[The Washington Post]

VOLUME 10, ISSUE 7

Disaster IN JAPAN

INSIDE

April 4, 2011

A Word About Disaster in Japan

Residents of Japan are used to earthquakes. Records indicate more than 402,000 of 2.0 magnitude or greater in the last two decades. Then came March 11. Endurance, resilience and respect for others shown through industry and nurture were exhibited in the days after a 9.0-magnitude earthquake, tsunami and aftershocks disrupted and took life on Honshu Island.

Washington Post coverage of the disaster in Japan is appropriate for use in many disciplines: Earth Science (tectonic plates, earthquakes, tsunamis), Economics and Business (supply and demand, stock markets, reconstruction), Health (mental, nourishment, radiation exposure), Physics (nuclear reactors, energy), and Journalism (fact finding in chaos, foreign correspondents, depth and follow-up stories, newspapers). Social studies and philosophy teachers can look at the modern expression of ancient beliefs and attitudes. Art, Mathematics and Photography can be used to quantify and relate events.

Suggested activities include studies of the stock market, nuclear reactors and tectonic plates. Informational graphics of maps, pie charts and illustrations are incorporated into lessons. In the midst of physical destruction, the human story cannot be lost: thousands have perished and relief workers seek survivors, residents without homes live in shelters and seek necessities, and many near and far from nuclear reactors face contamination of water and food.

A reminder to *Post* INSIDE program teachers:

e-Replica

If you plan to use articles in this guide in the e-Replica format more than three months after their publication date, remember to bookmark them.

ABOUT THE COVER

Images, left to right, Kyodo News via Associated Press, Kyodo News via Reuters, Fritz Hoffman/National Geographic Image Collection, Kyodo News via Associated Press, Katsushika Hokusai/The Mann Collection; Collage Illustration by Carol Porter.

Lessons: In the aftermath of natural disasters, such as the 9.0-magnitude earthquake in Japan, examination of theories and practices takes place. These include plate tectonics, construction methods, energy and fuel provisions, effective communication, economic and human resilience, and disaster preparedness.

Level: Low to High

Subjects: Earth Science, Economics, Health, Journalism, Social Studies

Related Activity: Art, Geography, Mathematics, Photography, Physics

NIE Online Guide
Editor — Carol Lange
Art Editor — Carol Porter

Contributing to this guide: Steven King, a second grade teacher at Shepherd Elementary in Washington, D.C., wrote the lesson "Understanding the Effects Disasters (Natural and Man-Made) Have on Stock Markets, Companies, and Consumers." He has previously taught third, fifth, and sixth grade classes since receiving his Masters degree in teaching and curriculum from Teachers College at Columbia University in 1994. Mr. King, a 2008 NOAA Environmental Hero award winner, has been working with NIE and *The Washington Post* since 2002, and he has contributed to the guides on the inauguration in 2008 and "Too Much, Too Little, or Just Right" lesson plan on citizens' rights in 2006.

Available Online
All Washington Post NIE guides may be downloaded at *www.washpost.com/nie.*

Send comments about this guide to:
Margaret Kaplow, Educational Services Manager, *kaplowm@washpost.com*

Disaster In Japan

On March 11 at 2:46 p.m. local time (12:46 a.m. EST) a massive earthquake occurred off the northeast coast of Honshu, Japan's largest island. From the many Washington Post *articles and informational graphics covering the disaster, selected ones are reprinted. Activities are suggested for use in many disciplines: art, business, composition, earth science, economics, health, journalism, mathematics, media arts, photography and physics.*

Expand Vocabulary

Every day the newspaper provides a source for vocabulary development. Stories of the earthquake and tsunami in Japan are rich with scientific, economic and technical terms. "Shaking and Shaping Your Vocabulary" encourages students to define terms, explore etymology and use each word in a sentence.

The sidebar on page 3 is a glossary of terms related to nuclear science and technology. It would be helpful to review these terms before reading "Thousands evacuated as radiation leaks from plant are detected" and related informational graphics.

Review Nuclear Basics

KidsPost explains the news to younger students. In "How nuclear reactors work" students are introduced through a short narrative and illustrations to how the Fukushima Daiichi nuclear power plants generate electricity. Questions about the current situation are answered.

Read an Editorial

The Washington Post editorial, "Heartbreaking: Tragedy, resilience and continuing danger in Japan," introduces the areas covered in articles and activities in this guide: human resilience in the face of great loss, economic impact, building codes and nuclear power concerns.

Wider margins are provided so students have room to annotate as they read the editorial. For example, students might underline unfamiliar terms and define them. They may ask questions after reading each paragraph, such as:

- What are the "advanced communications, energy and transportation networks"?
- Where did the tsunami hit Japan?
- How do the Japanese building codes compare to U.S. codes?
- How do regular people deal with the damage and disruption?
- Will there be an economic impact? Influence on all types of manufacturing?
- Why are there fears concerning the nuclear power plants?
- How are the relief efforts working?

Teachers might ask students about their annotations: Does the editorial provide answers to any of the questions it raises? Do students know the answers from what they have read and heard in other sources? Where will they find the answers to their questions?

Take the Lede

The lede (or lead) is the first paragraph(s) of an article. The earthquake took place on March 11. Read the ledes of four March 12 articles. Questions might include:

CONTINUED ON PAGE 4

In the Know

A glossary of some of the nuclear terms being used as Japan's nuclear plant crisis unfolds.

Containment building: The airtight building, which houses a nuclear reactor and its pressurized reactor coolant pumps, steam generator and other equipment or piping. Such buildings are usually made of steel-reinforced concrete.

Core: The central portion of a nuclear reactor, which contains the fuel assemblies, control rods and support structures. The reactor core is where fission takes place.

Fuel rod: Long, slender, zirconium metal tubes containing pellets of fissionable material, which provide fuel for nuclear reactors. Fuel rods are assembled into bundles called fuel assemblies, which are loaded into the reactor core.

Meltdown: Severe overheating of the core of a nuclear reactor resulting in the core melting and radiation escaping.

Radioactivity: The property possessed by some elements (such as uranium) of spontaneously emitting energy in the form of radiation as a result of the decay (or disintegration) of an unstable atom.

Radiation sickness: The complex symptoms that result from excessive exposure of the body to ionizing radiation. The earliest of these symptoms are nausea, fatigue, vomiting and diarrhea, which may be followed by loss of hair, hemorrhage, inflammation of the mouth and throat, and general loss of energy. In severe cases, death may occur within two to four weeks.

Spent fuel pool: An underwater storage and cooling facility for depleted fuel assemblies that have been removed from a reactor.

Spent nuclear fuel: Nuclear reactor fuel that has been used to the extent that it can no longer effectively sustain a chain reaction.

— Marc Kaufman

SOURCES: Nuclear Regulatory Commission, Merriam-Webster Dictionary, Scientific Digital Images

CONTINUED FROM PAGE 3

- What topics are covered?
- Underline adjectives found in the ledes. What kinds of information do they add?
- For which of the stories do you want a follow-up story?

Read the March 13 lede. Is *Post* reporter Chico Harlan reporting on the same angle to the disaster story? What does the dateline reveal?

- Look at the map of Japan. ("State of the power grid" is useful.) Locate the location of his datelines and where the tsunami hit shore.
- Is he an eyewitness to what he is reporting? If not, who might he be interviewing for information? Read the March 14 ledes.
- How has Mufson's story from March 12 moved forward? This is an example of a follow-up story.
- What accuracy is added to *Post* coverage with Andrew Higgins' news story?
- Higgins' lede is an example of a contrast lede. What is contrasted?

Explain Tectonic Plates

Although much study has been done on seismic activity, Joel Achenbach reports "how unpredictable the heaving and lurching earth can be."

Vocabulary in this article include "epicenter," "geologists," "mega-quake," "periodicity," "plate tectonics," "quiescent," "Ring of Fire," "seismologist," "subduction zone," "tremor," and "tsunami." Either review the terms with students before reading the article or ask students to find and define the terms in context.

Students will read that the earthquake was 8.9-magnitude. This was adjusted days later to be a 9.0-magnitude quake. This will illustrate the importance of using many sources, especially the most recent sources for accurate information. It also illustrates the unfolding nature of news coverage. The information reported is as accurate as can be known at that time.

Give students "Disaster struck, but not where it was expected" to read and discuss. Use the informational graphic, "Record quake, widespread destruction" to show the location of the tectonic plates that intersect in this part of the Pacific Ocean. Questions might include:

- What caused the earthquake?
- What is a tectonic plate? Which plates intersect by Japan?
- What is a subduction zone? [Subduction takes place when an ocean plate nudges under a continental plate, usually a few inches a year.]
- What reasons did geologists have to expect the Tokai Earthquake?
- In what ways might the events in Japan rewrite seismology texts?

Study the timeline "20 Years of Quakes in Japan" to understand why Japan has prepared for "the Big One."

Students should also consider the aftershocks represented on "Record quake, widespread destruction." Read to see how many more aftershocks have taken place since the two-day period illustrated. How many aftershocks are usually experienced?

Detail Nuclear Reactors

Both the KidsPost article ("How nuclear reactors work") and "Japanese authorities try to calm citizens as they begin evacuating 200,000 people" provide technical information and visual explanation.

