

SECONDARY


 **PUB** ACTIVE,
BEAUTIFUL,
CLEAN WATERS

Learning Trail

@ Yishun Pond

TRAINER'S GUIDE



The background of the page is a stylized illustration of a pond. The water is a light blue color with darker blue wavy lines representing ripples. In the foreground, there are green reeds with brown, oval-shaped heads. In the background, there are green bushes and brown tree trunks against a light yellow sky.

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Objectives of the Active, Beautiful, Clean (ABC) Waters Learning Trail @ Yishun Pond

This place-based inquiry experience aims to help students:

1. Foster a sense of national identity, pride as Singaporeans, and emotional rootedness to the nation.
2. Learn about the Singapore Water Story vis-a-vis Yishun Pond. Appreciate Singapore's unique challenges, constraints, and where we have succeeded.
3. Develop leadership skills, instilling core values and the will to prevail, to ensure Singapore's continued success.
4. Understand PUB's ABC Waters Programme which will transform Singapore's pervasive network of drains, canals and reservoirs into beautiful and clean streams, rivers and lakes. By integrating the streams, rivers and lakes with the parks and gardens, new community spaces can be created. These will be bustling with life and activities, and transform Singapore into a City of Gardens and Water, a vision outlined by Singapore's Prime Minister Lee Hsien Loong.
5. Evoke a sense of wonder towards innovations, as students understand water treatment processes that give us clean water.
6. Promote stewardship for our strategic water resource and the need for everyone to play a part to keep our waterways and reservoirs active, beautiful and clean.

Details of the ABC Waters Learning Trail @ Yishun Pond

Level: Lower Secondary Students (13 – 15 years old)

Programme Duration: 2 hours (with optional activities + 15min)

Ratio of Facilitator to Students: 1 : 20 students

Recommended maximum group size: 40 students (or 1 class)

Before the Trip:

- Show students and teachers the preparation brief (Annex 1) to help them prepare. Print these only if necessary.
- Fill in the information required for your Risk Assessment Management (RAM) form. Some information is given in Annex 2.

Educational Approaches

This trail uses inquire-based and experiential learning.

What is Inquiry-Based Learning?

The inquiry-based approach focuses on student constructed learning, as opposed to teacher or guide-transmitted information.

This process aims to enhance learning through:

1. Increased student involvement
2. Multiple ways of knowing

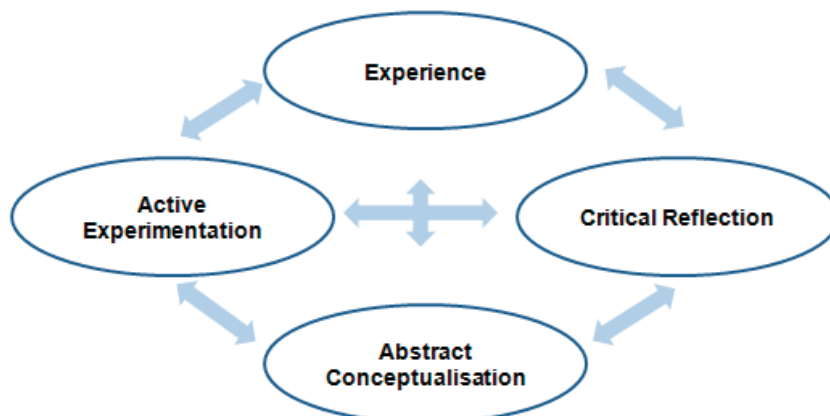
This is achieved by:

- Starting with an open-ended question or demonstration.
- Gather responses and subsequent questions from students with little comment or direction.
- Requiring students to collaborate on designing experiments or methods of inquiry.



What is Experiential Learning?

Experiential learning is the process of making meaning from direct experience.



Before the Trip

- Brief students on the field trip and what to bring and wear. Refer to Annex 1.
- To prepare students, show students the Pack List (Annex 1). Assign students to carry/be in charge of equipment/materials.
- Conduct a reconnaissance of Yishun Pond and familiarise yourself with the area and stations.
- Fill in the Risk Assessment Management (RAM) form required by Ministry of Education (MOE). Suggested information is given in Annex 2.
- Inform the relevant authorities – PUB and NParks and make a booking for your school visit.

Wet Weather Procedure

On the day of the field trip:

- Check the weather forecast and lightning status 1 to 2 hours before the Learning Trail begins:
 - Visit the National Environment Agency website www.weather.gov.sg.
 - Dial the lightning advisory number at 6282-6821 (Sector 1 and 2)
- If there is a heavy downpour or the Lightning Category 1 is still not cleared:
 - Do not start the trail
 - Take shelter at the sheltered area at Khoo Teck Puat Hospital to carry out discussions and other activities that can be conducted indoors
- If lightning or heavy rain persists, stop the programme and plan for another make-up session if possible.
- Should a storm be expected during the Learning Trail, bring students back to the sheltered area at Khoo Teck Puat Hospital as soon as possible. If it is impossible to reach the sheltered area in time, students should wait under shelters along the trail and move back to indoor area as soon as they can.

Summary of the ABC Waters Learning Trail @ Yishun Pond

Station	Duration	Location	Main Points	Subject Links	Page No.	Materials
-	20min	Lakeside Promenade	Introduction <ul style="list-style-type: none"> Treasures on the trail. Singapore's Water Challenge and 4 National Taps. Navigate Yishun Pond. What is the ABC Waters Programme? Preparation for the trail. Safety briefing. 	Geography <ul style="list-style-type: none"> Managing the changing environment – water resources Understanding the environment – environments through maps National Education <ul style="list-style-type: none"> No one owes Singapore a living We have confidence in the future 	2 3-5	'Water Sustainability' cards (Annex 4)
1	5min	Spice garden and statue of farmer and buffalo	History of Yishun <ul style="list-style-type: none"> History of Yishun Town and Yishun Pond. 	History <ul style="list-style-type: none"> History of Singapore National Education <ul style="list-style-type: none"> Singapore is our homeland. This is where we belong 	6	
2	15min	Timber deck, inlet and debris boom	Community Space and Human Impacts <ul style="list-style-type: none"> Journey of Water, urban catchment in Yishun Town. ABC Waters Programme – Community Space. Human impact at Yishun Pond. 	Geography <ul style="list-style-type: none"> Managing the changing environment – water resources 	7 14	
3	15min	Flower Trail	Flower Trail <ul style="list-style-type: none"> Conservation of local biodiversity. Flower trail as a natural connector from park and pond to hospital. 	Science <ul style="list-style-type: none"> Biodiversity – diversity of plants and animal life 	8-10	

