Teacher's Guide

Water

Part 3

Based on the curriculum for Kerala State Board
Standard VIII

JANAAGRAHA CENTRE FOR CITIZENSHIP & DEMOCRACY

Janaagraha's initiative to improve citizen engagement in India's democracy through their civic learning program

Developed in collaboration with Young Leaders for Active Citizenship (YLAC)

Water| Teacher's Guide (3/3)
Part 3

Class VIII
Board – Kerala State Board
Subject – Science
Textbook – Basic Science Part 2
Chapter 16 – Water
Number of parts – 03
Length – 75-85 minutes (estimated, for a class of 40-45 students)
Note: Teachers may divide the lesson plan into as many periods as they see fit

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Section I – What are we going to learn and why is it important?

Learning objectives

Students will:

- analyze the causes and effects of water pollution

Learning outcomes

Students will be able to:

- Explain the importance of water in sustaining life on Earth
- Examine water pollution and be able to explain the effects of water pollution on the ecosystem.
- Discuss solutions to conserve water and to combat water pollution

Key Terms

Water scarcity	Water pollution	Water conservation	Dissolved oxygen

Materials needed

- Images to be shown/drawn.
- Print-outs of the case study

Section II – How are we going to learn?

1. Introduction

Time: 10 minutes

Facilitation notes:

Terms that I know and am sure about	Terms that I do not know about	Terms that I learnt in today's class

Classify the following terms as whether you are already sure about it or whether you do not know about it at all. You do not have to define the terms. Do not write anything in the third column. At the end of the class you will be writing down the terms you learnt in today's class in the last column.

1. Water pollution
2. Water scarcity
3. Water conservation

Take 30 seconds to classify these terms in the first 2 columns.

Write the below questions on the board and ask students to answer them by discussing with their partners.

1. Which gas do all humans and animals on land breathe?

2. Which gas do animals under water breathe?

3. How is this gas available in water?

After a minute, take a few responses but do not disclose the correct answer to the third question. Show the below image of a fish tank/aquarium and ask if they have seen it before and if they have seen a small machine that creates bubbles in the fish tank.

