
Hitler's Sunken Secret

PROGRAM OVERVIEW

NOVA follows a team of underwater archeologists to the bottom Lake Tinn in Norway to locate and determine the historically significant contents of a ferry sabotaged in World War II.



The program:

- reviews the project's mission to bring up a barrel from the lake bottom and test its contents.
- notes that at the time of the ferry's sinking, Allied forces believed that the barrel's supposed contents—heavy water—were key to German attempts to build a nuclear bomb.
- relates that since World War II, secret documents have come to light casting doubt on whether the sabotage was necessary.
- shows scientists using a remotely operated vehicle to locate the ferry.
- summarizes the history of the Norsk factory that created heavy water as a by-product of its ammonia fertilizer production.
- conveys how physicists began to understand the importance of heavy water in the creation of a nuclear bomb.
- relates how the Allies teamed up with members of the Norwegian Resistance to destroy the Norsk factory.
- presents the three attempts to sabotage the factory.
- reports how Allied forces decided to sink the *Hydro* ferry that they believed contained a half-ton shipment of heavy water.
- recounts how the ferry was sabotaged on February 20, 1944, a sinking that resulted in the deaths of 14 Norwegian civilians and four German guards.
- reviews documents found after World War II that called into question whether the downed ferry was actually carrying heavy water.
- details the raising of a barrel from the lake depths and the subsequent testing of its contents.
- revisits the mission with one of the men involved in the sabotage and some survivors of the sinking.

BEFORE WATCHING

- 1 Review what heavy water is with students and why, during World War II, Allied forces were worried about the Germans stockpiling the substance (see Background on page 2).
- 2 As students watch, have them collect information using the viewing guide provided in the “Heavy Water Goes Down” activity on page 2 (see activity for instructions).

AFTER WATCHING

- 1 Historians are still trying to decide if the sinking of the *Hydro* was strategically important. At the end of the program, the archeologists discussed whether they would have had the courage to carry out the order to sink the ferry with civilians on board. As a class, generate a list of reasons supporting and disputing the decision to sink the ferry. Ask students which position they would support and why.
- 2 Lead a discussion about ethics and making difficult decisions. Ask students about difficult decisions they have had to make in their own lives. Consider the pros and cons of the decisions. Who are some people students talked with before making the decision?

Taping Rights: Can be used up to one year after the program is taped off the air.

CLASSROOM ACTIVITY

Activity Summary

Students will use a viewing guide while watching a program about Nazi Germany's production of heavy water during World War II, and discuss answers to their questions after watching.

Materials for Each Team

- copy of the “Heavy Water Goes Down” student handout

Background

In 1940, the Germans captured Norway and took possession of the Norsk Hydro plant in Vemork. The Germans were interested in the plant because it could be used to manufacture heavy water. Although chemically like H_2O , the hydrogen atoms in heavy water are made of the heavy isotope deuterium (heavy water is also known as deuterium oxide, D_2O). The nuclei in each heavy water molecule contain a neutron in addition to the proton normally found in hydrogen. At Vemork, heavy water was produced through electrolysis, a process in which an electric current is conducted through an ion-containing solution.

Allied forces feared that the heavy water, which can help moderate a nuclear reaction, was a part of Germany's atomic weapons program. Norwegian Resistance workers at the Hydro factory provided the Allies with information about the plant. The Allies joined with members of the Norwegian Resistance to plan and execute three attacks on the plant prior to bombing the ferry believed to be transporting barrels of heavy water.

At the time of the *Hydro*'s sinking, the sabotage was considered a success. However, some evidence suggests that the Germans may have planted barrels on the ferry that did not contain heavy water, and that the actual barrels with heavy water were shipped out of Norway to Germany at a later date.

LEARNING OBJECTIVES

Students will be able to:

- relate the history and significance of the *Hydro*'s sinking.
- note how recent documents have raised questions about the decision to sink the ferry.

STANDARDS CONNECTIONS

The “Heavy Water Goes Down” activity aligns with the following National Science Education Standards (see books.nap.edu/html/nses).

