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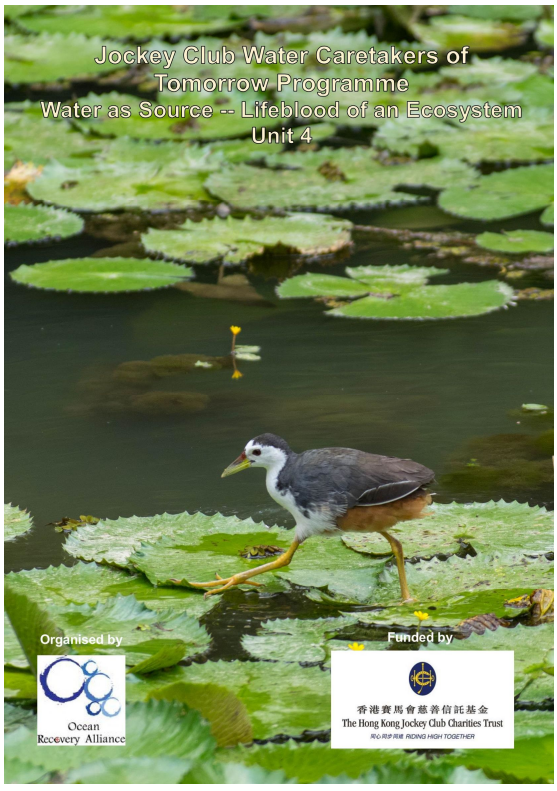
同心同步同進 RIDING HIGH TOGETHER

Teacher Notes for
Unit 4: Water as Source

About the Jockey Club Water Caretakers of Tomorrow Programme:

The Jockey Club Water Caretakers of Tomorrow Programme is a collaboration funded by The Hong Kong Jockey Club Charities Trust and developed by Ocean Recovery Alliance, Ltd. It is an educational curriculum programme designed for students in Form 1-3 early secondary school in Hong Kong. Through a combination of both inquiry-based and project-based learning, students develop understanding and appreciation for our water systems and functions, at both the local and global levels. They learn how to assess threats such as pollution and habitat destruction, while also developing ways to mitigate them. This understanding will empower our youth to take an active role as caretakers of our water resources of the future, and to share their commitment with their families and communities.

Using the Lessons in the Classroom



The Jockey Club Water Caretakers of Tomorrow Programme consists of eight units. The units have been developed to allow for using as many as your time and your curriculum will allow. Each unit can stand alone, although it is strongly recommended that Unit 1: Miraculous Water, be implemented first as it lays the groundwork for the other units. Please note that there is repetition in some of the topics covered in each of the units. This is intentional. As it is likely that most teachers will not be able to complete all of the eight units, the curriculum has been designed to contain as many of the important concepts as possible, within each unit. Teachers are encouraged to pick and choose from the range of topics and activities in each unit, such that unnecessary repetition is avoided.

Teacher Notes and Student Notes

Each unit consists of Teacher Notes and Student Notes. The Teacher Notes include information about skills accessed, materials needed, recommended assessments, suggested extensions, cross-curricular links and other information that could help determine how the Unit and the individual lessons might fit into a teacher's curriculum. In addition to this, Teacher Notes will contain links to websites with background material that can deepen the teacher's understanding on the topics covered in the unit.

The Student Notes can be printed out for the students to use throughout the unit. It includes background information, instructions for all the activities, as well as space to record their learning. The students should also have access to the Student Notes online as many of the activities and additional information are linked to websites on the internet.

It is also recommended that students keep their own "learning log" or journal to record their progress in understanding the issues as well as the actions they might take.

Extensions

All the lessons contain "Extensions" which provide additional rigor or challenges for students. These suggestions for enrichment can help to streamline the lessons to the grade level, curricular or differentiation needs of your own students. Some of the extensions utilize case studies or contain more photographic material or recommended websites, all of which might be suited to students with different learning styles.