Station	Duration	Location	Main Points	Subject Links	Page No.	Materials
4	35min	The Spiral @ Yishun	ABC Water Features and Water Quality Testing <ul style="list-style-type: none"> • ABC Waters Programme features – an iconic community space. • Water Quality testing and potable water • Observation of bird species. Sketching activity	Science <ul style="list-style-type: none"> • Measuring water parameters • Water pollution Geography <ul style="list-style-type: none"> • Sketching 	11-13	Pail with a rope, World Water Day Monitoring test kits Sketching paper
		Pumping station / Spillway channel	Pumping Station <ul style="list-style-type: none"> • Water in the pond is pumped to Lower Seletar Reservoir. Spillway <ul style="list-style-type: none"> • Allows excess water to be channelled to the sea. 	Geography <ul style="list-style-type: none"> • Managing the changing environment – water resources • Water quality 	4-5	
5	10min	Woodlands (Forested area)	The Journey of Water <ul style="list-style-type: none"> • The water cycle 	Geography <ul style="list-style-type: none"> • Managing the changing environment – water resources Science <ul style="list-style-type: none"> • The Water Cycle 	7	'Journey of Water' cards (Annex 5)

Station	Duration	Location	Main Points	Subject Links	Page No.	Materials
6	5min (+15min)	Floating wetlands and marshlands	Floating Wetlands and Marshlands Optional Activity: A second location for water testing (+15min)	Science <ul style="list-style-type: none"> Habitat – freshwater wetlands and community Measuring water parameters Water pollution Geography <ul style="list-style-type: none"> Managing the changing environment – water resources 	15-16 11-13	Optional” World Water Day Monitoring test kits, pail with rope
-	15min	Lakeside Promenade	Debrief and Reflection <ul style="list-style-type: none"> Main learning points on the trail. Reflection questions 	Geography and Science <ul style="list-style-type: none"> All of the above Critical thinking skills Civics and Moral Education <ul style="list-style-type: none"> Respect Responsibility Integrity Care National Education <ul style="list-style-type: none"> No one owes us a living We have to depend on ourselves 	17	
Total Duration: 2 hours						
EXTENSION ACTIVITY						
-	1-1.5hr	As preferred	Extension Activity – Problem-based Learning Activity	National Education, Social Studies, Geography	18-19	

Conduct the Learning Trail @ Yishun Pond

Overview
<ul style="list-style-type: none">• The trail will be conducted station by station as a class.• If there is more than one class, the other class can start with station and continue the stations in an anti-clockwise direction (station 1, followed by stations 6,5,4,3,2 then conduct the debrief).
Recommended Number of Facilitators and Participants
Two teachers per class of 40.
Before the Trail
The following preparation should be done before the trail to save time: <ul style="list-style-type: none">• Group students into teams of five or six members.• Ask students to go to the toilet before the start of the trail.• Distribute materials for student teams to carry and be in charge of.
Teacher's / Trainer's Roles
The trainer should conduct the planned activity as close as possible to the ABC Waters Learning Trail package. The trainer's guide includes: <ul style="list-style-type: none">• Instructions on how to implement the suggested activities.• Suggested questions to elicit a response – wither to focus on a learning point or arrive at a conclusion (answers provided).• Questions from the student's booklet with answers.
On the Day of the Trail
Students are to move from one station to the next, following the given planned route, within 2 hours (with optional activities +25min).

Lesson Plan for the ABC Waters Learning Trail @ Yishun Pond

Introduction

Duration: 20min

Location: Lakeside Promenade

Learning Points:

- Treasures on the trail
- Singapore’s Water Challenge and 4 National Taps
- Navigate Yishun Pond
- What is the ABC Waters Programme?
- Preparation for the trail
- Safety briefing

Trainer’s Notes		Cross Reference/ Materials
<p>1. Welcome students to Yishun Pond</p> <p>2. Treasures on the Trail</p> <ul style="list-style-type: none"> • On this Learning Trail, you will explore the many aspects of our waters and the flora and fauna at the park. • The Learning Trail will take approximately 2 hours. <p>3. Singapore’s Water Challenge and 4 National Taps</p> <ul style="list-style-type: none"> • Distribute the Water Sustainability cards to the students and ask them what the numbers represent. After 5 minutes, explain to the students what each number represents according to the answer template below. 		<p>Pg 2</p> <p>Pg 3 ‘Water Sustainability’ cards</p>
5.3 million	The population of Singapore. Elaborate that this number is increasing and hence water demand will increase.	
152 litres	The domestic water consumption per person per day in Singapore. (Emphasise to the students that this figure is only for our domestic consumption which makes up only 10% of our total water usage as a nation Industries and businesses use nine times more water.)	
1.1 billion	Number of people in the world who lack access to safe drinking water. Singaporeans are privileged to be able to get clean water conveniently from our taps.	
<ul style="list-style-type: none"> • Water for all – Explain that Singapore has ensured a stable and sustainable supply of water for its people with integrated water management system and four sources of water supply known as the Four National Taps. 		

4. Additional information on Singapore’s Water Challenge:

- Singapore receives 2400mm of rainfall a year. Global average is 1050mm. Unfortunately, Singapore is a small island with only 715.8km² of land. The growing population and economy exerts pressure on land use. Besides collecting and storing water, land is needed for housing, commerce, industry, transport, recreation and schools. Which of these sectors is most important to you?
- Together with the lack of natural aquifers or groundwater, these factors has led to Singapore being ranked 170th among a list of 190 countries in terms of fresh water availability.
- Singapore suffered its worst drought in 1963 and we had to carry out water rationing. This lasted for 10 months. Since then, there has not been another water rationing exercise except for mock exercises in 1971, 1990 and 1997 due to El Nino. El Nino is a periodic climatic pattern that occurs across the Pacific Ocean roughly every 5 years. It may cause extremes in the climate.

5. Navigate Yishun Pond.

- Explain how Yishun Pond is part of the First National Tap (Local Catchment Water). Look at the map of Singapore showing the 17 reservoirs in Singapore. Note that Yishun Pond is not a reservoir.
- Where is Yishun Pond? Mark an “X” on the map.