GRADES 5–8

Science Standard F

Science in Personal and Social Perspectives

Science and technology in society

GRADES 9–12

Science Standard F

Science in Personal and Social Perspectives

Science and technology in local, national, and global challenges

*Video is required
for this activity.*

Classroom Activity Author

Developed by WGBH Educational Outreach staff.

CLASSROOM ACTIVITY (CONT.)

Procedure

- 1 Organize students into five teams. Assign each team a set of four questions. The questions generally follow the sequence of the film. You can assign the questions in their current sequence, allocate them by themes, or choose a mix of simple and more complicated questions for each team.
- 2 Distribute a copy of the student handout to each team before viewing. Discuss appropriate background information with students.
- 3 Show the program and have students individually take notes on the questions their team has been assigned.
- 4 After watching the program, have students meet in their teams to discuss their notes. Beginning with the first question assigned, ask teams to come to consensus on an answer. The team response should be written down as the answer to each question. Continue until all questions are answered.
- 5 Have teams share the questions and answers that came out of their team work. (*See Activity Answer on page 4 for possible answers. Accept all reasonable answers.*) Ask students in the rest of the class if they agree with what the team has presented. If students don't agree, ask them to explain why and provide evidence from the program that will support their opinions. When possible, expand upon a question or provide additional historical background for students.
- 6 To conclude, discuss with students how the decisions were made to halt Germany's production of heavy water. What evidence was each decision based upon? How did time play a factor in the decisions? Do students think the Allied forces and Resistance fighters did or did not have enough information to base their decision on? Have students support the positions they choose.
- 7 As an extension, have students generate questions they have about World War II. Group together students who have related questions. Have teams research and answer their own questions and present their findings to the class.

ACTIVITY ANSWER

Suggested answers to the questions listed on the student handout:

- 1 Why were the Germans interested in heavy water? **they wanted to build a nuclear bomb and heavy water is a key ingredient**
- 2 What was the name of the ferry used to transport passengers and (purportedly) heavy water? **the *Hydro*** How many people died when the ferry went down, and who were they? **14 civilians, and 4 German soldiers**
- 3 Why were historians interested in finding out what was on the *Hydro*? **to discover whether heavy water was actually onboard the ferry**
- 4 Why was the Norsk Hydro plant built in the remote Rjukan Valley? **the plant was situated near a large waterfall that could provide hydroelectric power**
- 5 What was originally made at the Vemork factory? **fertilizer** How was it made? **hydrogen was extracted from water by electrolysis and then reacted with nitrogen in the air to make ammonia**
- 6 What by-product was created at the plant? **heavy water**
- 7 What did physicists come to realize about heavy water? **that it could play an important role in the creation of a nuclear bomb**
- 8 How much water does it take to make 1 kilogram of heavy water? **50 tons**
- 9 Once the Allies understood how heavy water could be used, what action did they take? **they teamed up with members of the Norwegian Resistance to try to destroy the Norsk plant**
- 10 How did the Allies attempt to destroy the plant? What were the results of their efforts? **the first attempt failed when weather prevented sending in 30 men by gliders; the second attempt was partially successful in bombing the heavy water production facility; and the third attempt succeeded in bombing the factory but not the heavy water plant**
- 11 What did the Germans do to make even more heavy water? **they used high-concentration cells and doubled the production apparatus**
- 12 What did the Allies and Resistance learn about the shipment of heavy water? **barrels of heavy water were to be transported to Germany by train and then by ferry; rail cars would board a ferry named *Hydro***
- 13 What was the ethical dilemma related to sinking the *Hydro*? **civilians would be at risk**
- 14 Describe the operation that sank the *Hydro*. **a team of saboteurs placed a bomb at the bottom of the ferry; 10 minutes after schedule, the ferry left the dock; 30 to 40 minutes later the bomb exploded and sank the boat**

ACTIVITY ANSWER (CONT.)

