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Crisis in Japan: Understanding Nuclear Energy and Reactors

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Overview | What is the extent of the nuclear crisis in Japan following the wake of the tsunami and earthquake? What is nuclear power, and how do nuclear power plants work? What are the benefits and risks associated with nuclear power? In this lesson, students learn about the nuclear crisis in Japan, then research nuclear energy to prepare informative news bulletins.

Materials | Computers with Internet access, projection equipment, research materials about nuclear power

Warm-Up | Show the Times video “Japanese Nuclear Plant in Jeopardy”:

As students watch the video, have them jot down terms or concepts they hear that they do not understand or know how to define. Afterward, ask for volunteers to summarize what the video was about, and list terms with which students were unfamiliar, or have only a partial understanding of, on the board.

Point out that the video makes a reference to how the power plant was designed in part to minimize the risk of a worst-case scenario, in which the fuel heats uncontrollably, causing a massive radiation leak. Tell the class they will take a closer look at the inner workings of the plant and the safety features it has in place.

Next, project the Times multimedia feature “[How a Reactor Shuts Down and What Happens in a Meltdown.](#)” View the images as a class, asking for volunteers to take turns reading the captions aloud. As students view the images, have them write down three facts and three questions they have about the nuclear reactors at Fukushima Daiichi in their journals.

Next, have students share what they learned, and record their remaining questions on the board. Explain that you will return to the lists of terms and questions later in class.

Finally, ask students what else they have heard about the nuclear situation in Japan. Jot down student ideas on the board, then explain they will read an article that reports on the status of Japan’s Fukushima Daiishi power plant.

Please note that the New York Times article featured here is about a continuing situation and that when you teach this lesson, there may well be a better, more up-to-date article choice. As is the nature of breaking news, portions of this very article — even the headline — are subject to change. You may need to adjust discussion questions accordingly.

Related | In the article “[Peril and Confusion at Japanese Nuclear Plant,](#)” Hiroko Tabuchi and Keith Bradsher describe the crisis in Japan after severe damage to nuclear power plants in the wake of the recent tsunami and earthquake:

Japan's nuclear crisis intensified on Wednesday after the authorities announced that a second reactor unit at the stricken Fukushima Daiichi plant in northeastern Japan may have ruptured and appeared to be releasing radioactive steam.

The break, at the No. 3 reactor unit, worsened the already perilous conditions at the plant, a day after officials said the containment vessel in the No. 2 reactor had also cracked.

Read the entire article with your class, using the questions below.

Questions | For discussion and reading comprehension:

- In your own words, describe the situation at the Fukushima Daiichi power plant.
- What things provide protection and containment on the reactors?
- Why is the exact situation at each of the six reactors at the plant unclear?
- What are the main causes for concern at the plant, and why?
- What challenges and risks are the workers who remain at the plant facing?

Activity | Explain to students that they will work in groups to create “news bulletins” about nuclear energy, using the situation in Japan as a way to lead into a greater exploration of the topic of nuclear power itself.

Split the class into five groups, and assign each group one of the following topics.

Provide each group with their tasks and guiding prompts, and tell them to use the resources available to find the answers. When they understand their topics quite well, they should prepare a segment designed for a television newscast, three to five minutes long, to provide “viewers” with background so that they can understand the situation at Fukushima Daiichi. They might include diagrams, charts, photographs and other images and infographics designed to be displayed on screen to aid understanding.

In their segments, they should connect the information to the Fukushima Daiichi plant, as well as refer to nuclear plants in the United States, as relevant. Their scripts can be designed for a single newscaster to deliver or can include “interviews” with “experts.”

Nuclear Energy and Fission

Task: To introduce and explain nuclear energy and fission.

Guiding questions: What is **nuclear energy**? What is **fission**, and what is a **fission chain reaction**? What chemical element undergoes fission in a nuclear plant, and why do power plants use this element? From where is this element obtained?

Nuclear Reactors and Nuclear Power Plants

Task: To investigate the inner workings of a nuclear power plant.

Guiding questions: What happens at a **nuclear power plant**? How do they **work**? Where does the energy come from in a nuclear power plant? What do the terms “fuel rod,” “reactor” and “power plant” mean? What role do **fuel rods** play in generating energy? How safe are nuclear power plants? What happens to the nuclear material when it is used up?

