UNIT 3: HOW SAFE IS OUR DRINKING WATER?

Grade Level: Upper Primary/Lower Secondary

Introduction:

We can never be sure whether the water that we drink is safe. People depend on the tap or wells for the water which they use for drinking, bathing, and other household needs. Even with bottled water, microorganisms have been found to exist. In many countries bottled water is very expensive.

Drinking unclean water can cause illness. In countries like Pakistan, children are often admitted to hospitals suffering from typhoid, diarrhoea, cholera and other ailments identified with contaminated water supplies.

Some causes of water pollution are bathing, washing, household garbage and harmful microorganisms.

Educational Objectives:

This script includes the following learning objectives:

1. Deciding on the suitability of water for drinking.
2. Detailing procedures for making drinking water safe to drink.
3. Communicating orally.
4. Cooperating as a member of a group.
5. Identifying microorganisms viewed through a microscope.

Scientific Concepts:

- Pathogenic or disease-causing microorganisms are generally present in polluted water bodies.
- Communities have set standards of quality for drinking water.
- Water can be made safe to drink at minimum cost by boiling.

- Water can also be purified by solar distillation and the addition of chemicals.
- Purification methods for water depend on its intended use.

Previous knowledge assumed:

1. Know how to use a microscope.
2. Awareness of methods for removing harmful microorganisms.

This unit is closely linked to *Unit 11: Why is the river dying? Helping living things to survive in a stream.*

Teaching/Learning Materials needed:

1. Two containers for collecting water samples.
2. Spirit lamp.
3. Chart of living organism.
4. Diagrams of microorganisms.
5. Information on expected minimum water standards.
6. Diagram of a solar still.

Student's Guide

Scenario

Cleverpupi, a village of 500 inhabitants, is on the banks of a dirty river. It is a poor village and the houses are made of mud with no water supply. All water for washing and other household needs comes from the river. A few weeks ago a number of villagers, especially children, became sick and the regional health worker was called in. Most of the victims suffered from severe dehydration, caused by diarrhoea. A few cases of dysentery were also diagnosed. The village headman decided that some action needed to be taken to improve the water supply. He asked the students in the local school to help.

Your Task

Working in groups of 3 to 4 members, undertake the following experiments:

Undertake the following experiments:

1. Collect samples of drinking water for different locations (sources of water will differ).

2. Place a drop of water taken from the collected drinking water on a microscope slide.

3. Determine whether microorganisms are present by viewing the water drop under the microscope.

4. Draw any microorganisms you see.

5. Compare your illustrations of microorganisms present in water with illustrations of microorganisms commonly present in water.

6. Determine whether the water meets standard requirements.

7. Discuss different ways of making your water safe to drink and how this may be carried out.

8. Devise experiments to show different ways of making water safe for drinking, cooking, washing, etc. In each case indicate the time involved for obtaining safe water.

Teacher's Guide

This activity relates to

a) identifying micro-organisms
b) knowing safety standards and how to make water safe to drink
c) being able to actually make the water safe for use.

Teaching Strategy

1. Students are asked to collect water sample from different sources. To introduce the lesson, a discussion can begin on the possible causes of the illness to the villagers. After the students have identified water as a possible carrier, the teacher can ask students to examine water samples under a microscope and determine whether microorganisms are present in the water.

2. The initial part of the lesson depends on the availability of microscopes. These may need to be borrowed from another school or local industry. The teacher will need to devise ways of allowing the student groups to share the use of the microscope(s). But it is important that the students make the slides for viewing themselves from their own collected water, and not the teacher. The teacher can assist by adjusting the microscope for best viewing and then allowing all groups to see. If much enthusiasm is generated among the students in the use of the microscope, additional viewing time may be needed after the lesson (after school, etc.)

   Without using a microscope, you can get an idea of the purity of water by dabbing a sample on a clean agar jelly plate. The agar plate can be taped to a volunteer's body so that the microorganisms can be incubated by body heat. Learners can then observe the amount of growth stimulated by the sample.