6. What is the ABC Waters Programme?

- Ask students, "What does the “ABC” in ‘the ABC Waters Programme’ stand for?" Active, Beautiful and Clean.
- Explain the concept of the ABC Waters Programme - The ABC Waters Programme by PUB transforms our network of drains, canals and reservoirs into beautiful and clean streams, rivers and lakes. This programme helps to realise Singapore’s vision as a “City of Gardens and Water”.
- Explain the individual components that make up the ABC Waters Concept i.e. Ecology, Hydrology and Community.

7. Photo Hunt

- Ask students to look at page 2. Students are to spot these along the trail and take a photo of it. They should complete the photo hunt by the time the trail ends.

8. Around Yishun Pond

- Look at Page 4. Note the location of Yishun Pond in relation to the central part of Yishun Town.
- Next look out from the Lakeside Promenade and note the key features around. Identify the ABC Waters features and mark them on the map (from “a” to “l”). Give students 3 minutes to complete the task and then point out some features to them and go through the answers.

9. Preparation

Pg 4, 5

Pg 2

Pg 4

- Ask students to apply insect repellent/sunblock, refill their water bottles and go to the toilet.

10. **Conduct a safety briefing**

Students should:

- Inform you or the teacher if they do not feel well, if they have a cut or have been stung or bitten.
- Be careful as trees and branches may fall.
- Be alert, and look out for potentially dangerous animals (E.g. snakes, bees along the trail, and move away from them if encountered).
- Do not enter the reed beds or lake.
- Stay hydrated by drinking water along the way.
- Always move in pairs or a group. Do not work or wander off alone.
- Not enter the pond.

Station 1: History of Yishun

Duration: 5min

Location: Spice garden and statue of farmer and buffalo

Learning Points:

- History of Yishun Town and Yishun Pond

Trainer's Notes	Cross Reference/ Materials
<p>1. Discuss the history of Yishun Pond</p> <ul style="list-style-type: none">• Ask student to turn to page 6 and run through the highlights of Yishun Pond's history:<ul style="list-style-type: none">○ What was Yishun Town named after? (Mr Lim Nee Soon – the Pineapple King. Yishun is the romanised name of Nee Soon.)○ What was the area known for? (Gambier plantations)○ When did the construction of Yishun Town begin? (1977)○ When was Yishun Pond constructed and what was its purpose? (In 1986, to collect rainwater from Yishun New Town.)○ When was ABC Waters Programme at Yishun Pond introduced? (2011)• Additional information As you can see, Yishun Pond has been rejuvenated, into a beautiful and green space where everyone can enjoy the space, taking part in healthy activities such as brisk walking, jogging and cycling.	Pg 6

Station 3: Flower Trail

Duration: 15min

Location: Flower Trail

Learning Points:

- Conservation of local biodiversity
- Flower trail as a natural connector from park and pond to hospital

Trainer's Notes	Cross Reference/ Materials
<p>1. Conservation of local biodiversity</p> <ul style="list-style-type: none">• The Flower Trail consists of many species of flowering plants which support local species of butterflies, birds and other pollinators. Ask students to:<ul style="list-style-type: none">○ Look at page 8. Which plants can they spot? Tick the boxes.○ Look at pages 9, 10. Which animals can they spot? Tick the boxes. <p>2. The Flower Trail is a natural connector from park and pond to hospital.</p> <ul style="list-style-type: none">• Yishun Park supports a rich forest life. The Flower Trail links the park to Khoo Teck Puat Hospital, enriching the biodiversity of life in the area.• Look for the park when students reach the next station – The Spiral @ Yishun.	Pg 8-10

Station 4: ABC Waters Programme and Water Quality Testing

Duration: 35min

Location: The Spiral @ Yishun

Learning Points:

- ABC Waters features – an iconic community space
- Water quality testing and potable water
- Observation of bird species
- Sketching activity

Trainer's Notes	Cross Reference/ Materials
<p>1. Features at Yishun Pond</p> <ul style="list-style-type: none"> • Ask students whether they know the function of the Spiral @ Yishun? (As a look-out point, a shelter, linked to a bridge that connects Yishun Pond to the Yishun Park across the road.) • What does the structure resemble? (A butterfly cocoon (pupa). It was designed to be an iconic structure for the pond.) <p>2. Bring students to the water collection point to observe the water:</p> <ul style="list-style-type: none"> • What do they think the water quality is like - good or poor? (Answers vary.) • Why does the water in a pond need to be of good quality? (It is a source for our water supply and to support aquatic life.) <p>3. Tie the rope of the pail to the railing and collect some water. Pour the water into one water kit and bring students to a shaded area to put down their bags.</p> <p>4. Ask students to turn to the pages 11 and 12 of their booklet. Explain why we carry out this water testing – to see what the water quality in the reservoir is like. It needs to be good as it is for our water supply. Although all the raw water undergoes treatment, the cleaner the water, the easier and cheaper it will be to treat. Also, water in the reservoir sustains aquatic life. The water testing activity during this trail is not an extensive one, but we will have a quick indication of water quality for that day and hour.</p> <p>5. Conduct a demonstration on how to use the World Water Day Monitoring test kits. You may also use the data loggers brought by the school. Introduce the World Water Monitoring test kit. Pour water from the pail into an emptied water kit to the fill-line. Highlight that for accuracy, the water needs to be filled exactly to this level.</p> <p>6. Run through the water parameters progressively, as in pages 11 and 12, explaining each parameter as you go (what each parameter is and some implications of the readings). Demonstrate how the Dissolved Oxygen (D.O.) and pH tests should be conducted.</p>	<p>Pg 11,12</p> <p>Pail, rope, data logger and sensors or World Water Day Monitoring test kits, turbidity disc</p>

7. After your demonstration, assign the teams and distribute the World Water Day Monitoring test kits to each team.
8. Collect more water from the pond in a pail to distribute to the students. Ensure that no student is allowed to collect water directly from the reservoir and that no equipment falls into the reservoir. Give teams 10-15 minutes to complete their tests and record their answers in the “observation” boxes in their booklets. They should not fill in the “analysis” boxes yet. You will analyse the results of all the teams after they have obtained their results.
9. After teams have obtained their readings, gather everyone for debrief. Ask them to give you their D.O and pH bottles. Place these together and start debrief.
10. Discuss the readings obtained and **evaluate the state of the reservoir water**. Expected results:

- **Debris and Smell** – there should not be any smell. “Nothing” is not considered a good answer as there is usually a natural smell for reservoirs and ponds, due to algae, soil particles and other natural materials in the water. There should not be any oil, rotting, etc. smell as this would indicate pollution. There may be debris washed down from upstream after a rain or fallen from overhanging tree branches. Analysis: natural if there is no oil or rotting smell.