Safety in the Classroom and in the Field
Teachers will go over their school's rules for safe and responsible behaviour both inside and outside the classroom, before doing all of the activities in the units. The Teacher Notes will, however, identify particular safety concerns to be aware of in specific activities.

Student Action and Social Responsibility
The aim of every unit in this project is to build student understanding of water resource issues. Through that understanding, it is hoped that they will be motivated to work toward positive change individually, locally and globally. It is, however, important that their teachers communicate the importance of their being sensitive to the complexities of cultural norms and political processes.

Objectives of Unit 4: Water as Source

At the end of the lessons in this unit, students will be able to:

- Describe a freshwater ecosystem and the factors that affect it
- Compare differences in natural and polluted ecosystems
- Understand appropriate conservation and management strategies for freshwater ecosystems

- Identify most common flora and fauna in Hong Kong freshwater ecosystems
- Understand how organisms are adapted to their unique environments
- Collect data in the field for studying a freshwater environment

Student skills table

Lesson	Critical thinking	Supporting Opinions with evidence	Applying scientific principles	Data collection	Graphing and Data Analysis	Reading for Understanding	Using technologies for mapping	Research and/or Presentation
1								
2								
3								
4								

Cross-curricular Links:

Lesson 1: *Biology/Ecology* (freshwater ecosystems, food webs), *Physical Geography* (physical characteristics of rivers)

Lesson 2: *Biology/Ecology* (classification of organisms, adaptations, biodiversity, use of microscope)

Lesson 3: *Biology/Ecology* (collecting data on living organisms in the field), *Mathematics* (calculations with field data)

Lesson 4: *Design* (improving field study sites, designing litter traps, constructing mini-ecosystems), *Humanities/Art* (fish in art, in different cultures)

Unit Vocabulary - refer to Student Notes

Student Notes includes all the vocabulary and definitions that the students should know in order to understand the topics covered.

Materials and Technology Needed

Activity						
Lesson	**1**	**2**	**3**	**4**	**5**	**6**
1	Access to internet	Access to internet	Access to internet	Access to internet , Large sheets of paper, drawing materials, scissors, paper glue	Copies of photos in student notes, string or wool	
2	Copy of same images as from Lesson 1 Activity 4, Paperclips		Access to biology textbook or book on animal classification or internet	Paper for making map, clipboards, access to school grounds, small digging implement		Microscopes, materials for making wet mount slides, dirty fish tank or pond water, prepared slides if available, copies of handouts from Resources section
3	Field trip equipment -- copies of data sheets, dip nets or materials to make them: wire coat hangers and stockings -- specimen jars, magnifying glasses, shallow trays, thermometers, tape measures, secchi disks (see student notes for how to make) recording equipment, cameras, any other water quality measuring equipment that might be available from your school such as probes to measure salinity					
4		Materials for drawing litter trap	Materials for building a wetland pond or aquarium; brine shrimp	Access to internet	Access to waterway near school, equipment for local waterway monitoring	Materials for planting a mini-ecosystem.

Unit Introduction:

1- Go over the Student Aims and the Vocabulary with the students.
2- Students access prior learning by looking at the photos in the “Skipping from Stone to Stone” activity and answering the questions. They should be able to understand that amphibians have thin skin that they sometimes breathe through. This makes it easy for them to absorb toxic chemicals among other things. Also, they live on both land and in water so they are susceptible to the pollution in both places.

Lesson 1: Ecology of Freshwater Ecosystems

Objectives: In this lesson, students will understand:

- Physical characteristics of rivers
- Importance of water quality indicators
- Connection between human activities and river pollution
- Freshwater food chains and food webs

Activity 1: Spot the Different Freshwater Ecosystems
Students contrast and compare a variety of freshwater ecosystems. Some of the characteristics they should notice include depth of water, vegetation, multiple uses, location in the watershed, water velocity, etc.

