develop the potential of children to an optimum level of all aspects according to children's uniqueness (Noraini and Nik Noriah, 1992) that allow children to "see" their thinking and analyze the knowledge in the activity (Dyasi, 2000). He also pointed out that inquiry may contribute to the social and intellectual development of children.

Based on the literature, there are three types of inquiry namely structured inquiry, guided inquiry and open inquiry. Refer to Table 1.

Table 1
Types of Inquiry (adapted from The Access Center, 2000)

Types of Inquiry	Characteristics
Structured Inquiry	Teachers instruct children to do step-by-step investigation based on the hands-on activities. The activities were selected by teachers. Answers are given to children.
Guided Inquiry	Teachers guide children to investigate based on the hands-on activities. The activities were selected by teachers. Teachers discuss with children in finding answers.
Open Inquiry	Children conduct investigations based on hands-on activities. The activities are chosen by children. Children look for answers / solutions based on their observations.

However, guided inquiry is suggested as it is easy for teachers to implement it in the classroom. In guided inquiry, a teacher will be a facilitator in guiding children to explore the activities. Therefore, questions are very important to stimulate children's' thinking.

Steps in implementing Guided Inquiry

Teacher **RAISE** several questions such as:
i. Why do we need watering the plant? – why
ii. Can we be watering plant using greywater
such as laundry water?

1

Teacher will **GUIDE** students to set up the apparatus for reused water from watering plant.
i. How can we set up the apparatus?
ii. Does the plant can survive?

2

Teacher **ASK** questions such as :
i. Is there any access water after watering the plant?
ii. Can we reused access water to rewatering the same plant?

3

Teacher should allow students to **DISCUSS** in finding answers.

4

Teacher should allow students to **OBSERVE** experimental result and discuss about the use of greywater

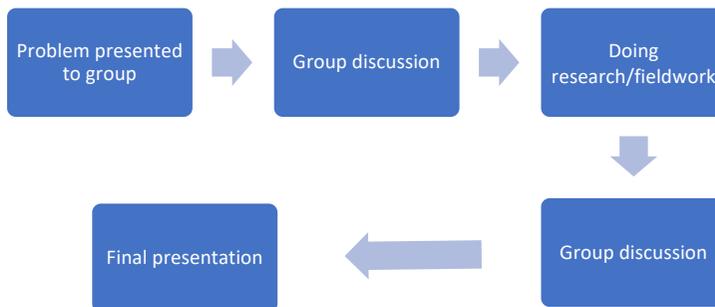
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Problem-based Learning(PBL) & 5Ts of Action L

In PBL, an ill structured problem is needed. According to Shin and McGee (2003), ill structured problem is a problem where students face routinely in daily life. For this reason, a teacher should be able to develop an ill structured problem. However, in this module, PBL will be integrated with 5T developed by Wildlife Environment Society of South Africa (WESSA).

PBL helps students to be more critical, problem-solver and self-directed learner. In this module, we suggest 5 steps PBL.



First step, a teacher **will present** an ill-structured problem to students by **asking** simple questions related to students' daily life. This step is important to stimulate students' thinking.

Second step, students will **discuss** the solution based on their experience – from what they know.

Third step, students will **explore** by doing research or fieldwork. They will have a **work plan** to set up the activity. In this step, guidance from a teacher is needed.

Fourth step, students will **discuss** and **do** the hands-on activity. The **consent** from all members is important to ensure every members contributes idea.

Last step, students will **present** the solution.

Besides, 5Ts of action learning also be used since it supports learning social. During discussion, students will exchange ideas in finding solutions in the forms of their understanding – based on students' experience and fieldwork.

The 5Ts consisted:

Thinking or reflection, based on a **given issue or question**, students will think and reflect to what they know and don't know.

Touch, fieldwork encounters, students will **discuss and explore** on the best solution of the issues. They will have their work plan.

Take-action, based on their work plan, students will **do** the hands-on activity.

Tune-in, students will use the knowledge that they have to **make sense** on what they see and experiencing.

Talk, students will **have dialogue** about the solutions based on their knowledge, understanding and experience.

