Water Classroom 1-1 (version 2)

Water and "My"self

Teaching plan for learning on water 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

1-1-1 Proposed plan

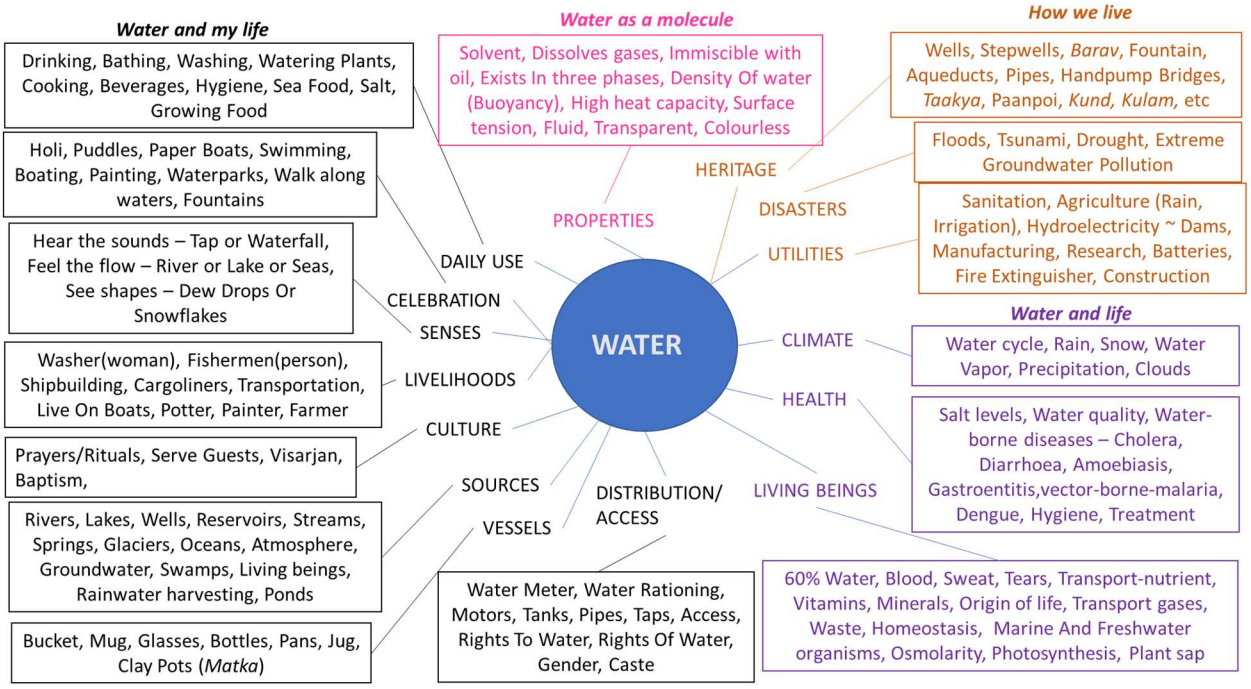
Teaching Plan number	WC-1-1
Topic	Water and "My"self
Discipline	Interdisciplinary
Time	60 minutes (can be divided into multiple sessions)
Prior learning	Basic interaction with water. Understanding of basic physical and chemical properties of water Can articulate thoughts and ideas.
Learning objectives	● Students can *recall* multi-faceted aspects of how we interact with water in our daily lives ● Students can *match* scientific knowledge with how water is used in our daily lives and that of other living organisms.
Learning outcomes	1. Students can *list* out the multiple ways in which their lives interact with water on a daily basis 2. Students can *identify* relationships between physical and/or chemical properties of water and various uses for water in our daily lives and that of other living organisms.

Resources/materials	Whiteboard, marker pens, image/prompt print outs, cellotape or magnets, paper chits, pens collection box
Use of teaching time	**25-30 min** – Educator enables students to explore their relationship with water through some of the following (not limited to) prompts: 1. What all comes to mind when you think about water? 2. In which activities do you or your family members use water? 3. Why is water important for living beings and life processes? 4. How does water affect our quality of life or how we live? 5. What properties of water are useful for living organisms? As students speak up, the educator uses their answers to draw a mindmap on a white/blackboard. This mindmap represents the collective current knowledge of students. The educator may ask students to make connections as well. *Refer to – Background content for facilitator/educator – sections 1-1-2a-c.* **10-15 min** – List out physical and chemical properties of water and Correlate properties of water to other aspects of water. *Refer to –* *WC-1-1-Activity-A* *Background content for facilitator/educator – section 1-1-2d* This can be done using Activity A.