- 15 Why was it important to locate the *Hydro* and examine the contents of the heavy water barrels? **some historians did not believe the operation achieved its main objective, destroying German's supply of heavy water**
- 16 How would the investigators be able to tell if the barrel had lake water or heavy water in it? **they would check the pH of the water—heavy water has a much higher pH (about 14.0) than lake water (about 9.0)**
- 17 Why did the investigators have to slowly maneuver the barrel as they lifted it from the water? **the barrel could have exploded and released caustic potassium hydroxide-laden heavy water**
- 18 How did investigators know what percentage of heavy water the barrel was supposed to contain? **the manifest showed that the barrel they were testing was 1.5 percent enriched**
- 19 What were the results of the testing? **the pH of the barrel water was more than 14.0**
- 20 How did one of the saboteurs feel about the bombing when asked about it 60 years later? **he said he didn't react to the bombing, but just swallowed what he had done; he noted he slept just as well at night as he had before the sabotage**

LINKS AND BOOKS

Links

NOVA—Hitler's Sunken Secret

www.pbs.org/nova/hydro

Read a book excerpt about the Norsk Hydro plant bombing raid, learn how near the Nazis were to developing a nuclear weapon, examine spy messages regarding the Hydro ferry bombing, and discover how heavy water can be used to turn relatively common uranium into weapons-grade plutonium.

Physics 2000: Isotopes

www.colorado.edu/physics/2000/isotopes

Offers a tutorial on atoms and isotopes.

Sinking Hitler's Bomb

www.kidscastle.si.edu/admin/channels/history/articles/historyarticle18.html

Retells the story of the sinking of the Hydro.

Books

Assault in Norway: Sabotaging the Nazi Nuclear Bomb

by Thomas M. Gallagher.

Harcourt Brace Jovanovich, 1975.

Recounts operations that destroyed a heavy water plant in Norway and a large shipment of heavy water on the way to Germany.

Heavy Water and the Wartime Race for Nuclear Energy

by Per F. Dahl. The Institute of Physics, 1999.

Reviews the scientific role that heavy water played in the wartime efforts and chronicles the air attacks on the Norwegian plant making heavy water.

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Google



HHMI



Heavy Water Goes Down

During World War II, Germany was making heavy water at a plant in a remote region of Norway, which Allied forces feared was going to be used for a nuclear bomb. In this activity, you will find out more about the mission to destroy German stores of heavy water.

Procedure

- 1 Read your question set. As you watch the video, take notes on the questions you have been assigned.
- 2 After watching the program, meet with your team members who have been assigned the same questions. Together, come up with an answer you all agree on for each question. Write these answers down on a new sheet of paper. Work with your team members to answer all your assigned questions.
- 3 Work together as a team to divide the questions so that each team member is assigned at least one question to present to the class.
- 4 Share answers to your team's questions with the class.



Questions

- 1 Why were the Germans interested in heavy water?
- 2 What was the name of the ferry used to transport passengers and heavy water? How many people died when the ferry went down, and who were they?
- 3 Why were historians interested in finding out what was on the *Hydro*?
- 4 Why was the Norsk Hydro plant built in the remote Rjukan Valley?
- 5 What was originally made at the Vemork factory? How was it made?
- 6 What by-product was created at the plant?
- 7 What did physicists come to realize about heavy water?
- 8 How much water does it take to make 1 kilogram of heavy water?
- 9 Once the Allies understood how heavy water could be used, what action did they take?
- 10 How did the Allies attempt to destroy the plant? What were the results of their efforts?
- 11 What did the Germans do to make even more heavy water?
- 12 What did the Allies and Resistance learn about the shipment of heavy water?
- 13 What was the ethical dilemma related to sinking the *Hydro*?
- 14 Describe the operation that sank the *Hydro*.
- 15 Why was it important to locate the *Hydro* and examine the contents of the heavy water barrels?
- 16 How would the investigators be able to tell if the barrel had lake water or heavy water in it?
- 17 Why did the investigators have to slowly maneuver the barrel as they lifted it from the water?
- 18 How did investigators know what percentage of heavy water the barrel was supposed to contain?
- 19 What were the results of the testing?
- 20 How did one of the saboteurs feel about the bombing when asked about it 60 years later?