Water Classroom 4-1 (version 1.2)

Water and climate

Teaching Plan for evaluating Water Classrooms for Middle School Students

Under a project initiated by the Living Waters Museum, Centre for Water Research, IISER Pune and Research and supported by Transforming Education for Sustainable Futures, IIHS, Bangalore

4-1-1 Proposed plan

Teaching Plan number	WC-4-1
Topic	Water and Climate
Discipline	Geography
Time	120 minutes (can be divided into multiple sessions)
Prior learning	Familiarity with phases of water (solid, liquid, gas), surface water, groundwater, aquifers Module 1, topic 1-2 – Where does my water come from? – to have some sense of water bodies in students' city/town/village.
Learning objectives	● Students would learn about the global water cycle and the different ways in which water is transported across the planet ● Students would learn to *identify* links between different parts of the water cycle (in the atmosphere, oceans, glaciers, surface and underground water) ● Students would develop a systems-thinking approach to understanding the climate and water cycle.
Learning outcomes	1. Students can start from any visible or imagined body of water and *trace out* reasonable pathways through which it is connected to

	some other body of water. 2. Students can *articulate* the impacts of disruption to one part of the water cycle.
Resources/materials	Images of two water bodies side by side. Images of precipitation and some other reservoir of water. Print outs of activities, scissors, glue
Use of teaching time	**3-5 mins** Welcome and introduction to the session. They may ask the students what they think climate is and what is the climate of Pune. **3-5 mins** Facilitator/educator will show students pictures of different climatic regions and ask them which fits their own city/region best, and why. This discussion leads to the definition of climate as "something you expect" whereas weather is "something you get" – you can have hot days even in a cold climate, or rainfall in a desert climate. *Refer to – Background for educators/facilitators -section 4-1-2a* **3-5 mins** Facilitator/educator will ask students to name reservoirs of water If no solid or gaseous reservoirs are named, facilitator/educator will prompt for them. If students mention river, use it as a cue to talk about flows, since river is a flow and not a reservoir. Facilitator/educator can list out the answers on the board.

	Refer to – *-Background for educators/facilitators -section 4-1-2b* *-appended file WC-4-1-Activity-I (list of flows/stocks)* **3-5 mins** Facilitator/educator will introduce students to the concepts of reservoir and flows of water, and discuss the notion of a water cycle, which moves water around the planet. *Refer to – Background for educators/facilitators -section 4-1-2b* **3-5 mins** Facilitator/educator will discuss that the water cycle (or any other cycle like carbon cycle) represents a continuous and permanent process, and therefore is a good pictorial description of the hydroclimate* of that region. **Hydroclimate is the scientific field that brings together hydrology and climate, including the impacts that water and its processes have on Earth's climate, and the impacts of climate patterns and change on the global hydrological (or water) cycle. It can apply in a similar sense to a given region and can be described by a water cycle that takes into account the water bodies in that region*. **30-35 min** Facilitator/educator will introduce and conduct activity – WC-4-1-Activity-I. This activity is designed to trace various pathways of water between

	reservoirs and flows and their phase changes. *Refer to – appended file WC-4-1-Activity-I* Facilitator/educator will wrap up by pointing out the difference between a simplistic water cycle image usually used and the more complex processes that contribute to the actual water cycle. And this is what will be attempted in WC-4-1-Activity-II. **30 mins** Facilitator/educator will introduce and conduct activity – WC-4-1-Activity-II. This activity is designed to use the elements from WC-4-1-Activity-I to develop the more complex and interconnected water cycle. *Refer to – appended file WC-4-1-Activity-II* **30 mins** Facilitator/educator will use the map generated during WC-4-1-Activity-II to discuss the following (depending on time and interest): 1. trace the various routes by which water reaches your tap during the monsoon season and the dry season. 2. discuss the impacts of a drought and the likely impacts on the water cycle of an area 3. discuss the impacts of global warming and the likely impacts on the water cycle This discussion will illustrate how changes in one part of the water cycle affects all parts since they are interconnected at local and

	global levels ● *Refer to – Background content for facilitator/educator- section 4-1-2-c.*
Differentiation	Different level of scaffolding may be required for different students. Some part of the activities can be done as a class activity on a board so everyone can be on the same page.
Additional activities	Facilitator/educator may ask students to draw water cycle as a homework What is groundwater? - https://www.usgs.gov/special-topics/water-science-school/science/groundwater-what-groundwater?qt-science_center_objects=0
Anticipated challenges and solutions	Including ground water and ice sheets /glaciers as part of the water cycle. Including water vapour and precipitation as part of the water cycle. Include examples where these reservoirs are crucial - Birth of rivers in Sahyadris (groundwater), Rainfall during Monsoon, Pictures of Icebergs.
Keywords	Water phases, Reservoir (of water), Evaporation, Precipitation (liquid or solid), water cycle, stock, flow, evaporation, global warming, drought