Explain that it is important not to litter. Throwing litter will pollute the waterways and reservoirs. For example, plastic bottles thrown in by inconsiderate people. These bottles are unsightly and non-biodegradable.

- **Colour** – the water should be colourless or slightly green (due to the presence of some algae, which is normal). Analysis: normal. Some algae is good as this can add to the level of dissolved oxygen in the water.
- **Turbidity** – this should be as clear as possible. The usual reading is the lightest or second lightest number. Ask students what contributes to turbidity of the water. (Algae, small particles/sediments from erosion)

Reiterate that turbidity is caused by small particles suspended in the water. It affects the light penetration in the reservoir. The clearer the water, the higher the light penetration – allowing more aquatic plants/algae to grow in the reservoir.

- **Temperature** – expected results is between 28 – 30°C. Ask students what factors can affect water temperature (weather conditions, rain).

Reiterate that temperature can affect the amount of dissolved gases, like dissolved oxygen. The higher the temperature, the lower the level of

dissolved oxygen. Water temperature also affects aquatic life. The metabolic reactions that are catalysed by enzymes in the body of organisms will be adversely affected when the temperature is too high or too low. High temperatures can kill living organisms.

- **Dissolved Oxygen** – this should be at least 4ppm (parts per million), below which the water will be too low and poor to support aquatic life. Ask students what affects the level of dissolved oxygen in the water (previously mentioned under temperature).
 - Organic materials that are present in the water will be decomposed by bacteria. These bacteria will use up oxygen in the water.
 - When the water is turbulent, for example due to windy conditions, more oxygen will be mixed into the water.
 - When photosynthesis takes place, plants take in carbon dioxide and release oxygen and vice versa when they respire. When there is sufficient light, like on sunny days, aquatic plants will photosynthesise more than they respire and therefore the level of oxygen in the water will increase.
- **pH** – pH of 6 – 9. The water may tend to be slightly acidic as it is fed from forest streams which have dissolved tannins (from leaf litter).
 - The pH scale is from 0 to 14, with pH 0 being very acidic, pH 7 being neutral and pH 14 being very alkaline.
 - H⁺ ions contribute to acidity while OH⁻ ions contribute to alkalinity. A solution is neutral when there is an equal amount of both ions. Most aquatic organisms survive well in pH range that is near neutral.

11. Summary. Ask students to turn to page 13. Give them 5 minutes to answer the water quality questions before you discuss them:

- What is your team's conclusion for the water quality in Yishun Pond: Overall quality of water is generally good.
- What are the consequences for our water supply and aquatic life? (If water quality is good, less cleansing and treatment is needed and it will support a rich aquatic community (enhancing biodiversity in the area).)
- What are the limitations of today's water testing?
 - Only one measurement was taken at each location – at the water's surface
 - For a more comprehensive water testing we need to test water from different depths, different times of day, from many locations throughout the year.
 - The test kit may pose some limitations as well: temperature strip does not work well or is inaccurate; water was sampled from only two sites.

12. Sketching Activity

Pg 13

Plain paper

<ul style="list-style-type: none"> • Ask students to place their bags on the ground and give them 5-10 minutes to sketch a feature at Yishun Pond. Distribute plain paper. • Remind them to title their sketch, calculate the scale and label the different parts of the feature drawn. <p>13. Optional Activity</p> <ul style="list-style-type: none"> • You can collect water and test for water quality again at another inlet after the “Woodlands” area. • If this is done, answer the last question: <ul style="list-style-type: none"> ○ Are there any differences between the water qualities of the two locations sampled? (Answers may vary) If so, why? (e.g. one place can be more polluted by rubbish, does not have a debris boom to collect litter) 	<p>for each student</p>
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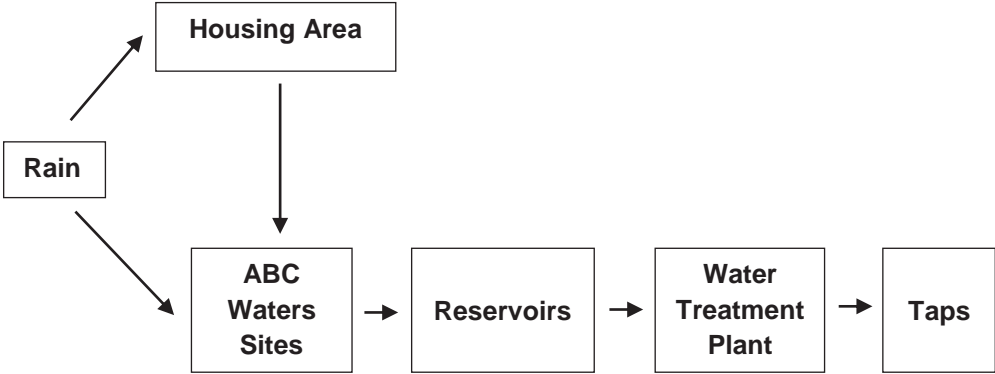
Station 5: Journey of Water

Duration: 15min

Location: Woodlands (Forested area)

Learning Points:

- The Journey of Water

Trainer's Notes	Cross Reference/ Materials
<p>1. Journey of water</p> <ul style="list-style-type: none"> • Ask the students what is the main source of water for the First National Tap. (Local catchment, rain) • Distribute 'Journey of Water' cards to each team (found in Annex 4) and ask student teams to arrange them in the correct order. • After all teams have finished, gather the class and go through the answer:  <pre> graph TD Rain[Rain] --> HousingArea[Housing Area] Rain --> ABCWaters[ABC Waters Sites] HousingArea --> ABCWaters ABCWaters --> Reservoirs[Reservoirs] Reservoirs --> WaterTreatment[Water Treatment Plant] WaterTreatment --> Taps[Taps] </pre> <ul style="list-style-type: none"> • Explain the following, referring to page 7 of the booklet if you like: Rain will fall directly into the ABC Waters site - Yishun Pond. Rain will also fall on the urban areas around the pond (Yishun Town), which will be channelled through drains and larger water inlets into Yishun Pond. • From Yishun Pond, the water is pumped to Lower Seletar Reservoir before being pumped to the water treatment plant. From the water treatment plant, potable water is channelled to the taps in our homes. <p>2. Additional Information.</p> <ul style="list-style-type: none"> • Yishun Pond was built in 1986 as a storm water storage pond. It helps to store the water from Yishun New Town for a period of time before it is pumped to Lower Seletar Reservoir. This helps to maintain water levels and also increases our capacity to capture every raindrop in Singapore. • Yishun Pond also serves as sedimentation pond. During storage, heavier particles like sand and pebbles sink to the bottom of the pond. After some time, when the bottom of the pond is full of sediments, the pond can be dredged to clear out the sediments. 	<p>'Journey of Water' cards (Annex 4)</p> <p>Pg 7</p>