4. Why are these bubbles necessary? What do they help achieve? (Take a few responses)

Answer Key

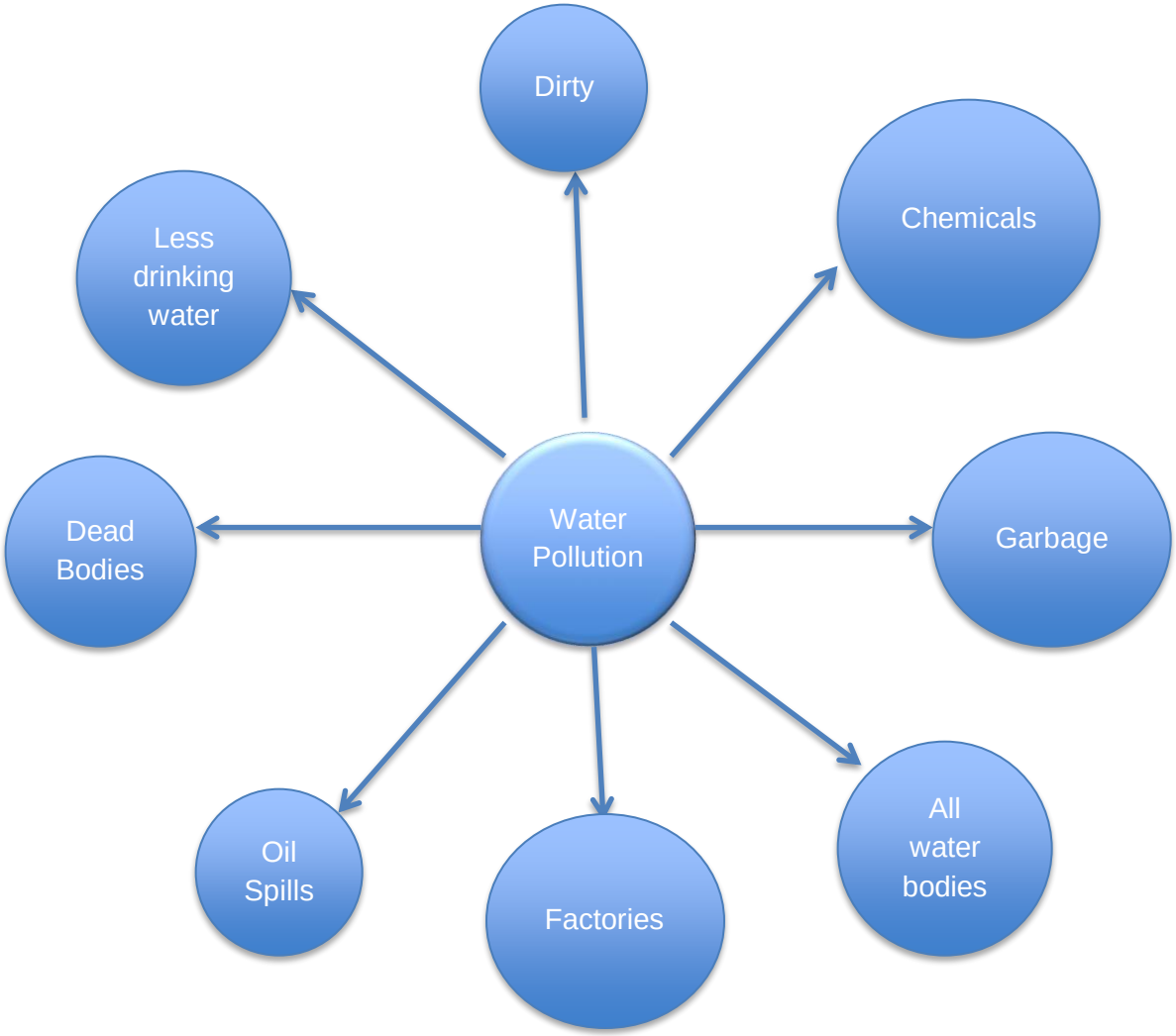
1. Oxygen
2. Oxygen
3. The oxygen molecule is dissolved in water just like how salt dissolves in water. It is this oxygen that aquatic plants and animals use for breathing. The water molecule is not decomposed by aquatic animals to breathe oxygen.
4. The bubbles in a fish tank is most often created by air pumps which increases the water circulation and the oxygen from the atmosphere gets dissolved in the water.

2. Water Pollution

Time: 10 minutes

Facilitation notes:

1. Write the term 'Water Pollution' on the board.
2. Ask the students to shout out different words or phrases that come to their mind when they see water pollution. Take about 10 different responses and write them on the board as a mind map. For example, refer to the diagram below.



3. Ask students to discuss with their partners about when, where and how have they witnessed water pollution in their city.
4. Can they think of solutions to address it?

Show the following news article (on the projector/print-out) and discuss the questions asked below. After answering the first question show the second paragraph, followed by the second question.

Amid the state government's efforts to rejuvenate and reclaim water sources, a study has come up with a startling finding that 26.90 % of water sources in Kerala are "completely" polluted.

As many as 46.10 % of over 3000 water sources including ponds, canals, river and backwater stretches and public wells, surveyed in 2003 wards across the southern state, are "partly polluted," it said.
However, in a relief to nature buffs, another 27 % of water sources are found unpolluted, the study, compiled by the Kerala State Literacy Mission Authority (KSLMA), said.

"As many as 26.90 % of water sources in Kerala are completely polluted," the study said.
As part of the study, 1302 ponds, 941 canals, 153 river stretches, 16 backwater stretches, 1107 public wells and 87 others in various districts were surveyed.

1. According to you, what are the different causes of pollution in Kerala?

Likely Response – Factories, Hotels, Garbage from households, air pollution from vehicles,

Solid waste accounts for 53 % of pollution of water sources, liquid waste 16.97 %, household waste 23.24 % and encroachment seven per cent, it said.

Among solid waste, hotel waste accounted for 40 % of pollution while plastic and glass 20 % and other wastes 30.55 %, it said.
Cleaning of vehicles and bathing of animals also caused water pollution, it said, adding, sand mining, absence of protective wall and encroachment are posing threat to water sources.

2. What is the effect of increased water pollution to aquatic animals and plants? Do you think it affects the oxygen level in the water?

