

## **UNIT 7: IMPROVING THE CONSTRUCTION OF UBONRAT DAM**

<b>Grade Level:</b>	11 or 12 <sup>th</sup> Grade
<b>Time Required:</b>	100 minutes (2 periods)
<b>Lesson:</b>	Environmental Study as an application of Physics

### **Introduction:**

In this exercise, student's consider the problem of modifying the construction of a dam to supply water to the local community. The teaching strategy used is a **role play**, taking into considerations the views of *engineer, environmentalist, farmer, tourist board member and local government official*. A decision will be made on actions to be taken after the different parties have analyzed the local situation.

### **Educational Objectives:**

This script includes the following learning objectives:

1. Making a decision about a daily life situation concerning irrigation needs of farmers
2. Justifying the decision made about the dam
3. Identifying scientific factors involved in modifying a dam
4. Cooperating as a member of a group
5. Communicating through a role play activity
6. Show an understanding of water pressure and how to calculate water pressure changes with depth.

**Scientific Concepts:**

A dam functions as a water reserve.

A dam could sustain a certain amount of water pressure.

**Previous Knowledge Assumed:**

The meaning of water pressure and the ability to undertake calculation related to the pressure of water.

**Teaching/Learning Materials needed:**

1. has to be identified at the Ubonrat Dam area.
2. Video, poster, ... etc.

## **Student's Guide**

### ***Scenario***

The Ubonrat dam does not keep enough water during the rainy season. As a result, there is insufficient water during the dry months – not only for home use, but for the irrigation of crops. Farming, the mainstay of the local economy, is being seriously undermined by the lack of water. Farmers are putting pressure on the government to modify the dam to allow it to hold more water. But more water behind the dam means more pressure on the dam walls. The dam would need to be strengthened. And more water behind the dam means flooding a greater area. This land is home to a range of flora and fauna. It is a favourite area for tourists who visit during the summer. Should the dam be modified to trap more water, or should no action be taken and the irrigation needs come from another (far more expensive) source?

### ***The original dam***

The main purpose of holding water by building a dam is to keep a reserve of water for the nearby community. The Ubonrat Dam was built about 30 years ago when the population in City Ubonrat was around 2,000. Now the population has increased to more than 6,000 and there is an urgent need to look for a larger amount of water supply. However, Ubonrat Dam is of the type \_\_\_\_\_ which could only hold water up to a maximum capacity of 1,000,000 cubic meters in its present dimension. This means that it could only sustain a maximum pressure of  $10,000 \text{ Nm}^{-2}$  which is equivalent to a maximum depth of 30 meters water.

### ***Your Tasks***

1. Discuss the problem related to Ubonrat dam in groups of 5 students.
2. Taking part in a role playing exercise in which you play the role of one expert to try to make a decision on the Ubonrat dam problem.

Five groups of personnel are identified for participating in the role playing exercise: Engineers, Environmentalists, Farmers, Local Government officials, Tourist board member  
– Worksheet 1.

3. Reach a decision within your group and prepare one member of the group to give a short presentation to the rest of the class to try to convince them that your decision is the most appropriate.
4. Participate in a whole class discussion to determine the whole class decision on the issue.
5. Record the class decision made, the arguments in its favour and then suggest how best to proceed to tackle the problem. In making this suggestion be specific as to which personnel should undertake what tasks and in which sequence.

## **Teacher's Guide**

This activity relates to:

- a) recognizing the conflicting factors involved in a sustainable development problem
- b) trying to make a decision by balancing developmental factors against environmental concerns
- c) a familiarization with water pressure.

### ***Teaching Strategy***

1. The students are asked to discuss the problem in groups. This is to ensure the students appreciate the problem and realize there is no simple solution.
2. Once the problem is understood, each group engages in a role playing exercise. The five members of the group each take on a different role and try to put forward that point of view during a discussion session. (If a chairman is required, and is the person who starts the discussion and keeps it going, this is the local government official.) Worksheet 1.
3. After all points have been discussed and no new factors are being brought up, the group takes a vote. The local government official from each group then present the decision of their group to the rest of the class.
4. After the presentation, a whole class discussion takes place so that each student can clarify their position as an individual (no longer taking on a role). A class vote is taken as to whether the dam should be modified, a new dam built or no action is taken.
5. Each student is then invited to write a report on the class decision to the local Government, justifying the decision put forward and ensuring details of pressure calculations put forward by the engineer are included.