CONTINUED ON PAGE 5

Tsunami

www.tsunami.noaa.gov/
Tsunami
National Oceanic and Atmospheric Administration informative website. Tsunami basics, events, news and links to other sites. Kids and teacher resources sections.

www.fema.gov/kids/tsunami.htm
Tsunami
FEMA site for students: Things to Know, Disaster Supply Kit, Pets and Disasters, Pets and Disasters

www.weather.gov/om/brochures/tsunami.htm
Tsunami: The Great Waves
Government agencies provide easy-to-read brochure. Topics include the "ring of fire," ocean trenches, wave height and water depth, and warning centers

www.smithsonianmag.com/specialsections/ecocenter/land/shocks.html
Future Shocks
Smithsonian Institution fascinating story that focuses on the Seattle area — and why it is "one of the world's worst places for an earthquake" — and U.S. Geological Survey geologist Brian Atwater. Listen to Atwater on NPR: *www.npr.org/templates/story/story.php?storyId=4629401*

www.asiantsunamivideos.com/
Asian Tsunami Videos
Citizens' videos of the 2011 tsunami in Japan and the 2004 tsunami in Thailand

www.npr.org/templates/story/story.php?storyId=134844645
Japan's Disaster Puts Pets in Dire Need
Pictures and story appeal to students who love cats and dogs

CONTINUED FROM PAGE 4

How helpful are the informational graphics to readers?

Review the illustrations to understand how the nuclear reactors work.

Read and discuss "Thousands evacuated as radiation leaks from plant are detected." In what ways does the historic references provide needed background for the reader?

Read additional articles about efforts to avert a meltdown at the plants. Assign students days between March 14-28. Use the e-Replica edition of *The Post* to locate articles in the time period. Create a timeline. Summarize actions being taken at the nuclear plants each day.

Teachers may also ask students to locate articles about reaction in the U.S. and around the world to nuclear energy. For example, the Sunday, March 13, 2011, article, "Safety concerns continue to hinder U.S. nuclear sector" and the informational graphic that locates commercial nuclear reactors in 31 countries provide considerable information to begin discussion.

Map the Power Grid

What is required for a nation to become industrialized? After listing essential components, discuss how a country powers its industries. How is this complicated when the nation is an island? Does it make business sense to produce your electricity rather than import oil?

Give students the informational graphic, "State of the power grid." Review the symbols in the key. What are the sources of energy in Japan? Discuss the distinctions (nuclear, thermal, hydroelectric), number and locations of each. What portion of electricity is provided by each type of power plants? (Read the pie chart.)

Has Japan experienced earthquakes before 2011? Review "20 Years of Quakes in Japan" timeline. What does this data reveal about the construction of Japan's nuclear plants?

On the map locate the epicenter of the earthquake and area of Japan hit by the tsunami waves. What have been the consequences of the 9.0-magnitude earthquake and tsunami striking in an area where nuclear power sources are located?

Study the Stock Market

"Understanding the Effects Disasters (Natural and Man-Made) Have on Stock Markets, Companies and Consumers" is provided. Teachers may use this activity to teach the relationship of natural disasters and man-made disruptions to supply and demand, the cost of goods and services, and activity on the stock market.

If students have difficulty naming products made in Japan, give them "Quake's effect on U.S. imports unclear." *Post* reporter Ylan Q. Mui reviews the four main categories of products exported to the U.S., according to trade data.

If time allows, teachers may extend the activity. How will the companies and countries that import products into Japan be affected by these natural disasters? For example, are major ports damaged? Will consumption lower for certain products? For what products will there be more demand now and during reconstruction?

Japan is one of the world's central supply hubs for automobile and technology industries. Think about how the Japanese and non-Japanese

CONTINUED ON PAGE 6

Satellite Photos of Japan

Before and After the Earthquake and Tsunami

Satellite images provided by GeoEye provide opportunities to compare and contrast the same geographic area. Many of the images are paired for easier contrast.

Images may be viewed in slideshow, full screen or thumbnails.

www.washingtonpost.com/world/satellite-photos-of-japan-before-and-after-the-earthquake-and-tsunami-/2011/03/13/ABMplkT_gallery.html#photo=1

GOOGLE VIA BLOOMBERG

This combination photo made up of two satellite images shows Yuriage in Natori, Japan, in 2008, top, and after the 9.0-magnitude earthquake and subsequent tsunami.

CONTINUED FROM PAGE 5

car companies will be affected by this disaster. Also, how will manufacturers and consumers of cars that use parts made in Japan be affected by this disaster? Will there be car parts available if they need them? Will the cost of repairs increase? Will the demand for Japanese-made cars and their resale value go up or down?

Consider the Impact on Industry

The impact of the earthquake and tsunami on the Japanese and world economies is an unfolding and complex story. It is complicated by the debt accrued by the world's third-largest economy, uncertainty of nuclear contamination and time frame before restoration of power and transportation networks.

"Quake's effect on U.S. imports unclear" is a brief look at four areas of export of Japanese products. Use this to discuss supply and demand, scarcity and speculation.

Teachers might have students select a product to chart stock value on January 1, before March 11, and at intervals after March 14. What events do these numbers reflect?

The opening paragraphs of three articles, published over five days, are provided in "Markets and Monetary Matters." As more of the damage is known, businesses respond. Here are three possible approaches to each article:

- On the first business day after the earthquake, the Japanese stock market fell more than 5 percent. Why did this happen? How did other markets respond? How will reconstruction fit into stock decisions?
- On March 15, *The Post* reported how American businesses were responding. Review the stock market numbers. What do they say?
- One week after the earthquake, the major industrialized nations were coordinating a currency intervention. This is described as "rare" and the reflecting "deep concern." Discuss why the value of the yen is a concern to industrialized countries.

Consider the Human Reaction

Study the faces of Japanese citizens, relief and rescue workers, and their surroundings in photographs. What are the stories that they tell?

By March 20, the death toll has risen by thousands, the 8.9-magnitude earthquake is now officially a 9.0-magnitude earthquake and survivors struggle to secure basic necessities. Give students "Hunt for necessities overshadows nuclear anxieties." In Sendai, in northeastern Japan, *Post* foreign correspondent Andrew Higgins reports on the human condition.

Meet Emperor Akihito

After homes, businesses and natural surroundings were ripped and tossed by a massive earthquake and tsunami, residents turned to help each other in the midst of aftershocks and debris. Individuals exhibited traditional attitudes. And the emperor spoke to them.

"An emperor comes down to earth" provides teachers an opportunity to discuss the historic role of the emperor and his present place in this industrialized country with the third largest economy in the world.

Eat Your Vegetables, Maybe

Read and discuss "Tokyo tap

CONTINUED ON PAGE 7

Read About It

Atwater, Brian
The Orphan Tsunami of 1700
University of Washington Press (2005); Grades 9 and up
Geologist as observer, detective and user of primary sources to tell the story of shifting tectonic plates from Alaska to Oregon that caused a tsunami recorded by Samurai, merchants and villagers in Japan. Super read. Atwater was named one of *Time* magazine's Most Influential People in 2005.

Boyce, Natalie Pope and Mary Pope Osborne
Tsunamis and Other Natural Disasters
Random House Books for Young Readers (2007); Grades 3-7
A Magic Tree House Research Guide that focuses on explaining tsunamis, earthquakes and volcanoes

Dudley, Walter and Min Lee
Tsunami!
University of Hawaii Press (1998); Grade 8 and up.
Readable book by a tsunami expert with true stories and pictures

Hatkoff, Isabella and others
Owen & Mzee: The True Story of a Remarkable Friendship
Scholastic Press (2006); Grades K-5
After baby hippo Owen is separated from his mother in a 2004 tsunami, he is rescued and taken to an animal sanctuary. The moving story of his attachment to a 130-year-old giant tortoise (Mzee). Special website: *www.owenandmzee.com/omweb/* partners with the book.

Winter, Jeanette (writer, illus)
Mama
Houghton, Mifflin Harcourt (2006); Grades K-3
Subtitled: "A true story in which a baby hippo loses his Mama during a tsunami, but finds a new home, and a new Mama."

CONTINUED FROM PAGE 6

water unfit for infants; radiation warning on 11 vegetables." Reporting from Tokyo, David Nakamura covers the story almost two weeks after the initial 9.0-magnitude earthquake and tsunami. Give examples of accuracy and balance in his reporting — facts, sources of information, people interviewed, and perspective. What are officials saying? What are residents thinking?

Pair the article with the informational graphic, "Effects of radiation." Discuss information provided for low and high dosage.

Would students eat vegetables if they were in Tokyo?

What products could U.S. relief agencies send to Japan?

Debate Media's Role

Discuss with students what they see as the role of media. For what kinds of information do they read and listen to media? Do they get most of their information from social media, news websites, radio, TV or newspapers?

Provide copies of "In Ishinomaki, news comes old-fashioned way: Via paper" to students to read. Andrew Higgins reports how information is communicated when no electricity exists and how important information is to people living through a disaster.