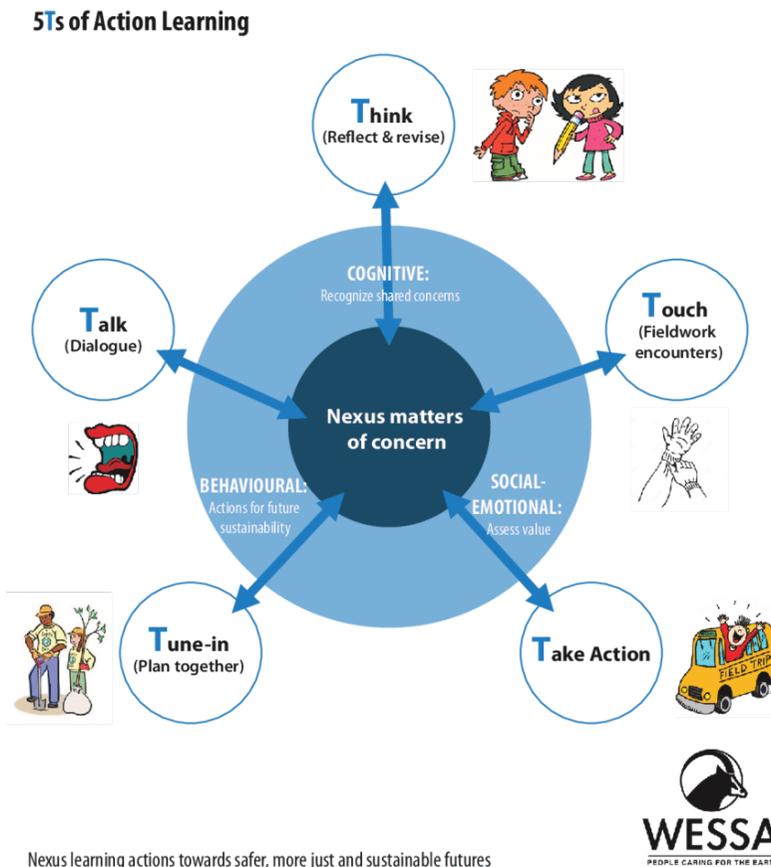
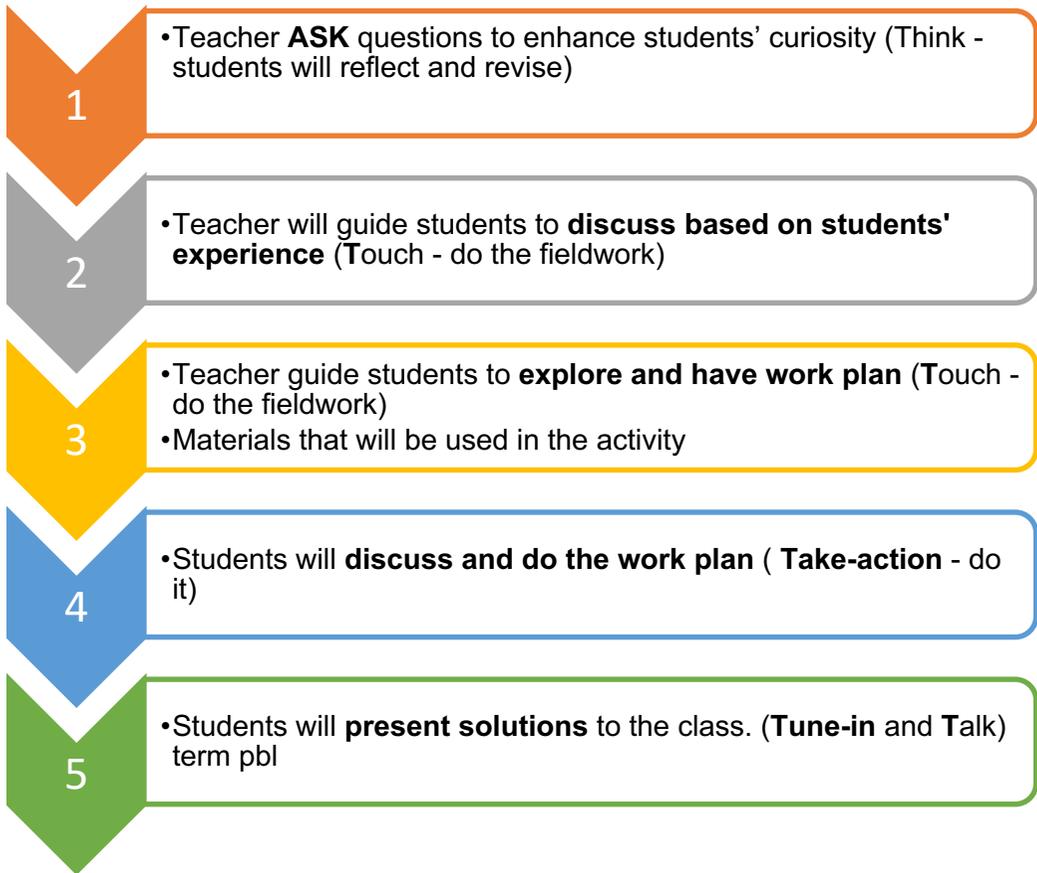


Figure 2: The 5Ts of Action Learning for framing a deliberative nexus learning environment

Steps in implementing Problem-based Learning(PBL) & 5Ts



1.7 Water Saving

Water saving or water conservation is use water efficiently without water waste. This is necessary because our mother earth will face insufficient fresh water in the future. As a responsible citizen, we need to be committed in ensuring that no wastage of water occurs at home or in school.



1.8 Water Reuse

Water reuse is water that has been used and can be used with different purpose. For example, water from washing machine can be used as cleaning the drain or wash a car. This situation can save your water consumption.

