

Digging Deeper: Uranium Mining

What are the advantages and disadvantages of various methods of uranium mining?



overview

LESSON CONTEXT

Uranium's most useful property is that its nuclear structure can be changed in a process that releases large amounts of energy in the form of heat. Inside Canada's nuclear power plants, this heat is harnessed to generate electricity. However, before uranium can be used in a power plant, it must first be located, extracted and refined.

LEARNING GOALS

- Investigate various methods of uranium mining in order to understand each method and its associated advantages and disadvantages.
- Draw conclusions based on observations and justify conclusions.
- Acquire science knowledge and skills using a variety of resources and methods.

LEARNING ACTIVITIES

In this lesson, students will participate in a hands-on investigation to explore various mining techniques and assess the advantages and disadvantages of each.

BIG IDEAS

Each method of uranium mining involves associated advantages and disadvantages which need to be considered for a given mining operation.

assessment & evaluation

PRIOR KNOWLEDGE AND SKILLS

- Awareness of uranium as a mineral resource
- Familiarity with different methods of exploring for mineral resources
- Experience working in cooperative small groups

SUCCESS CRITERIA

- Students successfully match mining words and definitions
- Students apply knowledge of mining methods in a simulated mining activity

ASSESSMENT STRATEGIES

- Review of **Mining Methods Comparison Chart BLM**
- Observation and anecdotal records during student investigation



time

60-75
MINUTES



subjects






SCIENCE
ENVIRONMENTAL SCIENCE
EARTH SCIENCE



skills

COLLABORATION
CREATIVITY

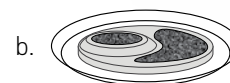
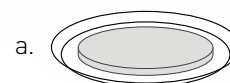
resources & materials required

-   **BLM – Mining Methods Comparison Chart** – one per student
-   **BLM – Uranium Mining Matching Cards** – one set for each group of eight students
-  Curriculum alignment

- Plasticine – half block per group
- Sand – quarter cup per group
- Narrow, transparent drinking straws – several per group
- Thick drinking straws – several per group
- Flat toothpicks – several per group
- Plastic plates – one per group
- Plastic knives – several per group
- Plastic spoons – several per group
- Plastic eyedropper or pipette – one per group
- Water

preparation

- For the **Uranium Mining Matching Cards BLM**, photocopy as many pages as you have groups of eight students. Cut along the solid and dashed lines to form cards containing either a word or a definition. Mix the cards up before distributing to students.
- Prepare each group's mining location as follows:
 - a. On a plastic plate, spread about half of the plasticine in an oval shape.
 - b. Spread a thin layer of sand over half of the oval. Make a ring of plasticine on the other half of the oval. Fill the ring of plasticine with sand.
 - c. Spread the remaining plasticine over everything and press down firmly to remove any air pockets from around the sand.



IMPLEMENTATION OPTIONS

- You can substitute the sand for rock salt, pepper, pony beads, etc.
- You could add layers of different colours of plasticine to represent different rock layers.

minds-on

 15 MINUTES

- Explain to the students that this lesson is about uranium mining. As an introduction, the students will play a matching game. Provide each student with one of the **Uranium Mining Matching Cards** that were prepared in advance. Next, have each student find the person with the card that goes with his/her card (word that matches the definition).
- Once each student has found the person with the card that correctly matches his/her card, have each pair of students sit together. Review the results to ensure that all groups have their words and definitions correctly paired up.