Station 6: Floating Wetlands and Marshlands

Duration: 5min

Location: Floating Wetlands and Marshlands

Learning Points:

- Optional Activity: Second location for water testing (+ 15min)
- Floating wetlands and marshlands

Trainer's Notes	Cross Reference/ Materials
<p>1. Optional Activity: Second location for water testing (+ 15 minutes)</p> <ul style="list-style-type: none"> • Collect water from the inlet and conduct a second water test. Ask students to compare the readings/findings with the first set of data. <p>2. Floating wetlands and marshlands</p> <ul style="list-style-type: none"> • Ask pupils what are the differences between a marshland and a wetland? (Floating wetlands are systems designed to allow emergent plants to grow on floating mats. Marshlands are plants growing in shallow water along the edge of the pond.) • Ask students to point out the floating wetlands and marshlands. Walk towards the wetlands and marshlands to: <ul style="list-style-type: none"> ○ Observe the main parts of the wetland. (Ask them to refer to page 15) ○ Identify some plants growing on the wetland (page 16). Tick those that they can observe. ○ Observe for any animals on the wetlands. • Ask students to answer the question on page 15: How does the floating wetlands and marshlands benefit Yishun Pond? Run through the answers: <ul style="list-style-type: none"> ○ Cleans the water of the pond. ○ Provides a habitat for animals – enhancing biodiversity in the area. ○ Aesthetic value – beautifies the surroundings. • Explain in greater detail: <ul style="list-style-type: none"> ○ The plants at the wetlands and marshland were specially chosen for their water cleansing properties. ○ These plants are highly efficient in absorbing phosphates and nitrates from the water. With lesser phosphates and nitrates, algae will not be able to bloom. This keeps the water clean and clear. • What are some animals found in and around the wetland plants? (Fishes, dragonflies, damselflies or nymphs etc.) <p>3. Additional information on some wetland plants</p> <ul style="list-style-type: none"> • Cattails are an important source of food and shelter for the marsh dwelling animals. The roots and bases of leaves are edible. The stem is cooked as a dish called bonbon in Vietnam. 	<p>Pg 11-13</p> <p>Pg 15, 16</p>

<ul style="list-style-type: none"> • Umbrella Sedge is a large and fast growing species. In some countries, it is used for paper and bio fuel production. • Water Canna has many uses, young shoots can be eaten as vegetables and the seeds are added to tortillas. In Zimbabwe, the seeds are used to make the hosho, a gourd rattle. The smoke from burning the leaf is a good insect repellent and in Thailand, the plant is a traditional gift during Father's Day. • Mangrove Fern rhizomes can be pounded into a paste and used to treat wounds. The leaves can also be used to stop bleeding. The Purple Heron often makes its nest in this plant. 	<p>Pg 9,10</p> <p>Pg 16</p>
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Debrief and Reflection

Duration: 15min

Location: Lakeside Promenade

Learning Points:

- Main learning points of the ABC Waters Learning Trail

Trainer's Notes		Cross Reference/ Materials									
<p>1. Debrief on the learning points:</p> <ul style="list-style-type: none"> • ABC Waters Programme <ul style="list-style-type: none"> ○ Recap the concept of the ABC Waters Programme. That it includes the Hydrology, Ecology, Community components. • Water quality at Yishun Pond <ul style="list-style-type: none"> ○ Recap the analyses and conclusion from page 13. • Biodiversity at Yishun Pond <ul style="list-style-type: none"> ○ Yishun Pond is home to a substantial number of animals – especially birds. The variety of plants around the pond provides shelter, shade and food attracting animals from the nearby Yishun Park. These plants further connect to the lush gardens at Khoo Teck Puat Hospital. ○ Ask students to recap all the animals observed as a class and discuss this number of animals seen. • Keeping Yishun Active, Beautiful and Clean – Human impact at Yishun Pond, causes and solutions. <ul style="list-style-type: none"> ○ Ask students to turn to page 14. Recap all the activities and impact they had observed along the whole trail (first column). Next give students 5-10 minutes to fill in possible causes and brainstorm solutions to prevent these impacts. (second and third columns) ○ After 10 minutes, ask a few teams to share their ideas. Here are some suggested ideas: 		<p>Pg 17</p> <p>Pg 13</p> <p>Pg 14</p>									
<table border="1"> <thead> <tr> <th>Activity/Impact</th> <th>Possible causes</th> <th>Solutions</th> </tr> </thead> <tbody> <tr> <td>Littering</td> <td>Thrown by the park users</td> <td> <ul style="list-style-type: none"> • Educate users on consequences of their actions • Enforcement of laws • Signs – reminder not to litter </td> </tr> <tr> <td>Fish in Yishun Pond – expecting Population of fish</td> <td>People regularly feeding fish; over-feeding</td> <td> <ul style="list-style-type: none"> • Signs – do not feed animals • Officer/volunteers to patrol pond and give </td> </tr> </tbody> </table>			Activity/Impact	Possible causes	Solutions	Littering	Thrown by the park users	<ul style="list-style-type: none"> • Educate users on consequences of their actions • Enforcement of laws • Signs – reminder not to litter 	Fish in Yishun Pond – expecting Population of fish	People regularly feeding fish; over-feeding	<ul style="list-style-type: none"> • Signs – do not feed animals • Officer/volunteers to patrol pond and give
Activity/Impact	Possible causes	Solutions									
Littering	Thrown by the park users	<ul style="list-style-type: none"> • Educate users on consequences of their actions • Enforcement of laws • Signs – reminder not to litter 									
Fish in Yishun Pond – expecting Population of fish	People regularly feeding fish; over-feeding	<ul style="list-style-type: none"> • Signs – do not feed animals • Officer/volunteers to patrol pond and give 									