For surface water, the healthy presence of certain larger creatures like fish, frogs, and insects are indirect indicators of the cleanness of the water.

3. The teacher will need illustrations of microorganisms so that students can compare their drawings with those supplied by the teacher and hence, identify the microorganisms. The teacher will also need data on water standards. This will involve chemical tests and insofar as apparatus is possible, students can also conduct these tests on their samples e.g. pH. Students can also boil their sample to dryness to see if any sediments are present.

4. The results of the students investigations will allow students to discuss ways of keeping water safe for drinking. The discussion on making the water safe for drinking is mainly concerned with the removal of microorganisms. Besides boiling, the standard suggestion, but one that needs a source of heat, students can be encouraged to consider solar distillation and the addition of chemicals (sterilizing tablets). The storage of purified water should be considered carefully also.

5. The students should be encouraged to follow up their discussions and devise practical ways to purify the water with respect to its use for drinking, cooking, washing, etc. Once the plan is approved by the teacher, students should actually carry out their planned investigation. From this, skills involved in scientific method can be taught as well as ending up with practical knowledge useful to the village. The importance of being able to reproduce the experimental results can also be stressed.

6. For example, students can investigate the length of time water should be boiled to kill all microorganisms. The plan could specify that samples of water be boiled for 1 minute, 2 minutes, 5 minutes and 10 minutes. The water from these tests is then checked for the presence of living micro-organisms by viewing through the microscope. The need for

controls would be important e.g. the same original water is used in each sample and the same or similar equipment is used for the experiment.

Achieving the objectives

Objective	This is achieved by
1. Deciding on the suitability of water for drinking.	comparing the results of the experiments with standards set up by the community.
2. Detailing procedures for making drinking water safe to drink.	devising experiments that show different ways of making water safe for drinking.
3. Communicating orally.	discussing within the group.
4. Cooperating as a member of a group.	sharing tasks and reaching consensus on issues within the group.
5. Identifying micro-organisms viewed through a microscope.	undertaking the experimental work and recording the identifications made.

1. Determine whether microorganisms are present in drinking water by viewing water drops under a microscope. Draw any microorganism you may see.

2. Compare your illustration of microorganisms present in water with illustrations of microorganisms commonly present in water.

Assessment:

Formative Assessment Strategies

A. Not able to make a decision on the suitability of the water from the information made available.

B. Able to make a decision on the suitability of the water even though information available may not be sufficiently complete. Able to make reasonable assumptions in arriving at a decision.

C. Able to make a decision on the water supply and to the relative seriousness of any current or future pollution problems. Can suggest how the pollution can be minimized.

Able to give a Science Method grade (objective 2)

A. Not usually able to devise experiments to show how water can be made safe. If able to put forward suggestions such as boiling the water, is not able to suggest the time needed, nor how this can be determined.

B. Able to put forward suggestions for experiments that can make the water safe and be able to specify apparatus, etc. that can be used to carry out the experiments.

C. Able to put forward experiments and the necessary parameters or variables that must be controlled in undertaking the experiments.

Able to give a Personal Skills grade (objectives 3 and 4)

A. Not able to put forward suggestions or communicate in the discussions. Does not participate effectively in the experimental work.

B. Willing to put forward suggestions and cooperate in the discussions in the experimental work.

C. Able to guide the group towards a consensus opinion and in carrying out the experimental work efficiently and effectively.

Able to give a Science Concept grade (objective 5)

A. Not able to relate organisms present in the water with the level of pollution. Does not appreciate the value of the experimental tests.

B. Able to identify organisms present in the water. Able to identify the level of pollution by investigating the organisms present in the water.

C. Able to identify the level of pollution and to explain how the solar still can reduce this. Able to understand the likely causes of the pollution.

Summative Assessment Strategies

Able to give a Science Method grade (objective 2)

A. Experiments not devised nor recorded.

B. Experiments devised to show different ways of making water safe are recorded.

C. Record of the experiments devised to show how water can be made safe exhibit a clear appreciation of the need to control variables.