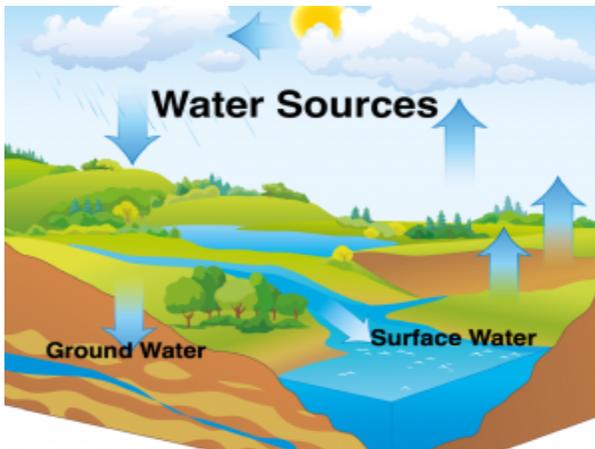


1.9 Water Recycle

Water recycle is refer to waste water that has been treated and can be reused with different purpose. For example, waste water from household such as greywater can be treated through filtration can be used to watering plant. In this case, the used of fresh water can be reduces and promotes the used of greywater efficiently.



1.10 Water Sources



Water is a source of life, livelihoods and prosperity as well as an important input to almost all types of productions viz. agriculture, industry, energy, transport and so on (Grey and Sadoff, 2007). It is an essential element in maintaining life and needed for the survival of all organisms (Azlan et al., 2012). Water resources are sources of water that are

valuable or potentially useful to humans. It has been well known for millennia that human survival and ecosystem conservation depend on the reliable availability of adequate water of appropriate quality (Asian Water Development Outlook, 2007). Without water, all forms of life could never exist and will not survive. The earth is probably the only planet in the vast universe that has lives on it and the only reason could be that the earth is blessed with abundant water (Zakaria et al., 2011).

So where does the water we need and use come from?

- Rain – Rain is a major source of fresh water. It is the condensed form of the water vapor in our atmosphere. Rain water accumulates on the earth to form our surface sources and ground sources.
- Surface Sources – Water that we can see on the surface of the earth like lakes, reservoirs, streams, seas, irrigation canals etc. are surface sources. They are usually formed due to rains or melting of snow.
- Ground Sources – Water that is found underground. Springs, wells, infiltration wells are sources that have to be dug out.
- Desalination – A man-made process by which sea water is converted to fresh water. It's quite an expensive process! The most common processes used for desalination are 'distillation' and 'reverse osmosis'.

1.11 Water and Electro Link

Electro means electricity. Hence by using electricity, waste water can be recycled and reused. Electricity is used to treat waste water through redox reaction which involved oxidation and reduction reaction. By using electrode – 2 carbon and waste water as electrolyte, electricity – 8V, waste water can be reused. For example, waste water such as from the sink can be treated through electrolysis and all the impurities will be separated through electrocoagulation process.

2.0 Activities

AND WE SENT DOWN

WATER

FROM THE SKY IN PROPER MEASURE
THEN STORED IT IN THE EARTH
AND INDEED WE ARE ABLE TO
TAKE IT AWAY!

Quran - 23:18



2.1 Activity 1 Greywater filtration

Background

Greywater is waste water from household except waste water from the toilet. It may contain bleach, dirt, bacteria, hair, grease, etc. According to Lesiker, et.al. (2005), greywater can be reused for gardening, landscaping, etc. In ensuring the concept of reuse and recycle can be understood, filtration of greywater is carried out. This activity can save water consumption and save money.

Objective and Values

- Introduce the concept of greywater
- Introduce the concept of water recycled
- Create awareness that greywater can be used for different purposes

Learning Outcome

At the end of this activity, students should be able to:

- Define what is greywater
- Define what is water recycled
- Conduct an experiment of greywater filtration

Teaching Strategies

There are two proposed teaching strategies and teacher can choose either one.

Guided inquiry

Step 1

Teacher raise several questions such as

- After taking shower, where did the water go? – introduce the greywater concept.
- Can we reuse greywater?
- How can we reuse greywater?

Step 2

Teacher will guide students to set up the filter by asking

- how can we set up the filter?
- does it work?

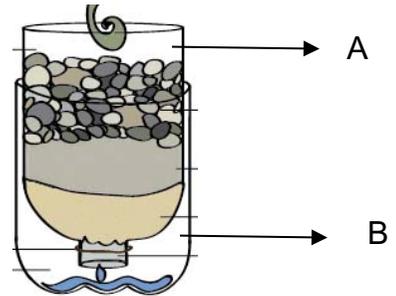
Materials

- 1 recycle bottle
- Large gravel
- Fine gravel
- Course sand
- Fine sand

- Activated carbon
- Cotton
- Coffee filter

Procedure

- Cut bottle into 2 parts – label it as upper part labelled as A and bottom part labelled as B
- Put inverted A into B
- Fill A with
 - Coffee filter
 - Cotton
 - Activated carbon
 - Fine sand
 - Course sand
 - Fine gravel
 - Large gravel
- Pour selected greywater
- Observe the color of greywater
- Use treated greywater as plant watering



Step 3

Teacher ask questions such as

- why we use activated carbon
- why the layer is composed coffee filter to large gravel

Step 4

Teacher should allow students to discuss in finding answers.

Step 5

Teacher should allow students to observe experimental result and discuss about the use of filtered greywater

Problem-based Learning & 5T

Step 1: Teacher formulate questions to enhance students' curiosity (Think - students will reflect and revise)

- After taking shower, where did the water go? – introduce the greywater concept.
- Can we reuse greywater?
- How can we reuse greywater?