Activity 2: Physical characteristics of a river
Students watch a video and note as many physical characteristics of a river as they can. They learn the definitions of the main water quality indicators. Finally, they learn about the world’s most polluted rivers from the indicated website. This helps them put river pollution into a global context.

Activity 3: Freshwater ecosystems
Students watch two videos to learn about life in freshwater and how these ecosystems are monitored. They follow the prompts to draw up a simple food chain.

Activity 4: Freshwater community and food web
Students design a food web after looking at the website. They print out the photos in the lesson and connect them with arrows that show the flow of energy in the food web.

Activity 5: Messing with the web

Method
1-Hand out the 24 photos, one per student. Any students remaining can help with the string.
2-Place students in a circle; sitting down is preferable.
3-Use the string to make food web connections between the organisms.

4-The food web will be represented by the string passing across the circle. Most students will have several strings. Keep going until the strings have run out.
5-Students should gently tug on their string to feel their connection with other organisms.
6-Below are three scenarios of how a river could be affected by outside impacts. Each scenario states which organism dies. Students holding these photos drop their string. Other students drop all of their strings if they no longer hold a string that is a source of food.

Scenarios:
a) Herbicide gets into the river killing all the plants
b) An introduced fish eats all the insects
c) An oil spill kills all the species that eat rotting material as well as the fish
7-Students keep doing this until the full effect of the scenario is completed. Discuss how the impact flows through the web.
8-Reset the web and do the next scenario.
9-As a class discuss how widespread the effect was for each of the scenarios.

Lesson 2: Who are you and what do you do?

Objectives: In this lesson, students will understand:

- How to use a dichotomous key for classifying an organism
- Characteristics of some major invertebrate groups
- The different components of biodiversity: species, genetic and ecosystem biodiversity
- Physical and behavioural adaptations
- Use of a compound microscope

Activity 1: 20 questions

Method
1-Use the animal and plant photos from Lesson 1. Use a paperclip to place one of the pictures on the back collar of every student without their seeing the picture.
2-Students then ask other students questions about the features of the animal. The answer can only be in the form of yes or no although the student being asked can pass if they can't answer. There are a maximum of ten questions that can be asked. Each time a question is asked, a line is marked on the student's card.
3-Each student counts the number of questions until they can name the animal or get as close as they can.

Activity 2: Animal and Plant Keys
Students follow the instructions to learn about how dichotomous keys work. They use the short keys to identify the four photos of plants in Lesson 1.

Activity 3: Major invertebrate groups
Students use the internet or their Biology textbooks to research the observable features of the invertebrates pictured on the Unit pages. Depending upon time and interest, they can add two more organisms to the chart, including a photo of each.

Activity 4: Biodiversity
1- Students do the reading about the three different types of biodiversity.
2- They look at the photos of areas in Hong Kong and write about the degree of biodiversity they would expect in each. Students may need to be reminded of the definition of an estuary, found in the Glossary. Ask them to consider why estuaries might have high biodiversity.
3-Students follow the instructions for species audit of school grounds.
4- After the results of the audit have been compiled, discuss the characteristics of areas with greater or less species diversity.

Activity 5: Adaptation
1- Students read about physical and behavioural adaptation.
2- They follow the prompts which focus on adaptations for movement, protection, and avoiding danger.

Activity 6: Microscope
Access the handouts on the microscope found in the Resources folder. Students follow the prompts for identifying the compound microscope parts, using the microscope, preparing a wet mount slide, collecting microorganisms to observe under the microscope, recording observations and identifying the organisms.

Extension
Students design an experiment using pillbugs or slaters which they can purchase on the internet if they cannot find them in nature. They follow the prompts and suggestions in the Student Notes.