Discussion of the article might include:

- How does the *Ishinomake Hibi Shinbun* posting of issues compare to early news conveyance?
- Does it seem an over-reaction to say the newspaper is a "lifeline"?
- Discuss the kind of information that the newspapers are providing. Compare it to the articles that were in the March 11 *Hibi Shinbun* before the earthquake.
- Higgins describes Sendai: "once-thriving," "more than 1 million," "digital juggernaut." What perspective on the situation does this provide?
- If students were reporters in northeastern Japan, what would they do to cover the news?

Review *The Post*'s coverage of the earthquake and tsunami. Has reporting been fair, balanced, accurate and comprehensive? How much of coverage has been "eyewitness" accounting? In what ways have the topics covered reflected the concerns of *The Post*'s readers?

Is coverage of the nuclear reactors necessary? Would any of the coverage frighten readers? Review the KidsPost article ("How nuclear reactors work"), infographic ("Record quake, widespread destruction") and articles including "Tokyo water unfit for infants; radiation alert on vegetables."

Headlines are to summarize content and draw readers to articles. What is the effect of this headline: "Thousands evacuated as radiation leaks from plant are detected"? After discussion, read the subhead: "Authorities screen for exposure, which poses range of health risks." Which words, if any, alarm readers?

Reporters have a duty to inform readers and viewers. Ask students to find examples of reporters providing facts and examples to give perspective on the news. For example, "The maximum radiation recorded by the team was 300 microsieverts per hour; by comparison, a roundtrip flight from Tokyo to New York exposes passengers to about 200 microsieverts of radiation from cosmic rays."

Create a Picture Graph

A picture graph uses pictures or symbols to show data and quickly convey information. The image may represent one item or five or more individuals. Be sure that a key is provided.

Students may be asked to select one of the photographs of the aftermath of the earthquake and tsunami to create a picture graph. Likewise, teachers could use one of the photographs to produce a picture graph with questions to answer.

Study Photographs

Discuss the camera as record keeper. Ask students to study photographs of the disaster in Japan found in print and online. To what extent is the eye of the beholder reflected as much as the physical scene captured by the lens?

Ask students to select a photograph that tells a story of the disaster. What elements of photography (line, rule of thirds, texture) are evident? What other characteristics draw them to this image? Put the story they see into fewer than 200 words or use it as the stimulus for a poem or essay.

For advanced art and photography students, locate Philip Kennicott's essay "A double lens on tragedy: Cameras capture Japan's disaster as a complex portrait" (March 16, Style).

He proposes "two visual styles emerge from the disasters in Japan." He describes the first style as that of the hand-held camera, in and out of focus and shifting details. The second he sees as the tripod-steady, "fixed view of a faraway industrial plant, hazy, vague and remote." Do students agree with Kennicott's categorization? ■

Name _____ Date _____

Shaking and Shaping Your Vocabulary

In the days that followed the March 11, 2011, earthquake and tsunami in Japan, journalists reported the devastation and loss of lives, people helping one another and relief efforts, and potential danger from contaminated water and radiation.

Read *The Washington Post* articles. You have learned some of the technical and scientific words in class. From the context of the articles, photographs and informational graphics, you can discern the meaning of new words.

Define the following words. Be sure to include etymology. Use each word in a sentence in which you tell something about the earthquake and tsunami in Japan and their influence on daily life, economy and energy. Add two words that are new to you to the list.

Here is an example from the March 15 KidsPost:

> Tsunami (pronounced *soo-NAH-mee*): A tsunami is a series of waves caused by huge movements in the water. Earthquakes, volcanic eruptions and landslides can cause tsunamis. Japan is one of the places in the world where tsunamis are most common. The word is Japanese and means "harbor wave."

1. Atom
2. Contamination
3. Earthquake
4. Epicenter
5. Fission
6. Humanitarian efforts
7. Magnitude
8. Nuclear power
9. Nuclear reactor
10. Power plant
11. Radiation
12. Seismic
13. Tectonic plate
14. _____
15. _____

An Integrated Curriculum For The Washington Post Newspaper In Education Program

EXPLAINING THE NEWS

How nuclear reactors work

The earthquake and tsunami that hit Japan last week killed thousands of people and caused incredible damage to homes, schools, roads and office buildings. But the damage to the Fukushima Daiichi nuclear power plant and another nearby plant has put words such as radiation, nuclear reactors and fuel rods on the front page of the newspaper and all over the Internet and television. KidsPost answers some questions you might have about nuclear energy and what's happening in Japan.

What is nuclear energy?

It's the energy in the center (or nucleus) of an atom. Atoms make up everything in the universe and are held together with great force. In a process called *fission*, atoms are broken apart, and the energy released can be used to generate electricity at power plants, including the one in Japan that was damaged. Atoms of uranium, a common element that can be mined from the Earth, are used in nuclear reactions. In fission, a tiny particle called a *neutron* hits a uranium atom; the atom splits, releasing more neutrons and generating a chain reaction. That reaction releases huge amounts of energy. That energy can boil water to create steam, which in turn causes turbines to spin, generating electricity in a power plant.

What is a nuclear reactor?

A *nuclear reactor* is the device in a power plant where fission takes place.

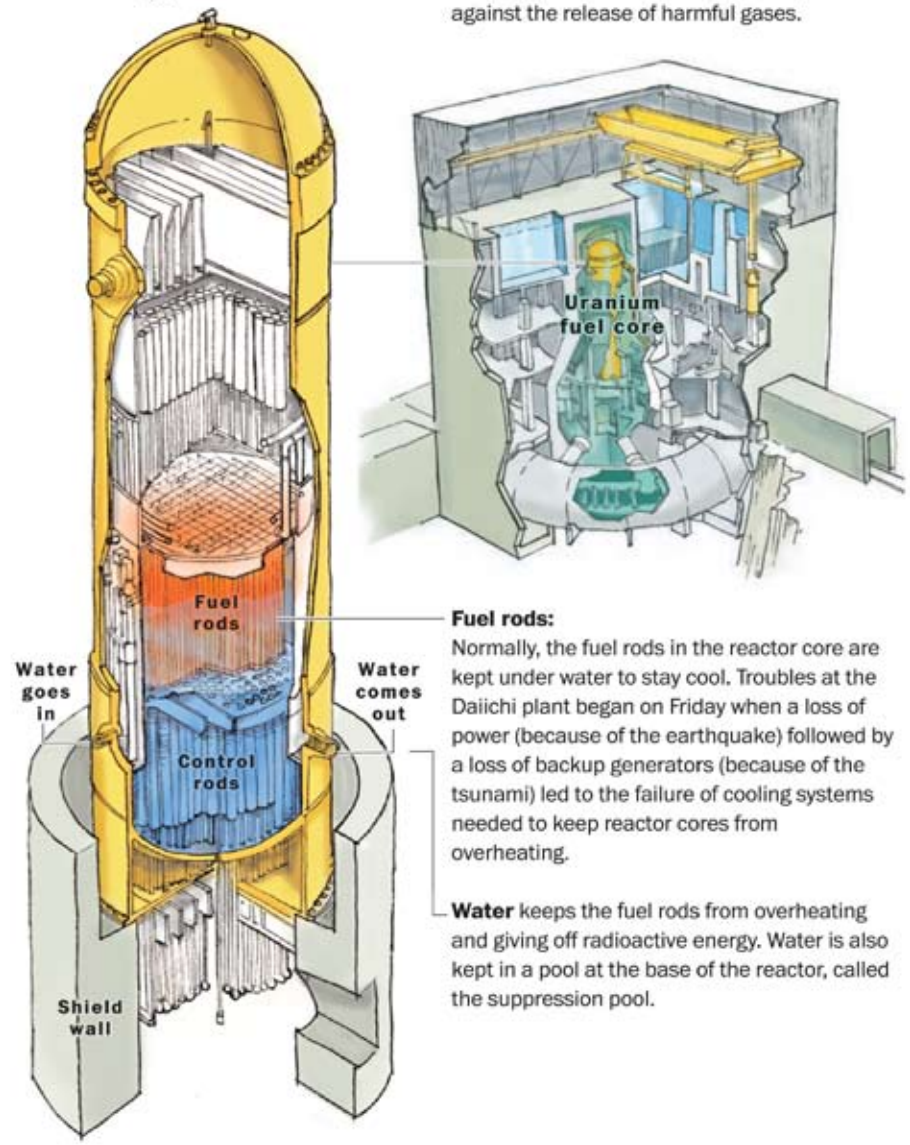
CONTINUED ON PAGE 10

Inside a nuclear reactor

Four nuclear reactors at a power plant in Japan have been affected by the earthquake and tsunami. Here is what a nuclear reactor looks like.

Nuclear reactor: Fission, the creation of nuclear energy, occurs here.

The buildings that house nuclear reactors are made of concrete and steel as extra protection against the release of harmful gases.



Fuel rods: Normally, the fuel rods in the reactor core are kept under water to stay cool. Troubles at the Daiichi plant began on Friday when a loss of power (because of the earthquake) followed by a loss of backup generators (because of the tsunami) led to the failure of cooling systems needed to keep reactor cores from overheating.

Water keeps the fuel rods from overheating and giving off radioactive energy. Water is also kept in a pool at the base of the reactor, called the suppression pool.