## **Student's Handout**

The responsibility of the various persons represented in the role playing exercise.

### **A. The Engineer**

The engineer is the expert on dam construction. The engineer is interested in ensuring modifications to the dam are sound and feasible. If not, the engineer will advise on a new dam. Modifications to the dam relate to pressure of water on the sloping wall of the dam and how much this thickness would need to be increased. (It would also relate to how well the added section of the wall can be made to bind with the existing wall, but this aspect is not considered at this time).

### **B. The Environmentalist**

The environmentalist is concerned with the effect of building dams on the environment and to the life of the people in the community. The environmentalist is interested to see there is minimal influence on the flora and fauna and that the aesthetics of the region is not destroyed.

### **C. Farmers**

The farmers are the ones who will directly benefit by changes to the dam. They are interested in a lasting solution to their water problems at a cost that is reasonable. The farmers are pushing strongly for modifications to the dam to be undertaken as soon as possible.

### **D. Tourist Board Member**

The tourist board is interested in attracting visitors to the region and promoting the country. They would be concerned if a modification to the dam would seriously affect the tourist industry in the region.

## Achieving the Objectives

Objective	This is achieved by
1. Making a decision about a daily life situation concerning irrigation needs of farmers.	participating in the role playing activity.
2. Justifying the decision made concerning irrigation needs of farmers.	recording, in writing, the class decision and including the arguments in favour of this decision.
3. Cooperating as a member of a group.	more than one student cooperating to play a given role.
4. Communicate through a role play activity and in written format.	<p>role playing by students either take part directly or by taking part in the decision to be made following the role playing exercise.</p> <p>The written communication is achieved by all students writing the class decision and putting forward the arguments in its favour.</p>
5. Showing an understanding of pressure and the ability to calculate pressure.	being able to perform the necessary calculations to determine whether changes with depth of water the dam is suitable.

### **Assessment:**

There are 3 main tasks that students are involved in the unit:

1. Identifying problems and issues related to the reconstruction of Ubonrat Dam.
2. Communicating ideas as how reconstruction of Ubonrat Dam should be conducted through role-play in class, and
3. Making decision as how reconstruction of Ubonrat Dam should be conducted.

### *Formative Assessment Strategies*

Able to give a Social Values grade (objectives 1 and 2)

- A. Not able to put forward a decision on how reconstruction of Ubonrat Dam should be conducted. Able to put forward a decision but without a rationale.
- B. Able to put forward a decision on how reconstruction of Ubonrat Dam should be conducted by making use of arguments from one specific role only.
- C. Able to put forward a decision on how reconstruction of Ubonrat Dam should be conducted by making use of arguments from more than one role. Able to change one decision already made upon listening to the view of others.

Able to give a Science Method grade (objective 3)

- A. Not able to identify problems and issues related to the reconstruction of the Ubonrat Dam.
- B. Able to identify major problems and issues related to the reconstruction of the Ubonrat Dam.
- C. Identifies major problems and issues related to the reconstruction of the Ubonrat Dam and is able to put these problems and issues into perspective in terms of an order of importance.

Able to give a Personal Skills grade (objectives 4 and 5)

- A. Able to present ideas but without a sound rationale.
- B. Able to present ideas from one specific perspective with supporting rationale.
- C. Able to present ideas from one specific perspective with supporting rationale and modify views after taking other's positions.

Able to give a Science Concept grade (objective 6)

- A. Not able to explain water pressure nor calculate changes in water pressure in the dam.
- B. Able to undertake all calculations related to pressure changes of water with depth.
- C. Able to appreciate the advantages of a sloping dam wall and the impact this has on the pressure differential with depth of water.

### *Summative Assessment Strategies*

Able to give a Social Values grade (objectives 1 and 2)

- A. Not able to put forward a decision on how reconstruction of Ubonrat Dam should be conducted. Able to put forward a decision but without a rationale.
- B. Able to put forward a decision on how reconstruction of Ubonrat Dam should be conducted by making use of argument from one specific role only.
- C. Able to put forward a decision on how reconstruction of Ubonrat Dam should be conducted by making use of argument from more than one role. Able to change one decision already made upon listening to the views of others.

Able to give a Science Concept grade (objective 6)

- A. Not able to explain pressure nor calculate changes in pressure in the dam.
- B. Able to undertake all calculations related to pressure changes of water with depth.
- C. Able to appreciate the advantages of a sloping dam wall and the impact this has on the pressure differential with depth of water.