Lesson 3: Wetland Field Trip or Excursion

Objectives: In this lesson students will understand:

- How to gather data for a field trip including water quality, flora and fauna
- Relationship between water quality and biodiversity
- How to describe physical and biological characteristics of a freshwater ecosystem
- How to document and interpret the data they collect

Make sure to read through the Student Notes instructions for making some of the equipment that will be used during the field trip. This includes a dip net and a Secchi disk. These things should be made prior to the actual field trip.

Excursion to Hong Kong Wetland Park

If your school does not have the ability to run a field trip to a couple of river sites, then the Hong Kong Wetland Park is a good alternative to explore wetlands. There are extensive walking tracks around the wetlands looking at many of the expected wetlands along with mangroves, and tidal mudflats. It has an amazing diversity of wetland birds. The park has extensive graphic panels.

Use the Hong Kong Wetland Park website http://www.wetlandpark.gov.hk/en/ to find out how to get there by train and and plan a visit. Cameras to photograph habitats, plants and graphic panels and binoculars would be useful.

Gathering data on a field trip

Introduction:
In this activity students help to design a field trip and fieldwork activities. It is preferable if students can visit a very urbanised site and a more natural site. This is particularly difficult on Hong Kong island where the creeks thunder down the steep creeks when it rains and then quickly dry out.

To organise the field trip you will need to:

1. Identify which two locations you will visit
2. How the students will safely arrive at the sites and return back to school.
3. How students will remain safe and the safety procedures they will follow
4. Who will be responsible for gathering and returning equipment
5. If there will be any cost to students

To gather fieldwork data

1. Decide which data activities students will do (some activities will depend on the availability of equipment)
2. Review and modify fieldwork activities
3. Collect and make equipment for the activities that will need them
4. Ask chemistry teachers for training for chemistry equipment

5. Design data gathering sheets for each activity

Equipment:
Thermometers
If your school has the following chemistry equipment for measuring pH, nitrates, phosphates and conductivity would be useful.
Stockings and wire coat hangers for making dip nets
Turbidity tube or Tin lid, black pen permanent marker, drill, string, ruler to make a secchi disk
Writing materials
Cameras

Safety:
Consider doing a safety audit before going on a fieldwork trip. Things that need to be considered include:

1. School safety policy
2. Getting to and from the transport you will be using
3. Avoiding students falling into the water and having a plan if a student does. Seek locations where students will not be in danger if they were to slip into the water
4. How to avoid dangerous litter
5. How to avoid harmful bacteria in the water eg wear rubber gloves, use hand disinfectant after water sampling, no eating food or drinking without cleaning hands with hand disinfectant.
6. Plan for wet weather and a plan B if the weather is really harsh
7. Waders that are waist high or longer are not suitable for student to use in water half a metre or more.
8. First aid kit

Location suggestions:

Big Wave Bay	Beach environment heavily used by people
Bride's Pool	Area rich in geomorphological features of a natural river course
High Island Reservoir	Freshwater storage and supply
Hong Kong Wetland Park	Tourist and information centre with abundance of estuarine birds and animals in a wetland setting
Kam Tin River	River that drains surrounding mountains, with sections that have been channelised

Kowloon Reservoir	Freshwater storage and supply
Lake Egret Nature Park	Connected to Tai Po Kau Country Park dotted with streams and rock pools that are mostly in a natural state. The Lake Egret Nature Park is run as a tourist attraction and information centre
Lam Tsuen River	Flows out into Tolo Harbour, the river courses change from natural stretches to modified ones
Mai Po Nature Reserve	Large wetland nature reserve
Plover Cove Reservoir	Freshwater storage and supply
Pok Fu Lam Reservoir	Freshwater storage and supply
Pui O	Marsh and estuarine environments that have been affected by human activities
Shek Pik Reservoir	Large water storage and supply on Lantau Island.
Shing Mun Reservoir	Freshwater storage and supply
Shing Mung River	Channelised urban river
Tai Mo Shan Waterfall	Highest peak in HK, part of Country Park with natural waterways including Ng Tung Chai waterfall, HK's biggest waterfall
Tai O	Estuarine environment with traditional stilt village, some modified and natural coastline and wetland
Tai Tam Reservoir	Freshwater storage and supply
Tung Chung River	Upper and middle courses are more natural with some modifications in the lower course
Wang Tong River	Example of channelisation.
Waterfall Bay	Waterfall into the sea, lower course runs through villages that discharge into the river affecting water quality