Toxic waste materials when drained into a water source can harm aquatic animals and plants as they will consume the toxic waste. The garbage that is thrown in the ocean and sea increases the bacterial decomposition process. This process requires oxygen that is dissolved in water. Thus, the plants and animals in the water have lesser oxygen to breathe.

3. Water Scarcity

Time: 20 minutes

Facilitation notes:

Ask students to make groups of 4 and read the below case study (Appendix 1) and answer the questions asked.

Source: Scroll.in

Karivellur Peralam has been reeling from a severe water crisis since March. Nearly all its ponds and wells have dried up. Such is the scarcity that even the tanker, run by the gram panchayat, can only provide 150 litres of water per household once in three days. The crisis in Karivellur Peralam is particularly severe, but all 14 of Kerala's districts, except Wayanad and Pathanamthitta, are facing acute drinking water shortage, just eight months after the state witnessed the worst floods in a century last August.

Many factors

The ongoing crisis is the result of a combination of factors, including a poor northeast monsoon and the lack of proper water conservation, experts said.

Kerala received 23% excess rainfall – 2515.7 mm – during the southwest monsoon, from June to September 2018, contributing to the devastating floods. The northeast monsoon, from October to December, however, yielded 3% less rainfall than normal. The situation worsened as the pre-monsoon season, which is from March 1 to May 15, saw 45% deficient rainfall.

"Groundwater levels dropped because of deficient rainfall in the months following the floods," explained VP Dineshan, senior principal scientist at the Centre for Water Resources Development and Management in Kozhikode. A study by Dineshan's team found groundwater levels have fallen by 1-4 metres across Kerala.

(Picture on the left)- A well that has almost dried up well in Karivellur, Kannur. Photo credit: TA Ameerudheen

Lack of forest and wetland conservation

Scientists pointed out that Kerala's unique **topography** allows rainwater to be quickly discharged into the Arabian Sea and the process quickens in the absence of rainwater conservation.

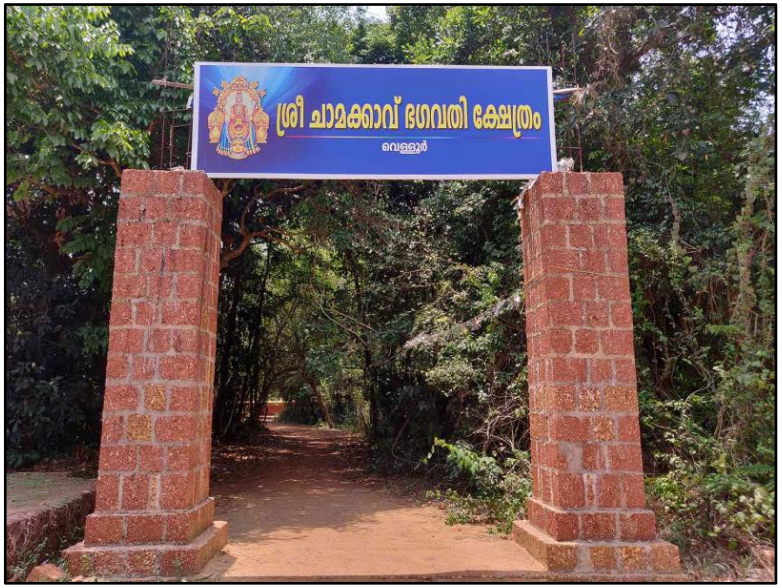
Kerala is a narrow strip of land. Between the Western Ghats in the east and the sea in the west, it is 140 km at its widest and 35 km at its narrowest. It takes rainwater from the Ghats only 48-72 hours to be discharged into the sea.

The destruction of forests, wetlands, sacred **groves** and laterite hills over the last few decades has meant that rainwater is discharged without **percolation** into the plateau, said TP Padmanabhan, director of the Society for Environmental Education in Kerala. "This results in depletion of groundwater levels," he added.

(Picture on the right) – Ponds across Karivellur Peralam gram panchayat have dried up. Photo credit: TA Ameerudheen

Before the ecosystem destruction became **rampant**, Padmanabhan said, 40% of the rainwater reached the Arabian Sea, 20% got evaporated, and 40% percolated down and **replenished** the water table. "Rate of percolation decreased with the destruction of the ecosystem," he added. "Low percolation and depletion of the water table explains why we are facing a water shortage just eight months after the floods."