SOURCES: International Atomic Energy Agency, World Nuclear Association, Peter Meisen of the Global Energy Network Institute, NHK, Federation of Electric Power Companies of Japan, Nomura Global Economics, Agency for Natural Resources and Energy, U.S. Energy Information Administration, Associated Press, Nuclear Energy Institute

BY PATTERSON CLARK AND ALBERTO CUADRA/THE WASHINGTON POST

An Integrated Curriculum For The Washington Post Newspaper In Education Program

CONTINUED FROM PAGE 9

Pieces of uranium about the size of your fingertip get stacked up in 12-foot-long metal tubes, called *rods*. Bunches of rods form the *core* of the reactor.

So what happened in Japan?

Rods are normally kept under water, which keeps the reactor core cool. When the earthquake hit last Friday, the entire electrical grid went down, just as it can here when we have an ice storm. The nuclear plant switched to a backup system of generators. But an hour after the earthquake, the tsunami hit the plant, knocking out the generators. Backup batteries lasted only eight hours. Without power, the water couldn't circulate and began to boil away, allowing the rods to get hot. The inability to keep cooling water on the fuel rods led to explosions and fires. Those events have sent radioactive elements into the air. High levels of radiation can be dangerous, even deadly. Close to the reactors, the radition levels have gone up and down. About 50 workers trying to fix the problem are risking their lives to save their fellow citizens.

Are people getting sick now?

No. People within 19 miles of the plant have been told to stay indoors. There is medicine that can treat the effects of radiation sickness, but it has not been given to people yet.

What will happen next?

Nobody knows for sure. If there isn't water available to keep the fuel rods cool, the fingertip-size pellets can melt, like candles. This melting damages the core, which could lead to the release of more radioactive gases.

Is nuclear power safe?

That question has been asked for many years, and you will hear much more debate about it now because of the events in Japan. Nuclear power is very efficient. For example, one of those small uranium pellets can produce as much electricity as 150 gallons of oil. Many people see nuclear power as an alternative energy source. The situation at the Japanese reactors will have people talking about developing other power sources, including solar and wind. ■

— March 17, 2011
kidspost@washpost.com

An Integrated Curriculum For The Washington Post Newspaper In Education Program

Quake's effect on U.S. imports unclear

By Ylan Q. Mui

• *Originally Published March 17, 2011*

Only 6.4 percent of U.S. imports come from Japan, but among those products are some of the most well-known consumer brands. Several Japanese manufacturers have shut down factories after last week's earthquake, with some sustaining damage and others conserving energy.

Analysts say consumers are unlikely to see shortages for now, but they cautioned that the disaster's impact may hinge on how long it takes to bring Japan's manufacturing sector back to life. Here are the top four categories of imports from Japan, according to U.S. trade data:

AUTOS

KIMIMASA MATAMA/BLOOMBERG NEWS

Accounted for: 34.5 percent of U.S. imports from Japan in 2010, or $41.5 billion.

Impact: Toyota and Nissan plan to open some plants in Japan on Thursday. Honda has said it will keep several of its facilities offline through Sunday.

Most Japanese cars sold in the United States are manufactured domestically, and automakers said they expect minimal disruptions. Honda, for example, said popular models such as the Accord and Civic Sedan are supported by North American suppliers. Nissan said it keeps a 50-day inventory of cars on the ground or in shipment.

In addition, parts that are manufactured in Japan tend to come from the southern region of the country, which escaped the devastation seen in the northeast, said Jessica Caldwell, senior analyst at Edmunds.com. "I wouldn't see a drastic impact," she said. "Inventories can definitely carry these manufacturers in for at least a month or so."

NUCLEAR REACTORS, BOILERS AND PARTS

MARY ANN CHASTAIN/ASSOCIATED PRESS

Accounted for: 20.6 percent of U.S. imports from Japan in 2010, or $24.8 billion

Impact: This category comprises a wide array of products, including machinery to separate isotopes in nuclear reactors, aircraft engines and gas station pumps, and the sector's diversity makes it difficult to assess the impact of the disaster. The country's largest nuclear operator, Exelon, said it is too early to determine the effects.

AUDIO AND TV

YOSHIKAZU TSONO/ AGENCE FRANCE-PRESSE VIA GETTY IMAGES

Accounted for: 15.2 percent of U.S. imports from Japan in 2010, or $18.3 billion.

Impact: Though popular brands such as Sony, Panasonic and Toshiba are based in the country, many of their products are manufactured in other Asian nations. Factories in Japan typically churn out only parts of those goods, or higher-end merchandise, said Stephen Baker, an analyst with market research firm NPD Group.

Sony has suspended operations at seven plants that make semiconductor lasers, lithium ion batteries and Blu-ray discs. SanDisk said there was "minimal" impact at two of its plants that make the chips used to store data in Apple's iPhone and iPad, though some analysts are expecting SanDisk to raise chip prices in the future.

Consumer Electronics Association spokesman Jason Oxman said companies may be able to transfer production to other facilities until their factories are up and running.

CAMERAS AND MEDICAL EQUIPMENT

BEAWIHARTA/REUTERS

Accounted for: 5.1 percent of U.S. imports from Japan in 2010, or $6.1 billion

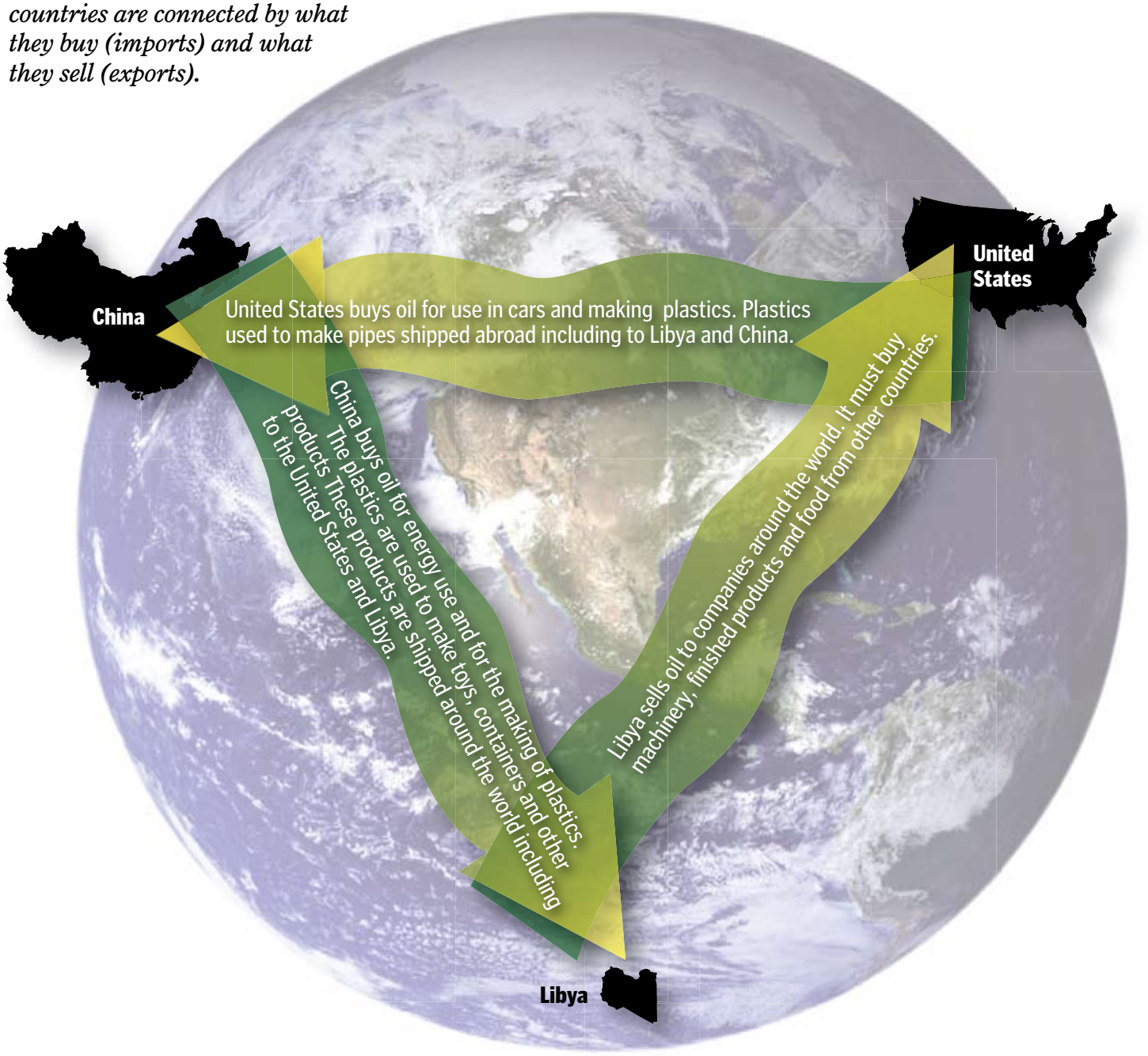
Impact: Two of the most popular camera brands, Canon and Nikon, reported damage to plants in Japan and are uncertain when they will be repaired. Fifteen Canon employees sustained injuries, and the company said some plants could be down for more than a month, forcing it to move production. Nikon also said some of its employees were injured during the disaster. ■

Name _____ Date _____

Understanding the Effects Disasters (Natural and Man-Made) Have on Stock Markets, Companies, and Consumers

Each country has resources that it buys and sells to other countries. For example, Brazil may have wood from its forests that it will sell to companies such as Home Depot or Lowe's. China has numerous products that it sells to companies all around the world. Consequently, all of these different countries and their economies are interconnected.