Step 2: teacher will guide students to discuss (Touch - do the fieldwork)

- Youtube : <https://www.youtube.com/watch?v=3-VmVC0K8v8>
- Greywater reuse in India
- <https://www.youtube.com/watch?v=wAcZrC1wnss>
- Where does the water go? - Sewerage treatment

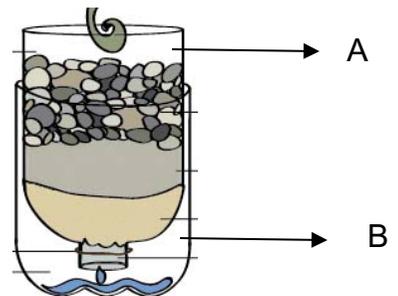
Step 3: teacher will guide students to explore (Touch - do the fieldwork)

Materials

- 1 recycle bottle
- Large gravel
- Fine gravel
- Course sand
- Fine sand
- Activated carbon
- Cotton
- Coffee filter

Procedure

- Cut bottle into 2 parts – label it as upper part labelled as A and bottom part labelled as B
- Put inverted A into B
- Fill A with
 - Coffee filter
 - Cotton
 - Activated carbon
 - Fine sand
 - Course sand
 - Fine gravel
 - Large gravel
- Pour selected greywater
- Observe the color of greywater
- Use treated greywater as plant watering



Step 4: students will discuss and do the activity (Take action)

- Teacher should encourage students to set up their own filter
- Teacher should allow students to observe experimental result.

Step 5: students will present the solutions by having discussion with friends and teachers (**Tune-in** and **Talk**)

- Teacher should allow students to discuss about the use of filtered greywater in overcoming the water wastage issue.

Resources

1. <https://www.hpwd.org/s/Graywater-rdjj.pdf>
2. <https://www.researchgate.net/file.PostFileLoader.html?id...assetKey=AS>
3. <https://www.ruaf.org/.../Greywater%20What%20it%20is%20and%20How%20to%20tr>.

2.2 Activity 2 Desalination of Salt Water

Desalination is a process of extract of minerals from salt water. It involves evaporation and condensation process. With this process, salt water can be as drink water.

Objective and Values

- Introduce the concept of desalination
- Introduce the concept of evaporation and condensation
- Introduce the concept of water recycled
- Create awareness that salt water can be used for different purposes

Learning Outcome

- At the end of this activity, students should be able to
- Define what is desalination through evaporation and condensation process
- Define what is salt water
- Define what is water recycled
- Conduct an experiment of salt water desalination

Teaching Strategies

There are two proposed teaching strategies and teacher can choose either one.

Guided inquiry

Step 1

Teacher raise several questions such as

- Can we drink salt water? – why
- Do you have any suggestions?

Step 2

Teacher will guide students to set up the apparatus for desalination

- how can we set up the apparatus?
- does it work?

Materials

- 1 recycle plastic container
- Salt water (water and salt)
- Straw

- Plastercine
- A small recycle plastic container
- Plastic cling wrap
- Solephane tape

Procedure

- Mix some of the salt into one cup (100 ml) water. Make sure the water is salty.
- Pour the salted water from the cup into the plastic container.
- Place the small container in the centre of the plastic container.
- Cover the plastic container tightly with plastic cling wrap. Then put plastic container cover on the top of plastic cling wrap.
- Put the plastic container at a safe and clean place with direct sun light. Make sure that place get the most sun light.
- This process will take several hours.
- Observe the amount of water accumulated on the plastic cling wrap and flow down to the small container. The process involved evaporation and condensation.
- Taste the water.

Step 3

Teacher ask questions such as

- Can we drink the water?
- If this activity is done at night, does the same thing happened?

Step 4

- Teacher should allow students to discuss in finding answers.

Step 5

- Teacher should allow students to observe experimental result and discuss about the use of salt water as drinking water.

Problem-based Learning & 5T

Step 1: Teacher formulate questions to enhance students' curiosity (Think - students will reflect and revise)

- After taking shower, where did the water go? – introduce the greywater concept.
- Can we reuse greywater?

- How can we reuse greywater?

Step 2: teacher will guide students to discuss (Touch - do the fieldwork)

- Water, water everywhere:
splash.abc.net.au/home#!/media/1902405/water-water

Step 3: teacher will guide students to explore (Touch – do the fieldwork)

Materials

- 1 recycle plastic container
- Salt water (water and salt)
- Straw
- Plastercine
- A small recycle plastic container
- Plastic cling wrap
- Solephane tape

Procedure

- Mix some of the salt into one cup (100 ml) water. Make sure the water is salty.
- Pour the salted water from the cup into the plastic container.
- Place the small container in the centre of the plastic container.
- Cover the plastic container tightly with plastic cling wrap. Then put plastic container cover on the top of plastic cling wrap.
- Put the plastic container at a safe and clean place with direct sun light. Make sure that place get the most sun light.
- This process will take several hours.
- Observe the amount of water accumulated on the plastic cling wrap and flow down to the small container. The process involved evaporation and condensation.
- Taste the water.

Step 4: students will discuss and do the activity (Take action)

- Teacher should encourage students to set up their own apparatus
- Teacher should allow students to observe experimental result

Step 5: students will present the solutions by having discussion with friends and teachers (**Tune-in** and **Talk**)

- Teacher should allow students to discuss about salt water as drinking water.