Risks Associated With Nuclear Energy

Task: To explore some of the actual and hypothetical risks associated with nuclear power.

Guiding questions: What **risks** are associated with nuclear power? How do the design and construction of power plants try to minimize risks? What does the term “**meltdown**” mean? What safety measures do plants like Fukushima Daiichi have in place in the event of a **potential meltdown**?

Past Nuclear Accidents

Task: To find out what happened in past nuclear power plant accidents.

Guiding questions: What was the nature of the accidents at **Three Mile Island** and **Chernobyl**? What caused them? What **other nuclear accidents** have occurred around the world? What lessons came from these accidents?

Radiation and Health

Task: To explore the health consequences of radiation exposure, starting with the basic biology of what happens to the body’s cells when they are exposed to high levels of radiation.

Guiding questions: How does radiation enter the body? How does it affect the body? What levels of radiation exposure pose a health problem? What is **radiation sickness**? Why do health authorities distribute potassium iodide tablets to people at risk of radiation exposure? What **steps can people take to minimize their risk of exposure to radiation in the event of a leak at a nuclear power plant**? **How can people tell** if they have been exposed to radiation? What is the potential for a public health crisis if the Japanese population becomes exposed to high levels of radiation from the damaged power plant?

In addition to the links provided in the text above and in the Related Resources list, the following resources may be helpful in guiding student research:

Argonne National Lab’s [Nuclear Resources for Schools](#) page

The U.S. Energy Information Administration’s [Energy Kids](#) page

The PBS “Frontline” feature “[Nuclear Reaction: Why Do Americans Fear Nuclear Power?](#),” including its [glossary of nuclear terms](#)

The [International Atomic Energy Agency](#) site

The “explainers” from [Mother Jones](#) and [The Atlantic](#)

The first portion of the [March 16, 2011, CNN Student News broadcast](#), which explains nuclear plants and radiation

Allow students ample time to research their topics and to prepare news bulletins, in the manner of a program like [TimesCast](#). They might simply be delivered live before the whole class, or might be videotaped and shared with a larger audience — perhaps even on [SchoolTube](#).

Students may appoint one or two group members to act as topical “experts,” like physicists or engineers, to explain concepts related to their topic; another student can play the role of the news anchor or correspondent in the field. Encourage them to incorporate video, multimedia and other visual elements to aid in their storytelling.

When students have finished presenting their news bulletins, circle back to the list of questions generated during the warm-up activity. Ask: have you been able to answer all the questions you had

coming into this lesson? If not, how might you address the questions that remain unanswered?

Going further | Students debate the role of [nuclear power in the United States](#), which until recently was one of the few components of the nation's energy policy to have bipartisan support. To start, students may read about how [policymakers](#) view the proposed expansion of nuclear power in the United States in the wake of the catastrophe in Japan.

Questions for students to consider as they prepare include the following: What are some of the arguments in support of nuclear energy? What do its detractors have to say? What other sources provide most of the energy used in the United States, and how safe are these sources?

They can use our [Debatable Issues](#) sheet (PDF) to organize facts, quotations and other materials to support their arguments.

They also may consider some of the [sources and technologies](#) that could provide our [energy in the future](#).

Still other ideas for taking this lesson further are provided in our posts "[Teaching Ideas: The Earthquake and Tsunami in Japan](#)" and "[20 Ways to Teach About the Disaster in Japan Across the Curriculum](#)."

Standards | This lesson is correlated to [McREL's national standards](#) (it can also be aligned to the new [Common Core State Standards](#)):

Language Arts

1. Demonstrates competence in the general skills and strategies of the writing process
2. Uses the stylistic and rhetorical aspects of writing
4. Gathers and uses information for research purposes

Health

2. Knows environmental and external factors that affect individual and community health

Science

5. Understands the structure and function of cells and organisms
8. Understands the structure and properties of matter
9. Understands the sources and properties of energy

Life Skills: Life Work

2. Uses various information sources, including those of a technical nature, to accomplish specific tasks

Life Skills: Working with Others

1. Contributes to the overall effort of a group
4. Displays effective interpersonal communication skills

Technology

3. Understands the relationships among science, technology, society and the individual
4. Understands the nature of technological design
5. Understands the nature and operation of systems

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