abnormally high. Pollution of waters by food items (e.g. bread strewn in inlets, spillway, etc.)		advice	Pg 17
Release of animals into the pond (e.g. Red Eared Sliders)	Religious significance Unwanted pets	<ul style="list-style-type: none"> • Signs – do not release animals • Officer/volunteers to patrol pond and give advice 	
Vandalism of features/benches – damage to park property	People using the park	<ul style="list-style-type: none"> • Officers/ volunteers to check and advise public • Install CCTV 	
<ul style="list-style-type: none"> • Ask students to give an overall rating of human impact around Yishun Pond. 			
<p>2. Reflection Questions</p> <ul style="list-style-type: none"> • Ask students to fill in the reflection questions on page 17. You may want to get a few students to share their thoughts. • What is Water Sustainability and what does it mean to you? Suggested answers: Water sustainability means we can continue to have sufficient clean water for now and the future. I do hope that we can always ensure water sustainability in Singapore. I can help by: <ul style="list-style-type: none"> ○ Not polluting our waterways. ○ Helping to pick up litter when I see any. ○ Telling others about the need to be responsible for our waters. ○ Learning to conduct this learning trail for other students. ○ Reporting to PUB if I encounter any illegal activities. • How can you encourage visitors to care for Yishun Pond and our other water bodies? Advise people to: <ul style="list-style-type: none"> ○ Throw rubbish responsibly into the bins. ○ Avoid throwing chemicals into drains. ○ Avoid feeding fishes or any other animals at our water bodies and parks. ○ Avoid releasing any animals at our water bodies and parks. 			
<p>3. Thank the students and end the programme.</p>			

Extension Activity: A Problem-based Learning Activity

Duration: 1-1.5hr

This can be conducted as a post-trip activity or wet weather programme at a sheltered area near Khoo Teck Puat Hospital.

Trainer's Notes	Cross Reference/ Materials
<ol style="list-style-type: none">1. Divide the class into 2 or 4 teams. Assign teams or let them choose their themes: technology, community, policy or community.2. Let each team develop their 5 year plan for MacRitchie Reservoir for 45 minutes. Guide them as they answer the scaffold questions provided on page 19.3. Gather the class and let them each make their presentations (5 minutes), followed by a 2 minutes question and answer session.4. Give your comments after each presentation and summarise the points raise after all teams have presented.	Pg 19 Flipchart, markers

References

- *Active, Beautiful, Clean Waters Design Guidelines*, (2009, 2011), PUB.
- *Water for All: Conserve, Value, Enjoy – Meeting our water needs for the next 50 years*, (2010), PUB Public Document.
- Tan Yong Soon, Lee Tun Jean and Karen Tan (2009) *Clean, Green and Blue. Singapore's Journey Towards Environmental and Water Sustainability*, Ministry of the Environment and Water Resource.

Annexes

Annex 1: Preparation Brief for ABC Waters Learning Trail

Suggested What-to-bring List for Students (Print only if you have to)

1. A fieldtrip bag (small bag for items below)
2. Water bottle
3. Insect repellent
4. Raincoat or umbrella (in case of rain)
5. Ziploc bag for waterproofing valuables (e.g. camera, hand phone)
6. A pen, or pencil and eraser

Do not bring:
Digital hand held gaming devices, text books, sports equipment for the fieldtrip.

Optional

- Snacks
- Digital camera or camera hand phone
- Cap

Suggested Attire for Students

- T-shirt
- Shorts, or track pants (lighter colours preferable)
- Covered shoes (no slippers)

Annex 2: Suggested Information for Risk Assessment Management (RAM) Form

Risk Assessment Management System
'W Checklist'

PROGRAMME DETAILS			
Activity:	ABC Waters Learning Trail	Venue:	Yishun Pond
Outgoing		Returning	
Date:	To be filled by teacher	Date:	To be filled by teacher
Estimated Time of Departure:	To be filled by teacher	Estimated Time of Arrival:	To be filled by teacher
Person-in-charge:	To be filled by teacher	Assistant(s):	To be filled by teacher

LOCAL VENDOR CONTACT DETAILS (IF ANY)			
Company name & full address:	Facilitator's Name Singapore Environment Council 1 Kay Siang Road #04-02 Singapore 248922		
Office number:		Mobile number:	HP of facilitator
Contact person:	Facilitator's name		

OVERSEAS VENDOR CONTACT DETAILS (IF ANY)			
Company name & full address:	NA		
Office number:	NA	Mobile number:	NA
Contact Person:	NA		

WHY

State learning objectives:

This programme aims to:

1. Foster a sense of national identity and emotional rootedness to Singapore
2. Learn about the Singapore Water Story, appreciating Singapore's unique challenges and successes
3. Understand one of PUB's long term initiatives – the ABC Waters Programme, which will transform Singapore's pervasive network of drains, canals and reservoirs into beautiful and clean streams, rivers and lakes
4. Better understand ecological and water topics in the Science syllabus
5. Promote stewardship for our strategic water resource and the need for everyone to play a part to keep our waterways and reservoirs active, beautiful and clean

Does the activity meet learning objectives? (Yes / No)

Note: Please attach the programme / itinerary.

S/n	Categories to consider:	Hazards Identification		Risk Evaluation Score			Risk Control: Strategies to reduce risk to an acceptable level	Implementation	
		Possible hazards	Potential incidents/ accidents	Severity (a)	Likelihood (b)	Risk level (a) x (b)		Action Officer	Follow-Up Date
WHAT (GENERAL)									
1.	Equipment								
	a) Appropriate equipment is available.								
	b) Appropriate equipment is serviceable.								
	c) Others :								
2.	Transport								
	a) Transportation service is reliable (e.g. driver, vehicle).						To be filled by teacher		
	b) Chartered vehicle is appropriate (e.g. using a 4WD for off-road terrain).						To be filled by teacher		
	c) Others :								
3.	Food								
	a) Food is provided by licensed caterer / restaurants.								
	b) Nutrition is appropriate.								
	c) Special dietary needs are met.								