Examine the diagram to see how countries are connected by what they buy (imports) and what they sell (exports).



GRAPHIC BY STEVEN KING, NOAA.GOV, CAROL PORTER FOR THE WASHINGTON POST; GENE THORP/THE WASHINGTON POST

Name _____ Date _____

Understanding the Effects ... | *continued*

Similarly, stock markets are connected to how these countries buy and sell products. Stocks of companies are bought and sold in different stock markets around the world. There are stock markets in the United States, Japan, Germany and Korea to name a few places.

Each of these markets is interconnected to all the countries around the world. So, let's think about how events can affect these countries and the stock markets.

Libya is one of the largest exporters of oil around the world. Political revolution and civil war has affected its ability to export oil to different countries. If it cannot send out (export) its oil, then the price of a barrel of oil will go up because of the decreased supply of oil.

Use the chart to decide what will be affected by the increase of oil prices. Think of products made with plastic and ways gas is used. Then list companies that are affected by the increase of oil price.

Plastic Products	Use of Gas	Companies Affected

Now examine the companies that you have listed. Those companies' stocks are traded on stock exchanges around the world. Consequently, a war in a country or a natural disaster, such as that in Japan, may affect companies and stocks around the world.

BOBBY YIP — REUTERS

The Nikkei index during the morning trading at the Hong Kong Stock Exchange on March 14, 2011.

Understanding the Effects ... | *continued*

Japanese Exports and Imports

The earthquake and the tsunami of March 11, 2011, devastated areas of Japan. Furthermore, with the threat of radiation poisoning on the horizon, many of the exports, such as the beans exported to Korea, may be tainted.

Exports	Imports
motorcycles, cars, computer accessories, electronics, semi-conductors, video equipment	precious metals, fuel oil, zinc (for computer parts), meat products, corn, steel

Research companies based in Japan and make a list of products they sell and where they export these products. Finally, determine what effect this will have on supply, demand and price of these items.

Company	Products	Exported To:	Effect on Supply/Demand and Price

An Integrated Curriculum For The Washington Post Newspaper In Education Program

Markets and Monetary Matters

MARCH 14

Japanese markets plummet as nation deals with damage, power shortages

By Howard Schneider

Japanese stock markets fell more than 5 percent Monday as the country's manufacturers shuttered plants to assess damage and deal with power shortages, and the nation's economy wrestled with the impact of not only a natural disaster but lingering concerns about nuclear safety.

The Nikkei index of major Tokyo Stock Exchange companies fell sharply as trading opened for the first full day since the earthquake and tsunami struck Friday. The impact around the world will be watched closely for signs of how a new round of economic uncertainty is received by markets balancing a U.S. economic recovery with rising oil prices and other emerging risks.

The world's third-largest economy was hobbled by a crisis that will challenge its financial system and energy infrastructure, as well as its capacity for dealing with a humanitarian disaster.

The first working day since the quake struck will dawn to rolling blackouts and hoarding, despite the Bank of Japan's vow to keep the economy on track. The central bank announced Monday that it will put a record $183.8 billion into the economy to keep the country's financial system stable and its trading system functioning.

Markets worldwide showed a measured response in early trading. Futures in the United States and Europe pointed to a lower market opening, and the ASX 200 index in Australia lost more than a percentage point in the first minutes of trading. Analysts warned that extended power disruptions or larger-than-expected damage to manufacturers could undercut a global economic recovery that was beginning to gain momentum.

The insured property losses from the quake could amount to between $14 billion and $35 billion, according to Air Worldwide, a risk consulting company.

Japan is already groaning under government debt equal to twice its yearly economic output, proportionally the world's largest load, but analysts said the country should have the financial muscle to deal with the reconstruction. ■

MARCH 15

U.S. stocks sink in face of worries about Japan

By Rita Nazareth

U.S. equities fell, sending the Standard & Poor's 500-stock index lower for a third time in four days, as investors struggled to assess how much damage Japan's worst earthquake on record will do to the global economy.

General Electric slumped 2.2 percent as Japan worked to contain radiation at a damaged nuclear plant. Coach and Tiffany sank at least 5.2 percent on concern that sales in Japan will fall. Las Vegas Sands, a casino company with most of its business in Asia, lost 3.6 percent as Jefferies cut its rating on the stock. MEMC Electronic Materials surged 11 percent on bets that demand for alternative energy will grow.

The S&P 500 closed 0.6 percent lower at 1296.39, paring an earlier drop of as much as 1.4 percent as oil settled little changed at $101.19 a barrel. The Dow Jones industrial average sank 51.24 points, or 0.4 percent, to 11,993.16. The iShares MSCI Japan Index Fund, a U.S. exchange-traded fund, tumbled 7 percent, the most since 2008.

TORU HANAI/REUTERS

Outside a brokerage in Tokyo on March 11, people watch an electronic board display a graph showing the movement of the Japanese yen's exchange rate against the U.S. dollar.

Losses continued Tuesday in early trading as the Nikkei 225 stock average fell 476.31 points, or 5 percent, to 9144.18.

"The market is pricing in a better understanding of the enormity and complexity of the natural disasters that struck Japan," said Mohamed El-Erian, chief executive at Newport Beach, Calif.-based Pacific Investment Management. "The immediate impact will be felt through lower global aggregate demand, disrupted supply chains and funds flows into Japan." ■

An Integrated Curriculum For The Washington Post Newspaper In Education Program

MARCH 18

G-7 to help avoid sharp yen rise

By Howard Schneider and Neil Irwin

HARUYOSHI YAMAGUCHI/BLOOMBERG

Yoshihiko Noda, Japan's finance minister, left, and Masaaki Shirakawa, governor of the Bank of Japan, speak to the media after a conference call with finance ministers and central bank governors from the Group of Seven nations, at the Ministry of Finance in Tokyo, Japan, on Friday, March 18, 2011. The Group of Seven nations will jointly intervene in the foreign exchange market for the first time in more than a decade after Japan's currency soared, threatening its recovery from the March 11 earthquake.

The United States and other major industrialized nations will combine in a rare coordinated currency intervention on Friday to keep the Japanese yen from rising too sharply in value in the wake of the country's recent natural disasters, a sign of the deep global concern about the health of the world's third-largest economy.

After a conference call on Thursday evening, finance ministers of the Group of 7 industrialized nations pledged "solidarity" with Japan and said that a recent run-up in the value of the yen led them to decide on a "concerted intervention in exchange markets" to try to stabilize the value of the currency.

The yen touched a historic high of about 76 to the dollar this week as markets anticipated a rush of money into the country to fund reconstruction, insurance payments and other needs following the earthquake, tsunami and lingering crisis over the state of several nuclear reactors. The rise in the value of the yen is of concern because an expensive currency might undercut the country's export industries and make it more difficult for Japan to avoid a return to recession.

No target rate for the yen was given, and it is not clear how aggressive the participating countries will have to become to prevent it from rising in value or to bring it back in line with pre-crisis levels. The fact that the United States, the United Kingdom, Canada and the European Central Bank are ready to sell or buy yen as needed may be enough to change market dynamics. The statement is also important because it gives the Bank of Japan a freer hand to intervene on its own, without worrying that its moves might be criticized as part of a "currency war."

The United States and other major economic powers typically argue for free-floating exchange rates — and have particularly criticized China for controlling the value of its currency to support its export industries. However, there was clear concern in the G-7 statement that the recent sharp movements in the yen's value could have unintended consequences for a world economy that is still mending from the recent financial crisis and recession. The last time a similar action took place was more than a decade ago, when efforts were made to support the value of the recently introduced euro.

"Excess volatility and disorderly movements in exchange rates have adverse implications for economic and financial stability," said a statement released by the group. The statement said that Japan had requested the assistance. ■

An Integrated Curriculum For The Washington Post Newspaper In Education Program

The Washington Post
AN INDEPENDENT NEWSPAPER
EDITORIALS

Heartbreaking

Tragedy, resilience and continuing danger in Japan

TWO DAYS AFTER the strongest earthquake Japan has ever recorded, the extent of damage and loss was far from clear. The quake and subsequent tsunami exposed once again the vulnerability of even the most advanced communications, energy and transportation networks — the lifelines of modern civilization. Rescuers were still groping their way to towns, villages and trains that seemed to have been washed away. But as the world watched Japan's early efforts at recovery, enough already was known to evoke both admiration and, as President Obama said, heartbreak.

Strange as it may sound, there were aspects of the natural disaster to be thankful for. Had the epicenter been on land and a bit further to the south, where Japan's population and economic centers are more densely clustered, the devastation could have been far worse. Rigorous building codes and disaster preparedness and training may have made a huge difference; people in Tokyo must have felt so as they watched skyscrapers sway but stand.