(Picture on the left)- A destroyed laterite hill in Karivellur, Kannur. Photo credit: TA Ameerudheen



No scarcity of water in this grove

In Chamakkavu, a sacred **grove** near a Bhagawati temple that is home to many plant species. It is a natural **aquifer** that keeps the area's water table intact.

"One acre of sacred grove gives water to four ponds and 40 wells," reads a board hanging from the fence of the grove. "This six-acre sacred grove gives us abundant water supply. Let us preserve this wealth."

People living near the grove said they never face water shortage during the summer. "These trees hold water and replenish the water table," said Ramachandran, a resident. "This sacred grove is our lifeline and we are committed to protect it."

(Picture on the left)- Chamakkavu near Vellur in Kannur. Photo credit: TA Ameerudheen

In recent years, Padmanabhan said, Kerala's people have come to understand the crucial role of laterite hills, paddy fields and sacred groves in protecting the water table. "Though it is too late, we have to resist moves to erase hills, reclaim paddy fields and destroy forestland," he said. One cannot live in this world without water. So we have to act now to avoid a **catastrophe**.

Glossary

1. Topography – The physical features of land surface
2. Percolation – Filtering through a porous surface
3. Rampant – Spreading in an uncontrolled way
4. Replenished – Fill up the supply again after using some of it
5. Grove – a group of trees
6. Catastrophe – an event causing sudden great damage
7. Aquifer – a large underground storage space for water, formed when water passes through underground layers of rock

Answer the following questions in your notebooks after discussion

1. Although Kerala witnessed devastating floods in 2018, why did it suffer from water shortage in the summer of 2019?
2. What is the unique feature of Kerala's topography that makes a contribution to this situation?
3. What does the example of the sacred grove near Chamakkavu prove?

Answer Key

1. Poor Northeast monsoon, lack of water conservation fueled by levelling of hills and reduction of forest cover resulted in ground water depletion.
2. The state of Kerala is narrow, with the western ghats in the east and the sea in the west, most of the rain water quickly drains into the Arabian sea.
3. Trees are essential in keeping ground water level intact, even with less rainfall the water level can be maintained if trees are maintained.

4. Water Conservation

Time: 15 minutes

Facilitation notes:

Quiz: Divide the class into 4-5 groups based on where they are seated for a quick pop quiz.

1. In India, on an average, how much water is used for a bath when using a shower?
(Ask the groups to discuss among each other and take one response per group. Write the number each group has guessed on the board.)
Answer: 35 litres for a 10 min shower

2. In India, on an average, how much water is used for a bath using a bucket?
(Ask the groups to discuss among each other and take one response per group. Write the number each group has guessed on the board.)
Answer: 25 litres (1 bucket)

3. How much water can be saved if the tap is turned off while brushing teeth by one person for one time?
(Ask the groups to discuss among each other and take one response per group. Write the number each group has guessed on the board.)
Answer: 15 litres

4. On an average, how much water is used when a toilet is flushed fully?
(Ask the groups to discuss among each other and take one response per group. Write the number each group has guessed on the board.)
Answer: 6 litres

Last Question,
5. On an average, how much water is used per person per day by a middle class urban Indian?
(Ask the groups to discuss among each other and take one response per group. Write the number each group has guessed on the board.)
Answer: 150-200 litres

Source: nic.in

- What do you think of these statistics? Are they high/low?
- Do you think we can play a role in conserving water?
- Brainstorm about all the activities that are done at home that use water in the classroom. Ask students to draw this table in their notebooks and write down only the activities that are relevant to their house. At home, ask them to find out how much water is used for each activity. Think of ways to reduce the quantity of water and discuss with family members. Try it for a week and check the amount of water being used after the conservation techniques.

Activity	*Quantity of water used (in buckets)*	*Measures to conserve water*	*Quantity of water used after conservation (in buckets)*
Bathing	*2 buckets*		
Washing clothes	*5 buckets*		
Washing vessels	*2 buckets*		
Car/bike washing	*3 buckets*		

Provide the following story as a print-out to students. Ask them to read it and discuss it their group. Discuss their understanding of this case with the whole class.