S/n	Categories to consider:	Hazards Identification		Risk Evaluation Score			Risk Control: Strategies to reduce risk to an acceptable level	Implementation	
		Possible hazards	Potential incidents/accidents	Severity (a)	Likelihood (b)	Risk level (a) x (b)		Action Officer	Follow-Up Date
	d) If self-catering, additional hygiene measures are in place.								
	e) Water is potable.								
	f) Others :								
WHEN (TIMING)									
4.	Programme								
	a) Duration of activity is appropriate (e.g. start/stop/rest time).	Participants tired out from the activity	Dehydration/ Physical exhaustion	2	1	2	- The trail will last for 2 hours in the outdoors, with activity stops at the stations.		
	b) Timing of activity is appropriate (e.g. 5km run conducted before 10.30am or after 3.30pm).	Possible heat injuries due to weather	Dehydration/ Physical exhaustion	2	1	2	- Activities at stations will be conducted in shady areas or under available shelter. - Students will not be under the sun for a prolonged period of time. - Students will be reminded to hydrate frequently.		
	c) Possible delay in activity (e.g. day hike extended into night).	NA							
	d) Others :								
WHO (PEOPLE)									
5.	Teachers and Adult Supervisors								

S/n	Categories to consider:	Hazards Identification		Risk Evaluation Score			Risk Control: Strategies to reduce risk to an acceptable level	Implementation	
		Possible hazards	Potential incidents/ accidents	Severity (a)	Likelihood (b)	Risk level (a) x (b)		Action Officer	Follow-Up Date
	a) Teacher(s)/adult supervisor(s) are competent to supervise activity and manage participants (e.g. teacher/adult supervisor: participant ratio met for specific activity, female adult supervisor present for overnight activity involving female participants).	Participants fall sick and need attention/ evacuation	Not enough teachers/ adult supervisors	2	1	2	<ul style="list-style-type: none"> - Facilitators are experienced in supervising/managing students - Program ratio will be 1 facilitator to 20 maximum students. 		
	b) Personnel is certified and competent to conduct activity.	Participants risk possible danger when outdoors	Participants may injure themselves	2	1	2	<ul style="list-style-type: none"> - Facilitators are experienced in conducting activities for students in indoor and outdoor settings. 		
	c) Certified First Aider or paramedic is on site.	Injured students do not get the proper first aid.	Minor injuries could manifest to major injuries if not treated well.	3	1	3	<ul style="list-style-type: none"> - Facilitators are first-aid certified. (please verify) - Should there be any student who is injured, he/she will be accompanied by a teacher/parent volunteer to the nearest shelter to be attended to by the main facilitator. 		
	d) Personnel is competent to coordinate/execute emergency evacuation plan (e.g. search and rescue).	Students with serious injuries cannot get to the hospital in time.	Injuries could be life threatening.	4	1	4	<ul style="list-style-type: none"> - Should there be a medical emergency involving the injured student, the main facilitator will call for an ambulance and the teacher/parent volunteer will 		

S/n	Categories to consider:	Hazards Identification		Risk Evaluation Score			Risk Control: Strategies to reduce risk to an acceptable level	Implementation	
		Possible hazards	Potential incidents/ accidents	Severity (a)	Likelihood (b)	Risk level (a) x (b)		Action Officer	Follow-Up Date
							accompany him/her to the hospital.		
	e) Others :								
6.	Participants								
	a) Participants understand the objectives of activity.						- A briefing will be given at the start of the Learning Trail.		
	b) Participants are competent for activity (e.g. participate in pre-activity training).								
	c) Participants are aware of and adhere to safety requirements of activity.						<ul style="list-style-type: none"> - A SAFETY briefing will be given at the start of the programme. Facilitators will reiterate safety points during the programme, when necessary. - Students will be briefed to react if they encounter potentially dangerous animals e.g. snake, monkeys, etc. - Students will be briefed not to enter water bodies; not cause anyone to fall into the water bodies. - Water collection for testing will not be carried out by students, but only by facilitators or teachers. 		
	d) Special needs of participants are met.								

S/n	Categories to consider:	Hazards Identification		Risk Evaluation Score			Risk Control: Strategies to reduce risk to an acceptable level	Implementation	
		Possible hazards	Potential incidents/ accidents	Severity (a)	Likelihood (b)	Risk level (a) x (b)		Action Officer	Follow-Up Date
	e) Medical declaration and information of participants are documented and disseminated to relevant personnel.						- Teacher/s to inform facilitators about any special cases – students with medical conditions.		
	f) Others :								
WHERE (LOCATION)									
7.	Venue								
	a) Accommodation is adequate (e.g. number of rooms).								
	b) Fire safety and evacuation route is communicated to all.								
	c) Area map is available for use during activity.	Students find themselves lost.	Injuries may ensue.	1	1	1	- Map of location is included in the student booklets. These are carried by both facilitators and students during the programme. - Students should be with the facilitators at all times.		
	d) Reconnaissance of area is conducted.	Dangerous hazards appear in between time of recon and actual	Injuries may ensue due to unforeseen hazards.	1	1	1	- Facilitators would have conducted a reconnaissance of the location before the date of the learning trail.		

S/n	Categories to consider:	Hazards Identification		Risk Evaluation Score			Risk Control: Strategies to reduce risk to an acceptable level	Implementation	
		Possible hazards	Potential incidents/ accidents	Severity (a)	Likelihood (b)	Risk level (a) x (b)		Action Officer	Follow-Up Date
		day							
	e) In-country authorities and facilities (e.g. police, national park rangers and hospital) are accessible and/or contactable for assistance and support in the event of an emergency.								
	f) Water conditions (e.g. tides, currents, flash floods) and traffic (e.g. ships, power boats).								
	g) Others :								
WEATHER									
8.	Inclement Weather								
	a) Weather forecast and warning (e.g. lightning, flash flood, hot or cold spell, haze).	Sudden down-pour	Participants get drenched which will cause participants to fall ill eventually.	1	1	1	- Facilitators to check NEA Rain animation and PSI level at these timings: ○ 2 hours before LT ○ 1 hour before LT ○ During LT if needed		
		Lightning	Participants strike by lightning	4	2	8	- Before students board bus for the location: In the case of impending thunderstorm, heavy rain or		

S/n	Categories to consider:	Hazards Identification		Risk Evaluation Score			Risk Control: Strategies to reduce risk to an acceptable level	Implementation	
		Possible hazards	Potential incidents/ accidents	Severity (a)	Likelihood (b)	Risk level (a) x (b)		Action Officer	Follow-Up Date
							<p>levels of PSI above 100, it is advised to delay the departure for the location, until Lightning Category 1 is lifted.</p> <ul style="list-style-type: none"> - If there is Lightning category 1 or PSI level of equal or greater than 100 during the Learning Trail, all activities will be stopped and students will be led to take shelter. - If the conditions persist, the programme will be aborted and students brought back to school. 		
	b) Others :								

Note: Please indicate "N.A." in cells that are not applicable.