The resilience of infrastructure, and the contrast to the hundreds of thousands killed by disasters in poorer countries, was a reminder of how much of the damage of "natural" disasters is avoidable. The calm, cooperative spirit with which the Japanese faced lost power, evacuations, stopped trains and emergency shelters was a reminder of the fortitude and neighborliness for which Japanese society has long been known.

Still, no one should underestimate the potential effects of such a catastrophe — human, political, economic. The casualty figures that rose steadily throughout Saturday will continue to climb as rescuers make their way to less accessible coastal towns and villages and comb painstakingly through collapsed buildings and mud-trapped trains and vehicles. The needs of hundreds of thousands displaced from their homes will be huge. Japanese will be watching the performance of their ruling party, still a relative newcomer to government, just as the world will be watching to see whether the disaster further weakens a stagnating economy or acts as a jolt toward renewal.

The greatest fears Saturday centered on the nuclear power plants that provide a large share of Japan's electricity, several of which were under stress after losing cooling ability. A catastrophic failure could expand Japan's suffering exponentially. If the plants get through the crisis without causing more serious environmental or health damage than they have so far, promoters of nuclear power may hail their responsiveness in the face of historic challenge. But the reminder of potential catastrophe certainly will energize opposition to nuclear power.

For now, the most appropriate response is the aid that the U.S. military, along with rescuers from South Korea, China and dozens of other countries, is providing — and the sympathy and prayers that people all over the world are sending Japan's way. ■

— March 13, 2011

An Integrated Curriculum For The Washington Post Newspaper In Education Program

From First Reports a Complex Story Unfolds

MARCH 12

Masses left stranded; officials brace for grim accounting

HIROSHIMA, JAPAN — A bulldozing tsunami triggered by an 8.9-magnitude earthquake devastated the northeast coast of Japan on Friday, turning cars into driftwood, washing away neighborhoods and leaving this industrialized country bracing for an epic huamanitarian disaster.

— Chico Harlan

Buildings sway, then hold fast

Huge shock absorbers, walls that slide and Teflon foundation pads that isolate buildings from the ground all help explain why medium- and high-rise structures in Japan remained standing in the wake of the country's largest earthquake on record, construction experts said Friday.

— Brian Vastag

Japan races to stabilize reactors

Japanese authorities declared a state of emergency Saturday for five nuclear reactors at two quake-stricken power plants as military and utility officials scrambled to tame rising pressure and radioactivity levels inside the units and stabilize the systems used to cool the plants' hot reactor cores.

— Steven Mufson

Catastrophe spares country's major economic zones

The earthquake and tsunami in Japan on Friday struck an area that accounts for only a small fraction of the country's economic activity, but damage could still run into the tens of billions of dollars, according to analysts trying to assess the impact of the disaster.

— Howard Scheider

MARCH 13

Toll's Reality Sets In

TOKYO — Rescue teams searched through matchstick rubble Saturday for thousands of people missing in flooded areas of northeastern Japan, beginning one of the most complex relief efforts in history.

A day after the 8.9-maganitude earthquake and massive tsunami, entire towns remained impossible to reach and some feared to be wiped off the map. Most estimates put the death toll at 1,700, but officials said that number will probably spike.

About 200,000 people are living in temporary shelters. A strip of Japan's main Honshu island has almost no electricity, with scarce means to communicate. Many shelters do not have heat. Survivors at an elementary school in the devastated coastal town of Minamisanriku used chalk to write their message on a dirt playground: "SOS."

— Chico Harlan

MARCH 14

Rescuers Stymie

TOKYO — Overwhelmed by a still growing catastrophe, Japanese authorities struggled Monday to reach buried survivors and the missing, faced roadblocks in delivering aid and raced to contain an expanding nuclear emergency.

— Chico Harlan

A battle to contain the meltdowns

Tokyo Electric Power Co. entered Day 4 of its battle against a cascade of failures at its two Fukushima nuclear complexes, using fire pumps to inject tens of thousands of gallons of seawater into two reactors to contain partial meltdowns of ultra-hot fuel rods.

— Steven Mufson

Tsunami leaves city cut in two

SENDAI, JAPAN — In the center of this city, the economic hub of northern Japan, the traffic lights and vending machines are still working.

But the scene turns to chaos in the east of Sendai, along the coast. There, a dark cloud of smoke from a still-raging fire wafted over a wasteland of smashed houses, garbage heaps and uprooted trees.

Cars crushed like tin cans — tossed by the tsunami that thundered across this part of Sendai on Friday — lay scattered next to a primary school, a clock on the outside wall stuck at 2:47, the time the quake struck. Inside, pictures of grinning schoolchildren hung on the wall. Blackbirds circled over crumpled wooden houses torn from their foundations.

— Andrew Higgins

An Integrated Curriculum For The Washington Post Newspaper In Education Program

Disaster struck, but not where it was expected

BY JOEL ACHENBACH
Washington Post Staff Writer

• *Originally Published March 12, 2011*

They have long been ready for the Big One in Japan. But when it arrived Friday, it was still surprising, still utterly devastating, and it left scientists around the world humbled at how unpredictable the heaving and lurching earth can be.

Japanese geologists have long forecast a huge earthquake along a major plate boundary southwest of Tokyo, and have poured enormous resources into monitoring the faint traces of strain building in that portion of the earth's crust. They have predicted in great detail the amount of property damage and the number of landslides such a tremor would generate. They have even given the conjectured event a name: The Tokai Earthquake.

But the grinding plates of the earth move in mysterious ways, and Friday the largest recorded earthquake in Japan's history — a stunning magnitude 8.9 on the short list of most violent events since the dawn of seismology — hit about 230 miles northeast of Tokyo, generating a tsunami that within minutes socked the coast of Honshu, Japan's largest island.

The epicenter of the earthquake was about 15 miles below the sea floor and about 80 miles east of the coastal city of Sendai. Tremors are common throughout Japan, and this one was near the Japan Trench, where the Pacific plate, the speediest of the earth's major slabs of crust, dives beneath the islands of Japan in what's called a subduction zone. There was a major tremor, magnitude 7.9, just two days ago — what now looks like a foreshock.

But although this is a seismic zone, part of the so-called Ring of Fire that lines much of the Pacific, until recently it wasn't considered one of Japan's most vulnerable areas. A 2009 paper by Japanese scientists discussed the possibility of a major earthquake in this part of Japan. Science does not instantly alter public policy, however.

The Japanese government has been prepared since the 1970s for the Tokai Earthquake, the idea of which emerged from the study of previous events along the Nankai Trough, another plate boundary that slides along the underside of Japan. This is among the most complex seismic zones in the world.

The plate boundary off the coast of Sendai had not had a "mega-quake" in the modern era. It may not have suffered a major rupture like this for more than 1,000 years. The closest analog may be a tremor recorded by monks in the year 869, according to Dave Applegate, a senior earthquake specialist at the U.S. Geological Survey.

"If anyone is in position to ride this out, it is the Japanese, and yet we see the scope of the devastation," Applegate said.

Scientists said the event has reinforced a growing sense that the field of seismology needs to ditch some of its presumptions.

"This is a continuation in a sense of the cold shower that we got in Sumatra — these mega-earthquakes take place in places we do not expect them," said Emile Okal, a Northwestern University geophysicist reached in Tahiti, where he was preparing to evacuate in advance of the tsunami generated by the quake. The huge Sumatra earthquake six years ago that generated the devastating tsunami along the rim of the Indian Ocean happened on what had been presumed to be a relatively quiescent stretch of a subduction zone.

"That means that on a global scale we should consider that all subduction zones are potential locations for such events," Okal said.

Quakes aren't predictable in time, space or intensity. Hazard maps give a good sense of where something is most likely to happen, and the theory of plate tectonics, developed largely since the 1960s, is considered a triumph of modern science. But there is an element of chaos in the way the stresses of the earth relieve themselves. And an earthquake in one place can increase strain on a fault some distance away.

"It's really just a kind of guessing game, and Mother Nature never really puts up with those guessing games," said seismologist Dave Wald of the U.S. Geological Survey's National Earthquake Information Center in Golden, Colo.

Susan Hough, a USGS seismologist in Pasadena, Calif., noted that the recent earthquake in Christchurch, New Zealand, happened on an unmapped fault and caught scientists somewhat by surprise.

"We do tend to focus on the expected events. We're going to get blindsided by unusual events. But uncommon events happen," Hough said. "The analog that's worrisome is Boston. Put a 6.1 under Boston. You have all that un-reinforced masonry."

Robert Geller, a geologist at the University of Tokyo, said by e-mail: "The bottom line is that it's not possible to identify in detail which specific areas are particularly dangerous. Also, quakes are not in any sense periodic. Unfortunately some earth scientists, including some government officials in both Japan and the U.S., persist in making highly area-specific risk forecasts and also using models based on periodicity of quakes." ■

Record quake, widespread destruction

The massive earthquake that struck Japan on Friday triggered a tsunami with waves up to 30 feet that devastated the northeast coast of the country, leaving at least a thousand people dead. More than 80 aftershocks followed the magnitude-8.9 offshore quake, some of them greater than 6.0 magnitude.