Case Study 2

Kerala Man Innovates Rainwater Syringe by Accident, Restores 300 Cr Litres in 30 Years!

KJ Antoji, a resident of the coastal village of Chellanam, Kochi in Kerala, was working as a wire technician in 1988. He had already spent a considerable amount of time to devise a technique to reduce his dependence on the municipal water supply. Yet to no avail.

One fine day, while watering his garden, Antoji was lost in thoughts about securing the water supply at his home when the hose in his hand slipped. The water pressure was at **full throttle**, and the hose was quite heavy. And as soon as it hit the ground, the high-water pressure drilled a 30 cm hole in the garden floor where the water started pooling.

This accident was Antoji's **eureka moment.**

He conceptualised a water harvesting system that could store fresh rainwater several metres below sea level for future use.

This Rainwater Syringe Technique, eventually, would go on to help several resorts, hundreds of farmers and independent houses harvest and conserve water, and draw students from IISC, Bengaluru to study the system.

"The accidental water syringe that I had created that day, some thirty years ago, wasn't deep. It was just a few centimetres in the surface, but I started experimenting so that it could help me store water in the ground and ensure that it doesn't become saline," the 67-year-old tells The Better India (TBI).

With the level of groundwater steadily depleting, the high concentration of **salinity** was making it unfit to drink. This spelt doom for a State whose economy depends on agriculture and fisheries. Both the issues were adversely affecting poor farmers who could neither rely on wells for their year-round supply nor afford to purchase water needed for the fields.

The abundant rainfall that is characteristic of God's Own Country was flowing back into the rivers and eventually in the seas without getting utilised by those who needed it the most.

"Fresh water obtained by the rains, if stored well below the sea levels, can be used throughout the year. The Rainwater Syringe System that I developed uses the pressure of the temporarily collected water to seep into the storage tank about 6 metres below the land surface. No machine is required to let it seep into the ground. A motor pump is used only to procure this water," the innovator explains.
The Rainwater Syringe System has its own method to direct the water deep below the earth's surface. The fresh rainwater in the shallow tank can hold up to a 1,000 litres of water. When it fills up, the total pressure pushes the water below. This pressure is so powerful, it can make the water percolate to about 70 feet deep. A specially made motor pump is used to pull this water from that depth. The motor draws the water from below the earth's surface to the overhead tank whenever you need to use it," he explains. The system essentially aims at increasing the groundwater levels.

The pit is fashioned according to the needs of the beneficiary. A family harvesting water will need a small-sized pit, whereas a farm will require a set of about ten deeper systems. However, the design of each pit is relatively the same.

Rainwater syringes have proven their success over the last three decades, but they are the most efficient only at sea levels. So places like Kerala, Andaman and Gujarat benefit from them." Since its finalisation, Antoji's invention has been installed in about 400 places, including private homes, farms and resorts. With a 90 per cent success rate, the Syringes have restored over 300 crore litres of water into Kerala's ground.

Glossary

1. Full throttle – High force
2. Eureka moment – Sudden realisation
3. Salinity - Saltiness

Debrief Questions

1. KJ Antoji has invented a system that can remove the salinity from sea water. True/False?
2. KJ Antoji has invented a system that can harvest rain water. True/False?
3. This system was trying to increase the ground water. True/False?

Answer Key

1. False.
2. True
3. True

Conclusion: There is a severe shortage of usable water on earth and there are several ways to conserve water. Every person can make a difference at home by following measures to reduce wastage. But by studying about the physical and chemical properties of water, there is immense potential in developing new, innovative methods to increase ground water, reduce the impact of floods, harvest rainwater, etc. The are no fixed solutions yet on how to combat this issue. It requires innovations from the current and future generations of people.

Section III –Assessment

Time: 10 minutes

Materials needed: Blackboard and chalk

Facilitation notes:

1. The oxygen from H2O is separated by the fish, which is then used for breathing. True/False?
2. Regions that get high rainfall do not have water scarcity. True/False?
3. All the pollution in water is caused by industries. Households have no role to play in them. True/False?
4. What water conservation techniques can be followed in our day-to day life by households?