Resources

1. <https://www.youtube.com/watch?v=JGwGcMsaKt4>
2. <https://www.youtube.com/watch?v=9ylt69-QwcA>
3. <https://www.youtube.com/watch?v=-bvZCdMecEo>

2.3 Activity 3 Plant in a Bottle

Watering the plant can cause wastage of water. The excess water can be reused to watering the plant again. The use of clean water can be saved.

Objective and Values

- Introduce the concept of water reused.
- Create awareness that excess water can be reused as rewatering the plant.

Learning Outcome

At the end of this activity, students should be able to

- Define what is water reused
- Conduct an experiment.

Teaching Strategies

There are two proposed teaching strategies and teacher can choose either one.

Guided inquiry

Step 1

Teacher raise several questions such as

- Why do we need watering the plant? – why
- Can we be watering plant using greywater such as laundry water?

Step 2

Teacher will guide students to set up the apparatus for reused water from watering plant.

- how can we set up the apparatus?
- Does the plant can survive?

Materials

- 1 recycle plastic bottle
- Knife/scissors
- Wool

Procedure

- Cut the middle part of the bottle
- Put soil in the bottle
- Germinate the seeds.
- Put a small bowl at the end of a bottle.



Step 3

Teacher ask questions such as

- Is there any excess water after watering the plant?
- Can we reuse excess water to rewatering the same plant?

Step 5

- Teacher should allow students to observe experimental result and discuss about the use of salt water as drinking water.

Problem-based Learning & 5T

Step 1: Teacher formulate questions to enhance students' curiosity (**Think** - students will reflect and revise)

- After watering the plant, where did the water go? – introduce the greywater concept.
- Can we reuse the excess water?

Step 2: teacher will guide students to discuss (**Touch** - do the fieldwork)

- Water, water everywhere:
splash.abc.net.au/home#!/media/1902405/water-water

Step 3: teacher will guide students to explore (**Touch** - do the fieldwork)

Materials

- 1 recycle plastic bottle
- Knife/scissors
- Thread

Procedure

- Cut the middle part of the bottle
- Put soil in the bottle
- Germinate the seeds.
- Hang a small bowl at the end of a bottle using thread

Step 4: students will discuss and do the activity (**Take action**)

- Teacher should encourage students to set up their own apparatus
- Teacher should allow students to observe experimental result

Step 5: students will present the solutions by having discussion with friends and teachers (**Tune-in** and **Talk**)

- Teacher should allow students to discuss about water reuse.

Resources

1. <https://www.youtube.com/watch?v=Wxrqms36eU0>
2. <https://www.youtube.com/watch?v=OJJvghf1E7A>

2.4 Activity 4 Grey Water Electro

Grey water is water that usually used for bathing and washing. Electro is one way of a water treatment that use solar powered electro-coagulator and vacuum membrane distillation system.

Objective and values

- Explain the difference between potable and non-potable water.
- Graph household water usage.
- Make recommendations of ways to reduce freshwater use in households

Guided inquiry

Materials

- shoebox (or any similarly-shaped box to support six funnels)
- (optional) 8 Popsicle sticks (to make shoebox more sturdy)
- (optional) duct tape (to make shoebox more sturdy)
- 6 funnels
- plastic tubing that fits snugly on the ends of the funnels
- 2 large measuring cups marked in ml
- marker
- masking tape
- scissors
- box cutter

Each group also needs:

- 1 medium-sized cup or beaker to hold and pour ≤ 100 ml water

- graduated cylinder or something to measure ≤ 100 ml
- colored pencils, markers or crayons (for coloring bar graphs)
- [Shades of Gray\(water\) Worksheet](#), one per student

To share with the entire class:

- pitcher of water
- 1 container of liquid food coloring
- sponge/paper towels, for any clean-up needed

Procedure



Figure 1: Example household water fixtures use setup.

copyright

- Gather materials and make copies of the [Shades of Gray\(water\) Worksheet](#).
- Make a graywater structure for each group by following the instructions in the [Shades of Gray\(water\) Activity Set-up](#). This household water fixtures use setup is shown in Figure 1.
- Place a few drops of food coloring into each measuring cup labeled "Blackwater."

With the Students

1. Divide the class into groups of three students each.
2. Hand out the worksheets.
3. Assign each group a family size from two to eight people, and tell them they are looking at how much water this family uses every day. Have students make calculations to complete the first two worksheets questions, based on their family size numbers.
4. Explain how the model represents various plumbing fixtures found in a house. This is a way to model a household's water fixtures use. Engineers often use models to help them understand projects they are working on.
5. For each fixture, have students measure into a cup or beaker the scaled amount of water (as calculated on the worksheet), and then pour it into the correct funnel.
6. Expect students to notice that all the graywater sources go into one measuring cup, and the blackwater goes into the other measuring cup and appears colored (due to the food dye).
7. Tell students that the clear water represents non-potable water and can be used again, and that the colored water represents blackwater and cannot be used again. Have students make observations about where their water went and record them on the worksheets (question 6).
8. Ask students the following questions to further their comprehension:
 - Which cup has more water? (Answer: The graywater cup.)
 - What kind of things might be in the clear water, assuming that the water was used in a shower or sink and then went down the drain? (Answer: Soap, hair, grit, dirt, food particles, anything that goes down a drain.)
 - In which of the fixtures could the non-potable (clear water) be used in again? (Answer: In the toilet for flushing.)
1. Have students measure how much graywater was produced (the clear water) and calculate how many times that amount of graywater could flush a toilet (worksheet question 7).
2. Have students finish their worksheets and color in their bar charts. Collect the worksheets.
3. Conclude with a class discussion, sharing and comparing results and conclusions. Ask the Investigating Questions.