	This can be limited to students' collective knowledge OR can be used as an opportunity to introduce some new concepts using activities listed in Additional activities – this will increase the time requirement. **10-15 min** – Conduct activity – WC-1-1-Activity-I This activity is designed to help students correlate everyday activities with the physical or chemical properties of water.
Differentiation	The level of discussion can be moderated according to the level of the students.
Additional activities	Episode-1: Story of Water https://www.youtube.com/watch?v=0W7pRa3_QFE Episode-2: Story of Water https://www.youtube.com/watch?v=GgfPjuzswQc Specific concepts- Surface tension https://www.arvindguptatoys.com/toys/Funwithsurfacetension.html Buoyancy https://www.arvindguptatoys.com/toys/buoyantballs.html Capillary action https://www.arvindguptatoys.com/toys/Capillaryaction.html Density https://www.arvindguptatoys.com/toys/Floatinglemon.html https://www.arvindguptatoys.com/toys/Sinkingandfloatingball.html https://www.arvindguptatoys.com/toys/Funwithhotwater.html

	Cohesion/surface tension https://www.arvindguptatoys.com/toys/Soapsize.html Solubility https://www.arvindguptatoys.com/toys/Solubilityinhotandcoldwater.html Dissolved gases in water https://www.arvindguptatoys.com/toys/oxygen.html
Anticipated challenges and solutions	Students may have language-related issues or hesitation to speak out. Urban students may need additional prompts to think about water in agriculture, celebration and livelihood.
Keywords	Interdisciplinary, Mindmap, Properties of water

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



Reference Water Mindmap

1-1-2a Water and my life

Water is essential for our daily household needs such as drinking, washing, bathing, cooking, cleaning, maintaining household hygiene, watering plants, during prayers and rituals, etc. People celebrate water through activities such as the holi festival, children playing in puddles or floating paper boats in ponds, painting, boating, swimming, enjoying rides in waterparks or a walk along the coast. Water fascinates us with the life in and around it, and triggers our senses through sounds of the oceans, expanse of the seas, flows in rivers, rains and waterfalls and the shapes of dew drops and snowflakes. Water can be a part of people's livelihoods, eg. washermen, fishermen, those employed in shipbuilding and also as a means of transport. Some people live on water (in boats). Water forms an essential part of rituals surrounding death.

Festival of holi with colours and water (photo credit: Chhavi Mathur)

1-1-2b Water and life

Water is the most abundant substance in living organisms, accounting for 60% or more of the weight. Life originated in water and much of the life processes in bacteria, animals and plants - structure and function - are adapted to physical and chemical properties of water.

Water can transport nutrients, vitamins, minerals to different parts in an organism - through blood/circulatory system in animals and through capillary action in plants for more details. Water dissolves gasses like oxygen and carbon dioxide which supports life under water (this also makes it an important part of the global carbon cycle). Water collects metabolic waste (waste created during normal body functions) and releases it outside the organism. This leads to a regular exchange of water between the organisms and their surroundings. Water plays a role in maintaining body temperature (homeostasis) and salt levels (osmolarity - for more details explore osmolarity of squids). Water also reflects our emotional state when we sweat while nervous or when tasty food makes our mouth water or when we cry. Water is present in plant sap.

Source: iStock, courtesy STEMPeers

1-1-2c Water and how we live

We depend on water in indirect ways. Water is required in agriculture, industry/manufacturing, transport, energy production, medical research, health and sanitation. Sometimes our lives have a paradoxical relationship with water - water is used to produce electricity - we use electricity to pump water into our houses; water is required for maintaining hygiene - contaminated water has long been involved in the life cycle of epidemics like cholera, malaria, dengue, etc.

Khadakwasla dam near Pune (source: wikicommons)

1-1-2d Properties of water important for life

Water has several interesting chemical and physical properties that support life in several different ways.

1. Water as a solvent - water serves as the medium for most biochemical reactions in our bodies (eg. maintaining salt balance, maintaining pH of biochemical reactions, neurotransmission), kidney function – removal of waste from our body, painting, pottery, agriculture – plant growth, applying fertilizers, industry – removal of effluents, water pollution/contamination,
2. Water dissolves gases - allows aquatic life to breathe, fixes carbon and take CO2 out of the atmosphere
3. Does not mix with oil - maintain body/cell structure - cell membranes are formed by lipids which are impermeable to water. Therefore, different aqueous conditions inside and outside a cell may be maintained and facilitate cellular uptake of nutrients and release of waste products, or electric nerve transmission, etc. (may be too advanced to students)