action

 30 MINUTES

- For this part, students will be working in small groups. Each group will get a prepared plasticine mining location and a variety of tools (straws, toothpicks, knives, eyedropper, etc.).
- Explain to the groups that they will be simulating mining 'uranium ore' to learn about the different mining methods they discussed in the MINDS-ON activity. They will recall that sometimes the uranium is close to the surface of the earth and sometimes it is deep below the surface. Show one of the plasticine mining locations and explain that there are deposits of uranium represented by sand hidden within the rock represented by plasticine.
- The students' first task, before mining, will be to prospect the mining area. Brainstorm with the students the methods that people use for locating uranium (e.g. geological surveys, GPS/satellite imaging, core sampling, radiation detectors, etc.). In the case of the sand and plasticine, students will be using the clear drinking straws to do "core sampling." Review or explain the types of information core sampling can provide (presence of uranium, how far down it is, how deep the vein is). Each student can take a core sample from the mining area to help the group determine where the uranium is in their sample.
TIP: For best results, students should twist the straw as they insert it into the plasticine.
- Once uranium is found, the group can work on extracting (mining) it. Each group should try at least two of the different mining methods from the MINDS-ON activity and, time permitting, they could try additional methods. Look for evidence of students practicing the various methods, which could look like the following:
 - a. Open-pit Mining: scoop out a hole using the plastic spoon to recover sand from the large deposit.
 - b. Strip Mining: drag the knife along the surface of the plasticine to uncover the thin layer of sand below.
 - c. Underground Mining: use a thick drinking straw to create a shaft or an adit then scoop out the sand with a toothpick.
 - d. In-situ Mining: use a thick drinking straw to create a shaft, use the eye dropper to drop water into the hole, and then suck up a mixture of sand and water.
- The goal of the mining experience is to extract the most uranium and remove the least rock (smallest environmental impact).
- Provide each student with a copy of **Mining Methods Comparison Chart BLM**. On it they can record their observations when they try the different methods, as well as describe what they perceive to be advantages and disadvantages of each method (e.g. ground subsidence, human health issues, disturbance of topography/viewscape, loss of habitat, pollution [noise, dust, water], erosion).



DID YOU KNOW?

Canada has been a major world producer of uranium since the global demand for this material developed. Today, the only producing area is northern Saskatchewan, although other areas have been active in the past. Canada is the world's leading exporter of uranium and hosts three of the top ten producing mines in the world.

IMPLEMENTATION OPTIONS

- You may want to move around the room and take digital photographs or video of the mines that could be viewed and discussed by the students.

consolidation

🕒 15 MINUTES

- Bring all of the groups together to share their experiences and observations.
- Questions for discussion could include:
 - » *What did you find were the greatest challenges in mining the uranium?*
 - » *Which types of mines required you to remove the most rock? Why?*
 - » *Which types of mines disrupt the greatest surface area?*
 - » *What might be some of the challenges with subsurface mines (e.g. safety, structural stability, etc.)?*
 - » *What environmental impacts would the various forms of mining have?*
 - » *How could people address these impacts?*



DID YOU KNOW?

- Canadian uranium production comes mainly from the McArthur River mine in northern Saskatchewan, which is the largest uranium mine in the world.

additional resources

CANADIAN NUCLEAR ASSOCIATION WEB PAGES

- [Uranium mining](#)
- [Uranium processing](#)

RELATED TEACHNUCLEAR LESSON PLANS

- [The Atomic Age in Canada](#)
- [It's All Greek to Me: Radioactive Decay](#)

background information

[Retrieved August 2019]

- **Mining & Milling – Uranium 101, Cameco**

The Cameco website has extensive information about uranium mining and milling, including what is involved in establishing and decommissioning mines.

- **Education Outreach – Saskatchewan Mining Association**

This free series of interactive lesson plans on mining and energy was developed by teachers and geoscientists to complement resources provided by the Saskatchewan Ministry of Education. The multidisciplinary lesson plans span across the sciences, math, social studies, chemistry and career education.

- **Uranium mines and mills – Canadian Nuclear Safety Commission, Government of Canada**

Information from the CNSC about how uranium mines and mills are regulated and licensed in Canada and a listing of operating and proposed uranium mines.

- **New Uranium Mining Projects: Canada – WISE Uranium Project**

A list of companies undertaking uranium exploration, existing mining projects and news stories related to uranium mining organized by province and territory.

- **Uranium Mining and Milling – WISE Uranium Project**

Includes links to information about current issues, the industry, impact of mining, tailings management and other related topics.

- **3d animation uranium mining – dailymotion**

An animation (4 min. 26 sec.) explaining the processes of in-situ uranium mining.

- **Uranium in Canada – World Nuclear Association**

Extensive information about uranium production in Canada, including a map showing locations of mines, production figures, planned mines and future exploration.

- **How Uranium Mining Works – HowStuffWorks**

The uranium mining process is charted tracking the element as it transitions from ore to fuel pellets ready to be used by nuclear reactors.