Answer key

1. False. It is the oxygen that is dissolved in water that is used by fishes for breathing
2. False.
3. False.

Homework

1. Ask your parents and grandparents about the changes they have noticed in their lifetime about the change in water availability, in forested area and floods. Document the changes as narrated by them and discuss them in class the next day.
2. What are the different meassures of water conservation that you can start in your own house? Maintain a record for the measure and its implementation. Discuss it in class.

Section IV – Closure

Time: 5 minutes

Summary by students

Get a student to summarise using the key words shared with them at the beginning of the class by writing their learning in the 3rd column of the table drawn on page 1. Ask different students to share the points one by one with the whole class.

Recap by a student

Time: 2 minutes

Recap by the teacher

Time: 3 minutes

Please ensure that all the following points are covered in the recap by the teacher and student.

- Aquatic plants and animals breathe the oxygen that is dissolved in water.
- The oxygen that is dissolved in water can reduce due to pollution. The bacteria use the dissolved oxygen for the decomposition process of the garbage in water.
- Water gets polluted by industrial waste, household waste, unplanned cities, plastic waste, etc.
- Ground water can get depleted if rainwater is not conserved. It can be conserved by large number of trees and rain water harvesting.
- There are small everyday changes we all can make in our lifestyle that can ensure conservation of water. There is a limited source of fresh, clean water for use by all plants, animals and humans.

Section V – Additional Resources

Resources for teachers

1. Video: How to make auto turn off switch for water pump
   This video illustrates an experiment to create an auto turn off switch for a water pump using simple materials.
   Link: YouTube

Resources for students

1. Video: Why care about water
   This National Geographic video explains the widening gap in the supply and demand of water
   Link: Video

2. Video: 3 thoughtful ways to conserve water
   This TED talk lists examples of water conservation techniques used by different water poor countries.
   Link: YouTube

Appendix

Case Study 1

Source: Scroll.in

Karivellur Peralam has been reeling from a severe water crisis since March. Nearly all its ponds and wells have dried up. Such is the scarcity that even the tanker, run by the gram panchayat, can only provide 150 litres of water per household once in three days. The crisis in Karivellur Peralam is particularly severe, but all 14 of Kerala's districts, save for Wayanad and Pathanamthitta, are facing acute drinking water shortage, just eight months after the state witnessed the worst floods in a century last August.

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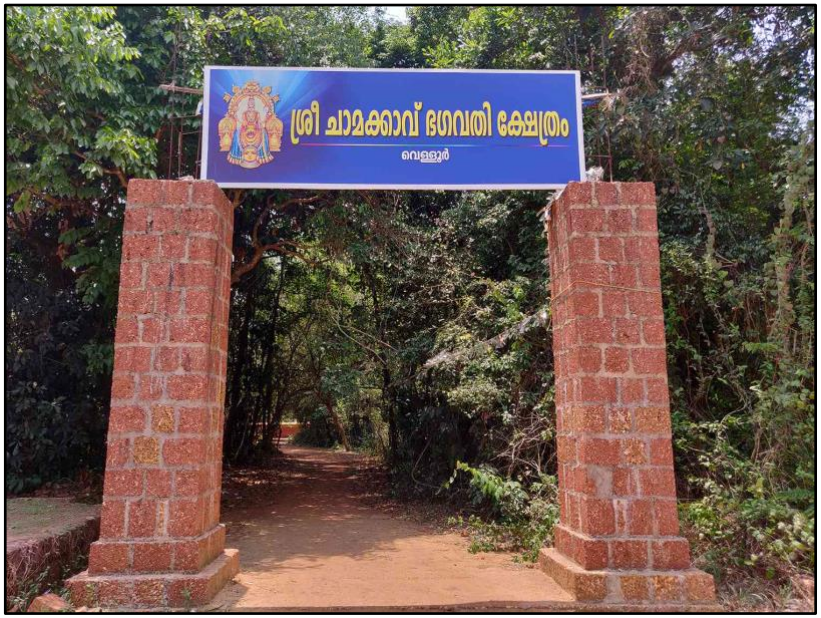

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Source: https://www.thebetterindia.com/184426/kerala-rainwater-harvesting-syringe-innovation-water-conservation-india/amp/

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