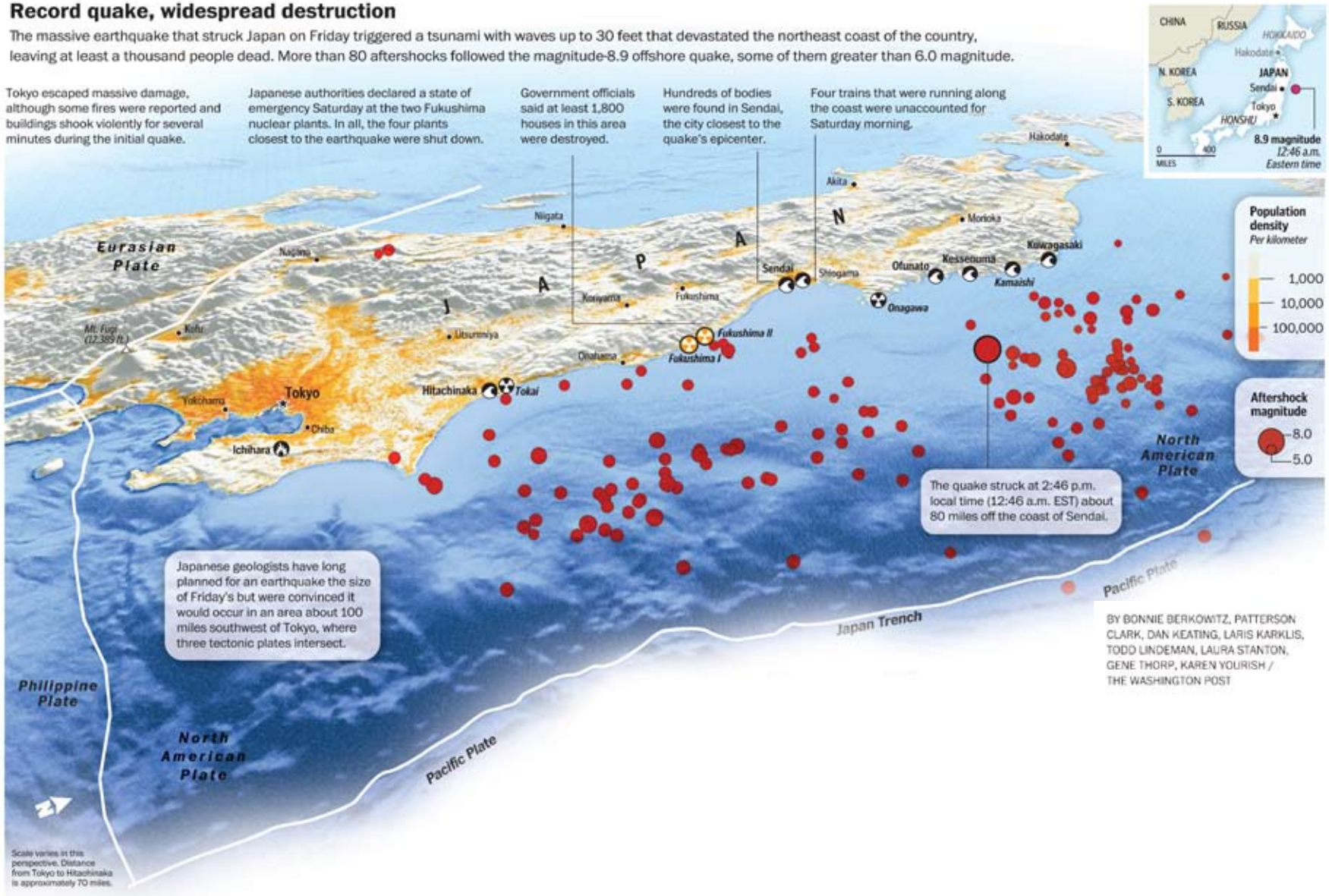
Tokyo escaped massive damage, although some fires were reported and buildings shook violently for several minutes during the initial quake.

Japanese authorities declared a state of emergency Saturday at the two Fukushima nuclear plants. In all, the four plants closest to the earthquake were shut down.

Government officials said at least 1,800 houses in this area were destroyed.

Hundreds of bodies were found in Sendai, the city closest to the quake's epicenter.

Four trains that were running along the coast were unaccounted for Saturday morning.



BY BONNIE BERKOWITZ, PATTERSON CLARK, DAN KEATING, LARIS KARKLIS, TODD LINDEMAN, LAURA STANTON, GENE THORP, KAREN YOURISH / THE WASHINGTON POST

• *Originally Published March 12, 2011*

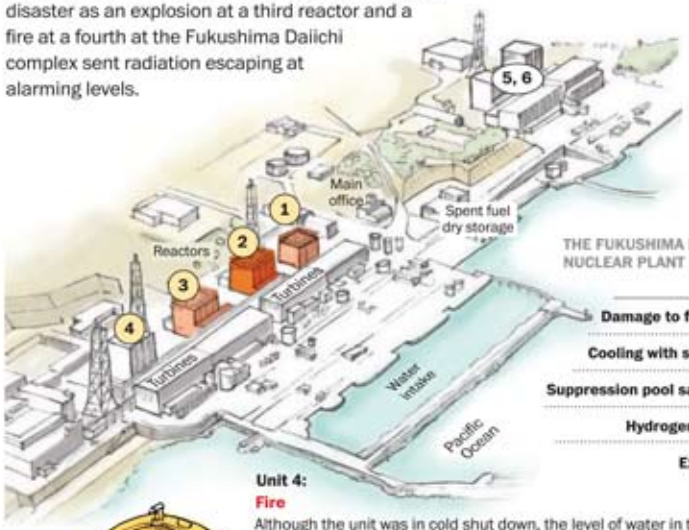
SOURCES: USGS; NOAA; Robert Stern, professor of geoscience at the University of Texas at Dallas; Bruce Shaw, geophysicist at Columbia University; Kyodo News, GoogleEarthPro, Incorporated Research Institutions for Seismology

An Integrated Curriculum For The Washington Post Newspaper In Education Program

DISASTER IN JAPAN

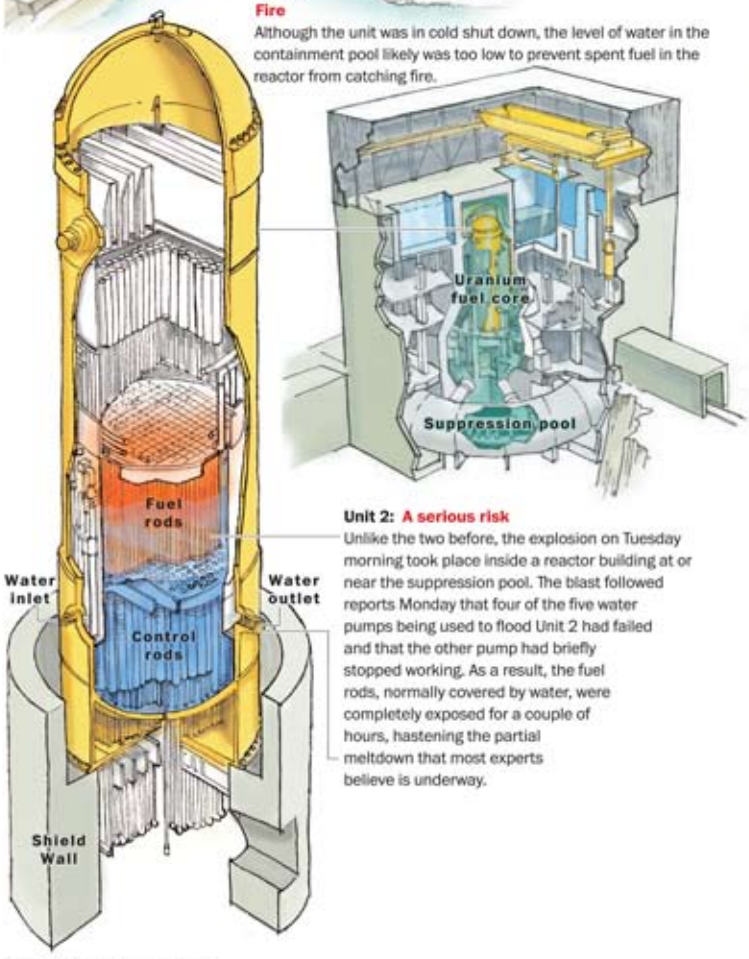
A dramatic escalation

Japan faced the potential of a catastrophic nuclear disaster as an explosion at a third reactor and a fire at a fourth at the Fukushima Daiichi complex sent radiation escaping at alarming levels.



THE FUKUSHIMA DAIICHI NUCLEAR PLANT	Reactors in state of emergency 1	2	3
Damage to fuel core	Probable	Probable	Probable
Cooling with seawater	Yes	Yes	Yes
Suppression pool saturated	Yes	Yes	Yes
Hydrogen vented	Yes	Yes	Yes
Explosion	Yes	Yes	Yes

Unit 4: **Fire**
Although the unit was in cold shut down, the level of water in the containment pool likely was too low to prevent spent fuel in the reactor from catching fire.