4-1-2 Background content for facilitator/educator:

4-1-2a Climate and weather

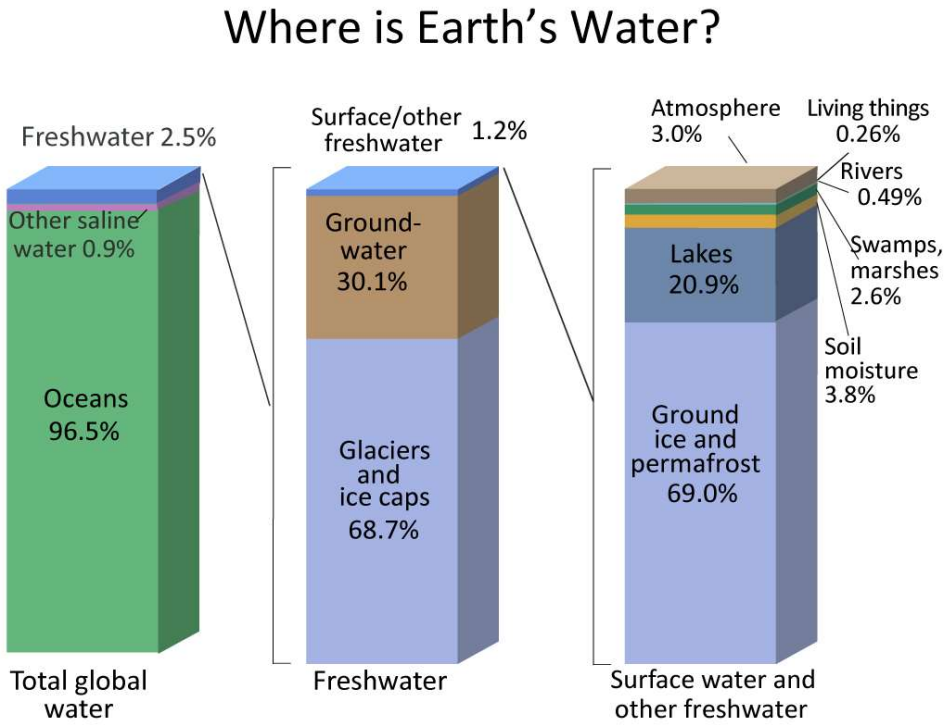
As an example of the instruction above in 'Use of time', show the above picture of the Atacama Desert in South America (you can choose any other, maybe of a snowing location) and ask the students if this is a picture from Pune district. The students are likely to answer "no", and then they could be asked why they think this is the case since they have likely not visited all parts of Pune in all seasons. Based on this discussion, the students are expected to infer that they have an intuitive understanding of what to expect from Pune's landscape, and that this expectation is closely linked to Pune's climate – its rainfall, temperature, vegetation patterns.

This discussion leads to the definition of climate as "something you expect" whereas weather is "something you get" – you can have hot days even in a cold climate, or rainfall in a desert climate. Climate change is defined as change in climatic parameters (eg. temperature, rainfall) over decades and therefore, weather changes may not always be indicative of climate change.

4-1-2b Reservoirs, flows and water cycle

Earth is unique to have water in all three phases - Liquid, solid and gas. The main reservoir of liquid water are oceans, lakes and groundwater. Solid water is mainly stocked in sea ice, glaciers and large ice sheets like the ones in Antarctica and Greenland. Gaseous water or water

vapour is stocked in the atmosphere. A relatively small but important reservoir of water is in living beings.