4. Water exists in three phases (evaporation/condensation) - ice, water, vapor - this is crucial for maintaining our climate (water cycle - discussed in a later topic), production of salt, water takes the shape of its container,
5. Density of water – Water is less dense as a solid (ice) that as liquid - allows survival of aquatic life in freezing conditions
6. Surface tension of water – detergents used for washing clothes/dishes reduce the surface tension of water (cohesive force between water molecules), allowing water to mix with other particles like grease.
7. Heat capacity of water - Water has high heat capacity which allows us cooking
8. Buoyancy – waterways/transportation
9. Cohesion – shapes of raindrops, dewdrops, snowflakes, cloud formation

References-

https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf

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https://sprf.in/water-policy-a-year-after-jal-shakti-paradigm-shift/

https://www.worldbank.org/en/news/feature/2019/12/09/solving-water-management-crisis-india

https://www.watereducation.org/aquapedia-background/potable-water

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Lehninger Principles of Biochemistry, 4th Edition

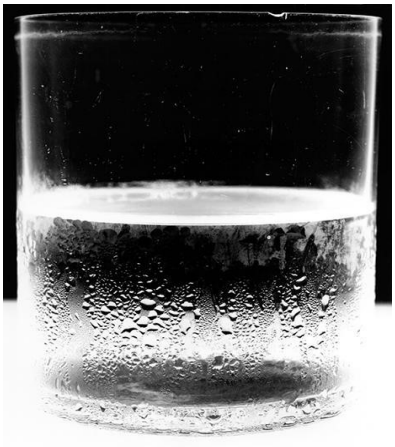
Water Classroom WC-1-1-Activity A - for teachers

Connecting properties of water to water in life

The educator/facilitator will use images given below (or other images or visual content of their choice). They will discuss each image from perspectives of different disciplines.
They will encourage students to identify the connections between science and other water-related aspects using the given questions.

(If some new words/phrases related to water come up, the educator may add those words to the mindmap.)

Image -1

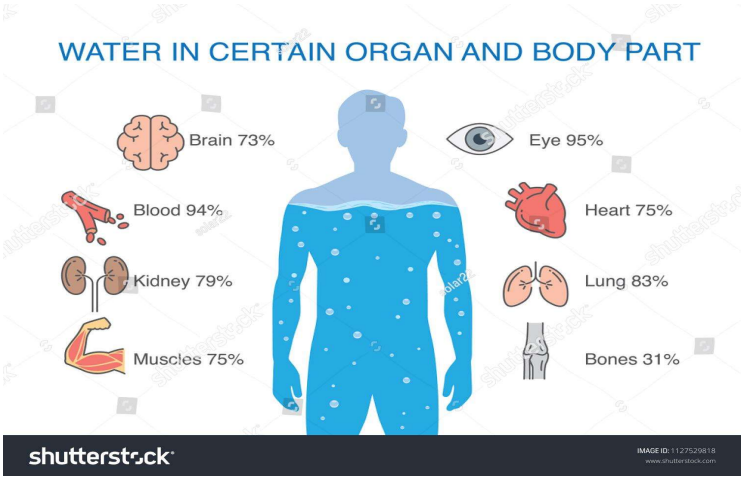


A glass with water (source - Wikicommons).

Optional activity - This can also be done as an exercise with a glass of cold water.

A glass of cold water is kept on the table at room temperature for 10 minutes.
--Will there be water droplets on the outer walls of the glass?
--Where do these water droplets come from?
--What is the name of the process that makes these water droplets appear?

Image 2



--How much water is present in living beings?

--Where is water present in living beings – tissues/cells/molecules/DNA….?

--Which property of water is useful for a living being to function properly?

Image-3

Women washing clothes at Ramnadi, Pune (photo credit: Chhavi Mathur).

Which property of water is important for washing clothes?

Why does foam appear when washing clothes?

How does one check water quality?

Water Classroom WC-1-1- ACTIVITY- I

Student Name: Class: Date:

Properties of water - *Water as a solvent, Water dissolves gases, Does not mix with oil, Water exists in three phases (evaporation/condensation), Density of water, Surface tension of water, Heat capacity of water, Buoyancy, Cohesion*

Which property of water is relevant to the following statements?

1. We went for a walk in the desert and got dehydrated. We suffered from salt imbalance.

2. Hari is a potter and makes beautiful clay pots that we use in our garden.

3. Sheila has successfully built a ship model that can float and cross the pond in the park.

4. In the Himalayas, the top of the lake freezes. We can walk on the ice while there are also fishes swimming under the sheet of ice.