Excursion Checklist		Action Plan	Implementation	
			Action Officer	Follow-up Date
1.	Communication			
	a) Establish communication with school and service provider via hand phone, satellite phone and/or other appropriate devices.			
	b) Establish communication with in-country authorities and facilities (e.g. police, national park rangers, hospital) for assistance and support in the event of an emergency.			
	c) Compile contact list of stakeholders (e.g. parents, MFA Duty Office, and in-country medical facilities).			
2.	Medical			
	a) Arrange for medical screening and vaccinations for teachers/adult supervisors and participants (if necessary).			
	b) Procure comprehensive travel insurance for all (e.g. International SOS for emergency evacuation).			
	c) Ensure accessibility to medical facilities or personnel in the event of an emergency.			
3.	Overseas Travel			
	a) E-register with MFA at least 3 days before departure.			
	b) Monitor and comply with MFA travel advisory on natural disasters, pandemic outbreak, social-political unrest.			
4.	Others			
	a)			

Risk Assessment Team comprises:

Name of Officer(s)	Designation

Name of Person-in-charge	Signature	Date

Vetted by:

Name of HOD	Signature	Date

Chief Safety Officer/Principal Checklist

To ensure that the following are completed prior to the programme:

- Communicate programme details to parents and participants
- Compile medical information and consent forms
- Ensure that personnel conducting activity is qualified
- Ensure that pre-activity training is carried out
- Ensure that relevant safety and emergency procedures are in place

Submission of Overseas Excursion details to MFA via MFA eRegister (if applicable):

- Prepare details of itinerary and participants for overseas excursion
- Enter details for BF01_MFA-MOE form via the Overseas Excursion Management (OEM) Module in the School Cockpit
- Generate the BF01_MFA-MOE form from the Reports Portal in the School Cockpit
- Submit BF01_MFA-MOE form as an attachment at www.mfa.gov.sg at least 3 days before departure

Approved by:

Name of Chief Safety Officer/Principal	Signature	Date
Comments:		

Assessment Review:

Name of Person-in-charge	Signature	Date

Annex 3: Subject Links

No	Theme	PUB's Educational Objectives	Lower Secondary School Curricula
1	Our Four National Taps, water supply and water sustainability	Technology and an integrated approach for a robust supply of 'WATER FOR ALL'	<p>Geography</p> <ul style="list-style-type: none"> Managing the changing environment – Water resources: Water as a precious resource. Responses to the rising demand of water. Case study of water management in Singapore. <p>Science-Chemistry</p> <ul style="list-style-type: none"> Process of reverse osmosis in NEWater and desalination to get clean water.
2	The ABC Waters design features that integrates ecology (green parks), hydrology (blue waters) and the community (the public).	Appreciating our Active, Beautiful and Clean waters for all to VALUE and ENJOY by encouraging the community to play a responsible role in its upkeep	<p>Geography</p> <ul style="list-style-type: none"> Components of the physical and human environment. Important interrelationship and inter-dependence between man and his environment.
3	Retaining the rich historical and cultural background of Yishun Pond	Importance of history and culture despite urbanisation of Yishun Pond for all to VALUE	<p>History</p> <ul style="list-style-type: none"> The history of Yishun Pond The growth and clean-up of the rivers <p>Geography</p> <ul style="list-style-type: none"> The changing environment and factors responsible for the change Skills in basic techniques namely: comparing and contrasting the changes and inferring information through photos and maps
4	The water cycle and water quality at Yishun Pond	Clean WATER FOR ALL	<p>Geography</p> <ul style="list-style-type: none"> The physical environment – Rivers: The Hydrologic Cycle (evaporation, transpiration, condensation, rainfall, runoff). The physical environment – Weather and Climate: <ul style="list-style-type: none"> Weather elements (temperature, rainfall, wind); Weather, climate and people. <p>Science</p> <ul style="list-style-type: none"> Process skills: Observing, comparing, using apparatus, analysing and interpreting. Diversity of matter.

No	Theme	PUB's Educational Objectives	Lower Secondary School Curricula
			<ul style="list-style-type: none"> • Solutions (chemical or minerals) and suspensions (turbidity). • Measurements: <ul style="list-style-type: none"> ○ Use of measuring instruments. ○ Physical quantities and units. • Parameters for water quality: appearance, smell, temperature, pH, dissolved oxygen.
5	Human activities and their impact	<p>WATER IS PRECIOUS.</p> <p>CONSERVE the waterway at all times.</p>	<p>Geography</p> <ul style="list-style-type: none"> • Water pollution – sources, impact and measure to curb or reduce pollution • Conserving the environment namely at national and individual level <p>Science</p> <ul style="list-style-type: none"> • Conservation of the environment <p>National Education</p> <ul style="list-style-type: none"> • No one owes us a living. We have to depend on ourselves.

Annex 4: “Water Sustainability” Cards

5.3 Million

152

1.1 Billion

Rain

Urban Areas

(Apartments, houses, town facilities roads, etc.)

ABC Waters Site(s)

Reservoirs

Water Treatment Plant

Taps

Annex 6: Suggested Packing List (of Resources) – for Trainers

1. First Aid Kit
2. Insect repellent
3. 4-5 sets of “Water Sustainability” Cards (Annex 4)
4. 4-5 sets of “Water Wise” Cards (Annex 5)
5. 4-5 pails with rope attached (for collection of water)
6. World Water Day Monitoring test kits with pH strips, turbidity discs, thermometer and dissolved oxygen tablets, glass vial and pH vial
7. Plastic bag to collect used pH strips and water which has been tested

Optional:

8. Charged data loggers including temperature, pH and Dissolved oxygen sensors
9. Bird and insect cards, nature guide books
10. Camera



Acknowledgement

Northbrooks Secondary School

Northland Secondary School

Woodgrove Secondary School

Yishun Secondary School

Khoo Teck Puat Hospital

Ministry of Education, Curriculum Planning and Development Division,
Humanities Branch and Sciences Branch

PUB, Singapore's national water agency

PUB is the national water agency that manages Singapore's water supply, water catchment and used water network in an integrated way. PUB won the 2007 Stockholm Industry Water Award and was named Water Agency of the Year at the Global Water Awards 2006.

About PUB's tagline: Water for All: Conserve, Value, Enjoy

PUB has ensured a diversified and sustainable supply of water for Singapore with the Four National Taps (local catchment water, imported water, NEWater, desalinated water).

To provide water for all, PUB calls on all Singaporeans to play our part to conserve water, keep our water catchments and waterways clean and build a relationship with water so we can enjoy our water resources. We can then have enough water for all uses – for industry, for living, for life.