Wong Lung Hang	Medium sized rocky river, easy access next from roads with some well-known aquatic animals and plants occurring here.
Wong Lung Hang	Waterfall and streams along the river course
Yan Chau Tong Marine Park	Some natural and some channelised estuarine environment

When planning locations for fieldwork:

1. The teacher should visit the locations to find out if it is safe for the planned activities
2. Locate toilet stops during the day
3. Identify and plan to take drinking water, food and suitable clothing and shoes for the predicted weather. Will suncream be required?
4. Students will need to be able to clean their hands. Consider bringing sterilising hand cleaner.

Activity 1: Sampling for water creatures

1- Review safety procedures for behaviour on the field site.
2- Students make dip nets, as per the instructions.
3- They collect samples and place them in the white trays for identification.
4- Ask them what they think the general water quality might be, based on the types of organisms they have collected, using the table.

Activity 2: Frog calls

Students can record different frog calls if they are lucky enough to hear them on their field trip.

Activity 3: Litter

1- Review the instructions provided for doing a litter survey.
2- Consider dividing the students according to task such as photographing, counting, recording, calculating data
3- Students follow the prompts for the litter survey.

Activity 4: Litter Hotspots

If the students see any parts of the area they are surveying that have large concentrations of litter or any other pollution, have them follow the prompts for this activity.

Activity 5: Stormwater outlets

If there are any stormwater outlets in the area the students are surveying, they should take special note of this and follow the prompts.

Activity 6: Basic water quality measurements

Students follow the instructions for measuring temperature, flow and turbidity. They record their data in the sheets provided in the Student Notes at end of the lesson.

Activity 7: Using field chemistry equipment

Depending on the availability of equipment from your school, the students can measure chemical properties of the water such as oxygen content, pH, conductivity, nitrates and phosphates.

Activity 8: Report your data

Once the students are back in school again, they should get into small groups to discuss their data and what they think it might mean in terms of the overall health of the ecosystem they observed. They should be able to present their data and their conclusions, along with photographs and tables, in a short slide show to the class.

Lesson 4: Conservation and Management

Objectives: In this lesson, students will understand:

- How impacts to a freshwater ecosystem might be mitigated
- How to design a freshwater aquarium/wetland/pond
- Connections between our environment and our culture
- How to monitor a waterway for signs of pollution

Activity 1: Improve a site
Students consider possible ways to improve their field study site, making it a more natural ecosystem. If there is time, these recommendations can be shared with the class. Ask students to consider what impediments they might encounter with implementing their recommendations.

Activity 2: Design a litter trap
Students develop a design for a litter trap for a river or stream. They should be encouraged to consider which characteristics or a river or stream must be taken into account in their design, based on what they learned in their field trip.

Activity 3: Design your own wetland pond or aquarium
Depending upon space and time, students can design an outdoor pond or an indoor aquarium. This should be a whole-class project. A quick alternative to this would be to grow brine shrimp from eggs and have the student observe them over a period of time.

Activity 4: Fish and culture
Students follow the prompts to learn about how important fish are in different cultures.

Activity 5: Looking forward - monitoring a local waterway
Students monitor a local waterway for at least a week. Depending upon their findings, the local authorities can be contacted to report sources of preventable pollution. A link is provided for reporting this.

Activity 6: Plant a Mini-Ecosystem
If there is a small outdoor space available, students can follow the prompts to design a small ecosystem which they can monitor to look for changes. These changes may include presence of different organisms, speed of growth of different plants, etc.