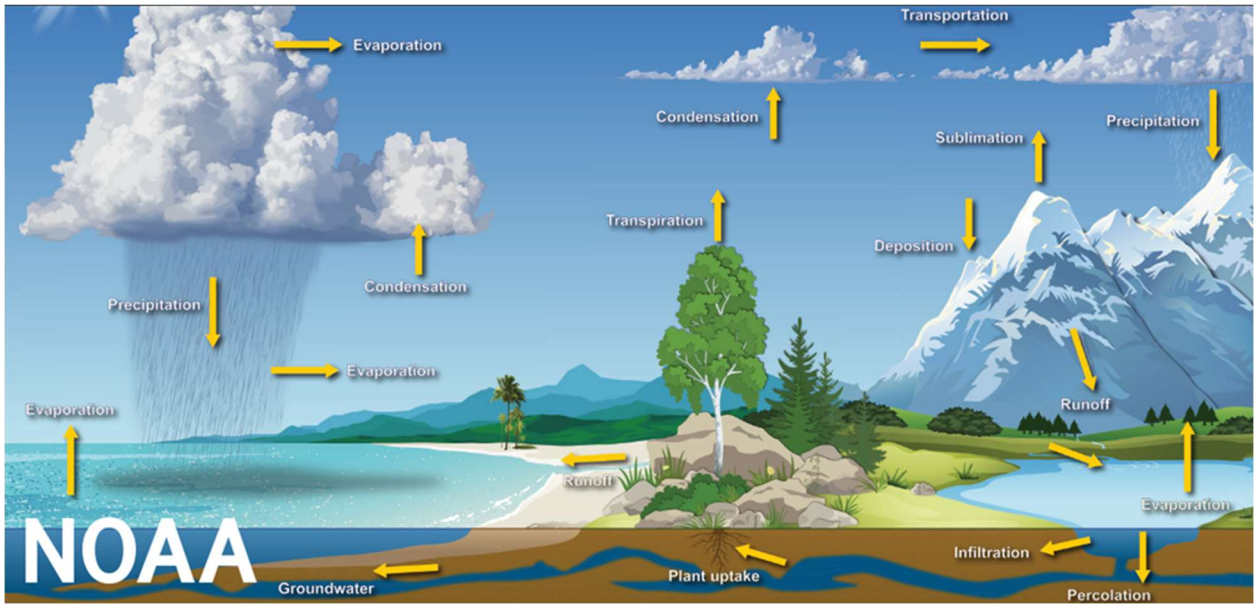
Source: Igor Shiklomanov's chapter "World fresh water resources" in Peter H. Gleick (editor), 1993, Water in Crisis: A Guide to the World's Fresh Water Resources. (Numbers are rounded).

Water is continuously being moved from one reservoir to another. The movement of water from one reservoir to another is called a flow. Rivers, springs, icebergs, evaporation and rainfall are all examples of flows of water. If water has to move from a reservoir in one phase to a reservoir in another phase, it also involves a phase change. This continuous movement is called the Water cycle.

The hardest reservoir to visualize is groundwater, which is the largest reservoir of freshwater. It is also challenging to understand the flow to and from the ground, which is percolation. Educators can use the sponge activity to help illustrate how water from the surface percolates to the subsurface as well as how such movement is changed in the presence of impermeable layers such as rocks.

A change of phase of water also involves the absorption or release of energy. For example, surface water absorbs sunlight and is converted to water vapour. Water vapour condenses to form clouds, releasing the energy absorbed from sunlight. Similarly, when ice melts to form liquid water, it absorbs energy from its environment.

The water cycle is crucial for our survival. During the monsoon, water that evaporates over the ocean falls as rain and snow over India. This water is stocked in glaciers in the Himalayas, in lakes, and as groundwater. The water stocked in glaciers and ground water is slowly released in rivers and springs and provides water for living beings all year round.



4-1-2c Changes in water cycle

Global warming can disrupt the water cycle and cause harmful effects to human societies as well as ecosystems. Increasing temperatures will melt glaciers and ice sheets, increasing the flow of water in rivers and to oceans. This causes rise in sea level which can drown areas close to the coast as well as cause flooding in rivers. Increasing temperatures also cause an increase in evaporation of water from various surface stocks of water. This can dry wells and lakes. Global warming also increases the likelihood of heavy rainfall which results in floods and

reduced percolation of water into underground aquifers. This can reduce the amount of groundwater which is a source of water during the dry season.

On the other hand, during a drought, a lake may dry up, and therefore, evaporation and river flow reduces. This reduces the amount of water entering the atmosphere and the ocean. This can in turn reduce rain and snowfall and further reduce water in lakes and glaciers, thus affecting the water cycle.

Water classroom WC-4-1-Activity-I

Refer to appended File: WC-4-1-Activity-I.pdf

Page 2 of the document contains pictures of stocks and flows of water. Students have to cut out the pictures from these printouts.

Facilitator/educator will ask the students to stick the appropriate pictures in the blank boxes and also label all boxes as stocks or flows as shown in the worked out example. The students must also write down the phase of water in each picture.

The first exercise is solved as an example (in italics). This can be used by the educator to illustrate to the students how to complete the subsequent exercises.

Water classroom WC-4-1- Activity-II

Refer to appended File: WC-4-1-Activity-II.pdf

See instructions in WC-4-1-Activity-II.pdf