4. Assign the post-activity assessments, as described in the Assessment section.

2.5 Activity 5 Water Recycle: A/C Water

Conserving water is one of the prime things that we can do to help the environment. Reusing the water from the drip tray of your air conditioner is a great way to dispose of the water. According to J. Anderson (2003), water conservation, reuse and recycling can greatly increase the benefits obtained from limited supplies of freshwater. By recycling a/c water, it can be used to water indoor and outdoor plants and its save the fresh water too.

Objective and Values

- Introduce the concept of air conditioner condensation water
- Introduce the concept of water reused/ recycled
- Create awareness that a/c condensate water can be used for watering plants in the garden

Learning Outcome

At the end of this activity, students should be able to

- Define what is a/c condensation water
- Define what is water recycled / reused
- Conduct or build drip tray/barrel or pipe to dispose the water to garden or plants

Teaching Strategies

Guided inquiry

Step 1

Teacher raise several questions such as

- What is a/c condensation water? – introduce the a/c condensate water & the concept of recycling a/c water.
- Can we reuse water from a/c condensation water?
- How can we reuse a/c condensation water?

Step 2

Teacher will guide students to set up the barrel for condensate a/c water.

Materials

- 1 large barrel/ tank
- 3 pipes
- Connector

- 1 garden hose
- 1 water hose

Procedure

- Prepare 1 barrel below a/c to collect water from air conditioner unit
- Make a hole on the barrel and insert water hose pipe to the drip hole
- Connects piping from the internal air conditioning unit to the barrel
- Connects garden hose to the water hose and pour water to the plants



Step 3

Teacher ask questions such as

- Is it safe to use a/c water for plants?
- why we use recycling a/c water for pouring the plants?

Step 4

- Teacher should allow students to discuss in finding the answer.

Step 5

- Teacher should allow students to observe the process of saving and diverting the a/c waste water to pouring the plants.

Problem-based Learning & 5T

Step 1: Teacher formulate questions to enhance students' curiosity (**T**hink - students will reflect and revise)

- What is a/c condensation water? – introduce the a/c condensate water & the concept of recycling a/c water.
- Can we reuse water from a/c condensation water?
- How can we reuse a/c condensation water?

Step 2: teacher will guide students to discuss (**T**ouch - do the fieldwork)

- <https://www.youtube.com/watch?v=ii2WldDlIj8>

Step 3: teacher will guide students to explore (**T**ouch - do the fieldwork)

Materials

Materials

- 1 large barrel/ tank
- 3 pipes
- Connector

- 1 garden hose
- 1 water hose

Procedure

- Prepare 1 barrel below a/c to collect water from air conditioner unit
- Make a hole on the barrel and insert water hose pipe to the drip hole
- Connects piping from the internal air conditioning unit to the barrel
- Connects garden hose to the water hose and pour water to the plants

Step 4: students will discuss and do the activity (Take action)

- Teacher should encourage students to set up their own apparatus
- Teacher should allow students to observe experimental result

Step 5: students will present the solutions by having discussion with friends and teachers (**Tune-in** and **Talk**)

- Teacher should allow students to discuss about water recycle.

Resources

1. https://www.researchgate.net/publication/255619095_The_environmental_benefits_of_water_recycling_and_reuse
2. <https://removeandreplace.com/2015/06/30/how-to-divert-water-dripping-outside-from-an-air-conditioner-window-unit/>
3. <https://sustainableschools.ead.ae/SSI/>

2.6 Activity 6 Rainwater Harvesting Spectrum

Rainwater harvesting is kind of ways or technique for reuse by collecting or storing the water. It is collected from many type of surface or place rooftops or gutters.

Objective and values

- Importance of water management
- Important of water conservation

Guided inquiry

Materials

- Short piece of corrugated plastic/tin/wood (2 feet × 2 feet)
- Sprinkling can to simulate a rain event
- Short piece of gutter to divert the water
- Container to hold water from the gutter
- Bucket or container to catch the water

Procedure

- Have two students hold the short piece of corrugated plastic/tin (one on each side) and a third student to use the sprinkling can.
- Sprinkle water onto the small roof to simulate a rain.
- . Discuss where this water is going—running off of the roof; splashing on the ground; and running off into a ditch, drain, and down the watershed.
- Then slip the piece of gutter under the roof, slope it to one end, and have a container there to catch the water.
- Discuss how much water per square foot of surface you can catch (measure your roof to determine the area and amount of water).
Example: 2 feet × 2 feet = 4 square feet of surface. Approximately .6 gallons of water per square foot per 1 inch of rainfall. $4 \times .6 = 2.4$ gallons of runoff.

Questions to ask

1. Where is the water going when there are no gutters? *When there are no gutters, water runs off the roof and all across the yard.*
2. What is the advantage of having gutters? *Gutters channel water away from most of the yard into one spot.*
3. How much water can be captured from a roof with an inch of rain? *1 square foot of roof, 1 inch deep is approximately 0.6 gallons of water (0.623 gallons). If the roof is 2 feet × 3 feet, then $2 \times 3 = 6$ square feet. $6 \times 0.6 = 3.6$ gallons from 1 inch of rain.*

4. How can you use harvested rainwater? *Rainwater can be used to water plants, provide water for pets, birds, wildlife, or other uses.*

Resources

http://www.twdb.texas.gov/conservation/education/doc/RWH_Youth_Education_Manual_2014_0923.pdf

2.7 Activity 7 Don't Pollute Water

Polluted water is water that is not safe or healthy for people and animals to drink or wash in. It usually becomes polluted when we add bad things to it

Objective and Values

- Introduce the condition of polluted water
- Create awareness of the consequences of polluted water

Learning Outcome

At the end of this activity, students should be able to

- Define what is water pollution
- Conduct an activity to demonstrate how water is polluted

Teaching Strategies

There are two proposed teaching strategies and teacher can choose either one.

Guided inquiry

Step 1

Teacher raise several questions such as

- Can we use polluted water?
- Can we treat water that is polluted?

Step 2

Teacher will guide students to make a model of a polluted river

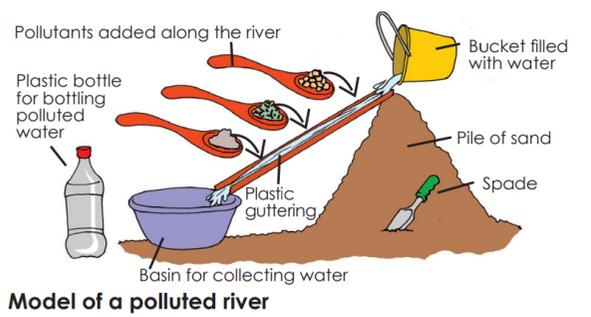
- how can we make model of polluted river?
- Is it possible?

Materials

- A hose or bucket to provide a source of water;
- A small spade;
- Guttering or halved swimming pool hose;
- Basin or 2ℓ plastic bottle for the dam;
- Sand, food colourants, lentils and other harmless substances that can be used as pollutants;
- Bottles, jars;
- Plastic bottle for bottling polluted water;
- Spoons; and
- Paper, pens and coloured pencils.

Procedure

- Make a table showing pollutants that could be found in a river that flows through a city.
- Think of safe, cheap, easily obtainable ingredients that could be used to represent the pollutants.
- Decide on the amount of each pollutant you will add to your river. Give reasons for your choice
- Design and build a short river in the school ground. You will need a source of water and a dam at the end.



- Pour the water into the model. As the water flows down the river, the pollutants can be added.
- Collect the polluted water in a bottle.
- Write a label for the bottle of polluted water. The label must show what is in the water. Keep this bottle in your classroom to remind you that we need to care for our rivers.

Step 3

Teacher ask questions such as

- Can we clean his water?

Step 4

- Teacher should allow students to discuss in finding answers.

Step 5

- Teacher should allow students to observe activity result and discuss about the consequences of polluted water.

Problem-based Learning & 5T

Step 1: Teacher formulate questions to enhance students' curiosity (**T**hink - students will reflect and revise)

- Can we use polluted water?
- Can we treat water that is polluted?

Step 2: teacher will guide students to discuss (**T**ouch - do the fieldwork)

- <https://www.youtube.com/watch?v=5HRcU1cctqs>

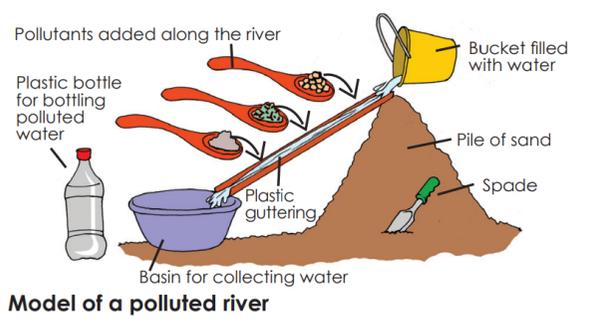
Step 3: teacher will guide students to explore (**T**ouch - do the fieldwork)

Materials

- A hose or bucket to provide a source of water;
- A small spade;
- Guttering or halved swimming pool hose;
- Basin or 2ℓ plastic bottle for the dam;
- Sand, food colourants, lentils and other harmless substances that can be used as pollutants;
- Bottles, jars;
- Plastic bottle for bottling polluted water;
- Spoons; and
- Paper, pens and coloured pencils.

Procedure

- Make a table showing pollutants that could be found in a river that flows through a city.
- Think of safe, cheap, easily obtainable ingredients that could be used to represent the pollutants.
- Decide on the amount of each pollutant you will add to your river. Give reasons for your choice
- Design and build a short river in the school ground. You will need a source of water and a dam at the end.



- Pour the water into the model. As the water flows down the river, the pollutants can be added.
- Collect the polluted water in a bottle.
- Write a label for the bottle of polluted water. The label must show what is in the water. Keep this bottle in your classroom to remind you that we need to care for our rivers.

Step 4: students will discuss and do the activity (Take action)

- Teacher should encourage students to set up their own apparatus
- Teacher should allow students to observe experimental result

Step 5: students will present the solutions by having discussion with friends and teachers (**Tune-in** and **Talk**)

- Teacher should allow students to discuss on how to minimize river pollution in Malaysia.

Resources:

1. http://www.waterwise.co.za/export/sites/water-wise/education/activities/dont-pollute/downloads/Respect_our_Rivers.pdf

2.8 Activity 8 Watering Garden

Watering garden using recycling air condition water. According to Alliance for Water Efficiency (2018), a window air condition will collect about 3.78 to 7.57 liter. With this amount of water, it can be reused as watering plant.

Objective and Values

- Introduce the concept of water recycled
- Create awareness that water from air condition can be used for different purposes

Learning Outcome

At the end of this activity, students should be able to

- Define what is water recycled
- Conduct an activity to build piping from air condition to watering plant

Teaching Strategies

- There are two proposed teaching strategies and teacher can choose either one.

Guided inquiry

Step 1

Teacher raise several questions such as

- Can we use water from air condition? Why?
- Do we need to treat water from air condition?

Step 2

Teacher will guide students to set up the filter by asking

- how can we set up the piping?
- does it work?

Materials

- area with air condition
- used rubber hose with sufficient length
- Coffee filter
- Black Rubbish Bin
- Submersible Filtering Pump
- 16 mm Polypipe
- Silvershine/ plastic bag
- Polybags
- Cocopeat
- 1.2 mm Capillary Tube
- Dripper
- Timer
- Power Supply



Procedure

- Place coffee filter on one side of rubber hose
- Then, connect the other side of rubber hose to air condition's pipe.
- Connect the 'drain pipe' to the 'black rubbish bin', to allow the air condition's water will be collected.
- Install 'submersible filtering pump' into the 'black rubbish bin'.
- Connect 'outlet check valve' with the '16 mm polypipe'.
- '16 mm polypipe' stretched over 10 feet on the crop site that covered with 'silvershine'
- 20 units of 'polybags' that have been filled with 'cocopeat', are arranged on the right and left side of '16 mm polypipe' with a distance of 1 feet each.
- 20 units of '1.2 mm capillary tube', stabbed on a '16 mm polypipe' surface with a distance of 1 feet each.
- Connect '1.2 mm capillary tube' with 'dripper' and pin on 'cocopeat' surface.
- Connect the 'submersible filtering pump switch', to the 'timer' and connect the timer to the 'power source'.
- Set time on 'timer', to allow scheduled flushing.

Step 3

Teacher ask questions such as

- why we use coffee filter and timer

Step 4

- Teacher should allow students to discuss in finding answers.

Step 5

- Teacher should allow students to observe activity result and discuss about the use of water from air condition.

Problem-based Learning & 5T

Step 1: Teacher formulate questions to enhance students' curiosity (Think - students will reflect and revise)

- Can we use water from air condition? Why?
- Do we need to treat water from air condition?

Step 2: teacher will guide students to discuss (Touch - do the fieldwork)

- Youtube : <https://www.youtube.com/watch?v=2PJcWGf318>
- Water from air condition <https://www.buildinggreen.com/blog/revise-air-conditioner-condensate-calculator-available-buildinggreencom>

Step 3: teacher will guide students to discuss (Touch - do the fieldwork)

Materials

- area with air condition
- used rubber hose with sufficient length
- Coffee filter
- Black Rubbish Bin
- Submersible Filtering Pump
- 16 mm Polypipe
- Silvershine/ plastic bag
- Polybags
- Cocopeat
- 1.2 mm Capillary Tube
- Dripper
- Timer
- Power Supply

Procedure

- Place coffee filter on one side of rubber hose
- Then, connect the other side of rubber hose to air condition's pipe.
- Connect the 'drain pipe' to the 'black rubbish bin', to allow the air condition's water will be collected.
- Install 'submersible filtering pump' into the 'black rubbish bin'.
- Connect 'outlet check valve' with the '16 mm polypipe'.
- '16 mm polypipe' stretched over 10 feet on the crop site that covered with 'silvershine'
- 20 units of 'polybags' that have been filled with 'cocopeat', are arranged on the right and left side of '16 mm polypipe' with a distance of 1 feet each.
- 20 units of '1.2 mm capillary tube', stabbed on a '16 mm polypipe' surface with a distance of 1 feet each.
- Connect '1.2 mm capillary tube' with 'dripper' and pin on 'cocopeat' surface.
- Connect the 'submersible filtering pump switch', to the 'timer' and connect the timer to the 'power source'.

Step 4: students will discuss and do the activity (Take action)

- Teacher should encourage students to set up their own filter
- Teacher should allow students to observe experimental result

Step 5: students will present the solutions by having discussion with friends and teachers (**Tune-in** and **Talk**)

- Teacher should allow students to discuss about the use of water from air condition.

Resources

1. <https://www.instructables.com/id/Self-Watering-Garden-Using-recycled-water-from-a/>
2. https://www.youtube.com/watch?v=ztik_7KX6Tg