Units 1 & 3: **Exploded**
Like Saturday's explosion at Unit 1, Monday's blast at Unit 3 took place after a buildup of hydrogen was vented by the reactor, blowing the top off the building but not damaging the core containment structure. The hydrogen was produced by the exposure of the reactor's fuel rods and their zirconium alloy casing to hot steam.

Unit 2: **A serious risk**
Unlike the two before, the explosion on Tuesday morning took place inside a reactor building at or near the suppression pool. The blast followed reports Monday that four of the five water pumps being used to flood Unit 2 had failed and that the other pump had briefly stopped working. As a result, the fuel rods, normally covered by water, were completely exposed for a couple of hours, hastening the partial meltdown that most experts believe is underway.

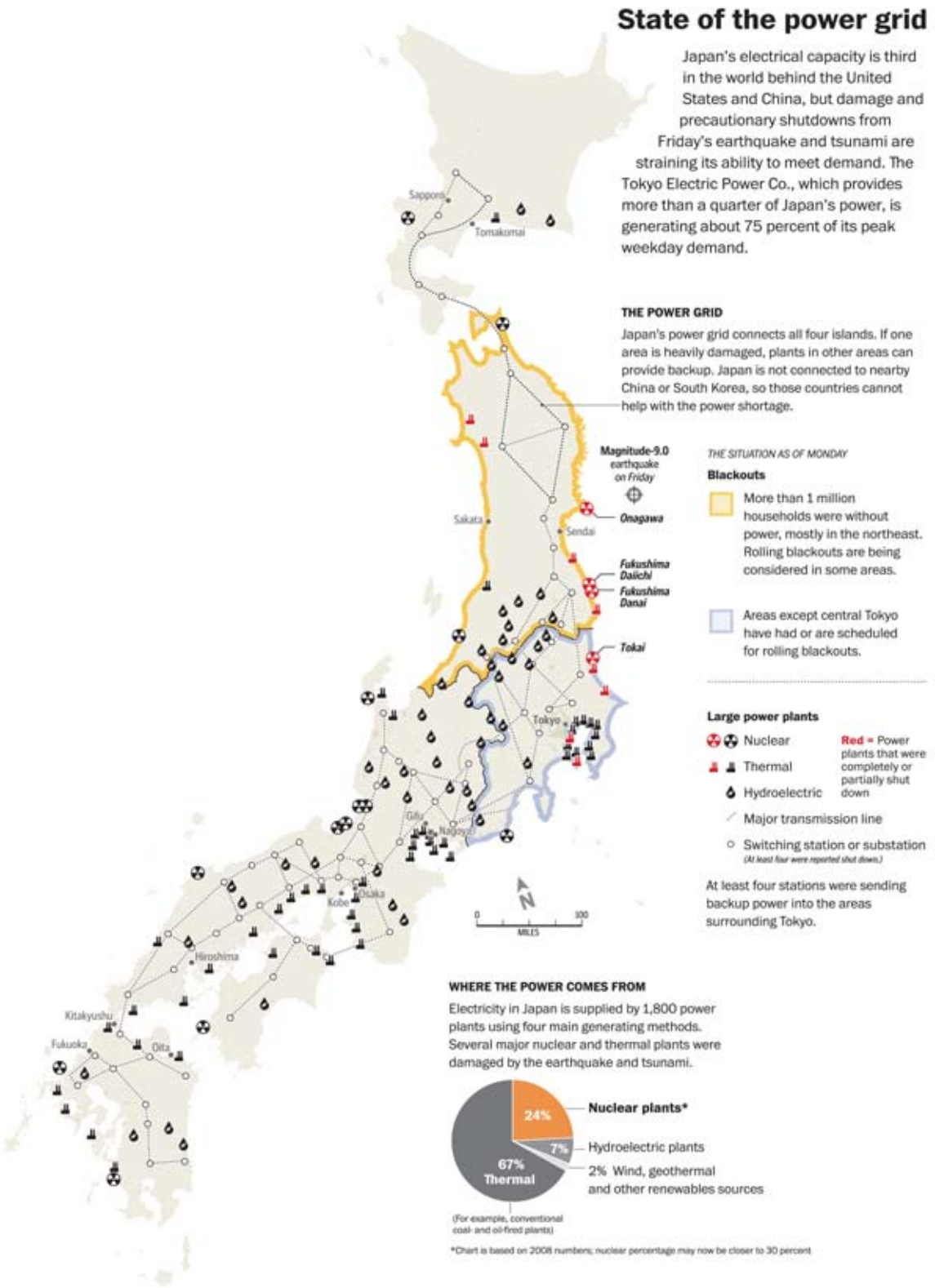
NOTE: Drawings are schematic cutaways.

SOURCES: International Atomic Energy Agency, World Nuclear Association, Peter Meisen of the Global Energy Network Institute, NHK, Federation of Electric Power Companies of Japan, Nomura Global Economics, Agency for Natural Resources and Energy, U.S. Energy Information Administration, Associated Press, Nuclear Energy Institute

• *Originally Published March 15, 2011*

BY BONNIE BERKOWITZ, MARY KATE CANNISTRA, PATTERSON CLARK, ALBERTO CUADRA, LAURA STANTON, GENE THORP, BILL WEBSTER, KAREN YOURISH/THE WASHINGTON POST

An Integrated Curriculum For The Washington Post Newspaper In Education Program

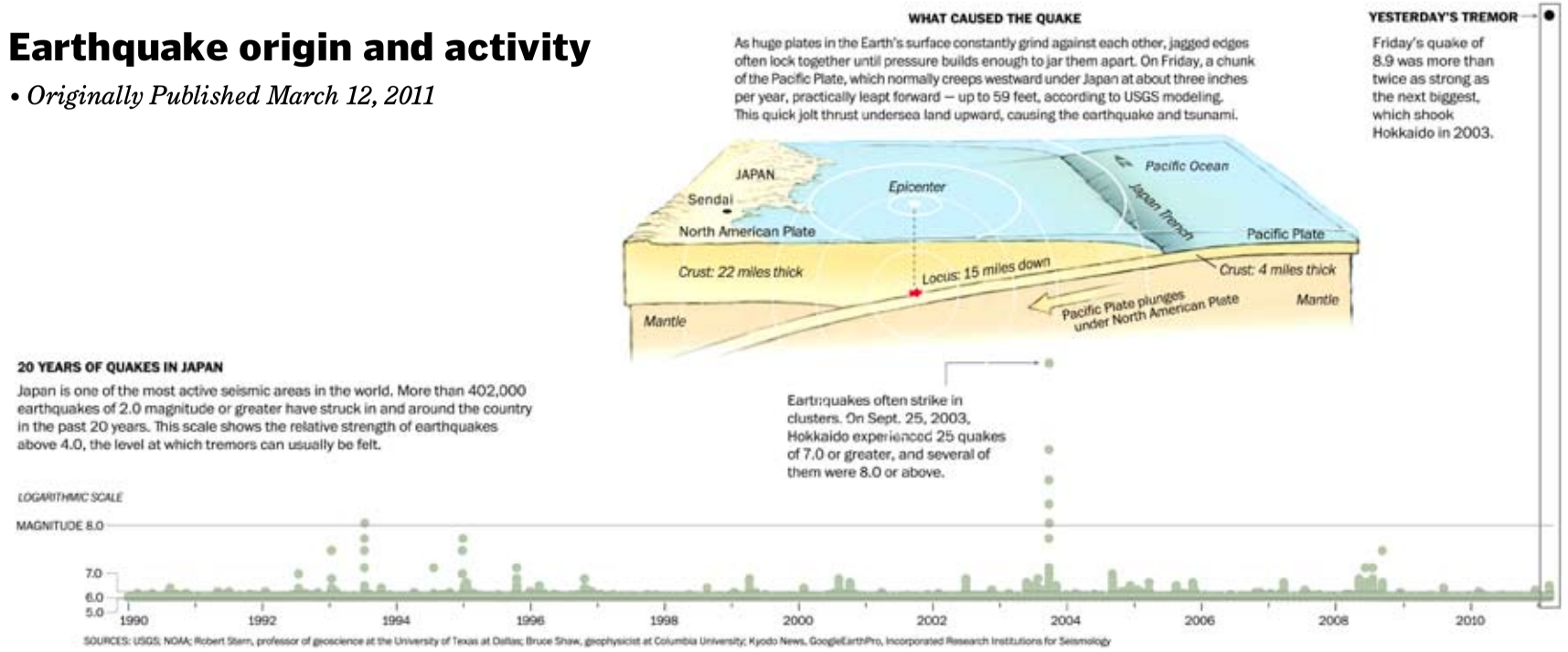


• *Originally Published March 15, 2011*

BY BONNIE BERKOWITZ, MARY KATE CANNISTRA, PATTERSON CLARK, ALBERTO CUADRA, LAURA STANTON, GENE THORP, BILL WEBSTER, KAREN YOURISH/THE WASHINGTON POST

Earthquake origin and activity

• *Originally Published March 12, 2011*

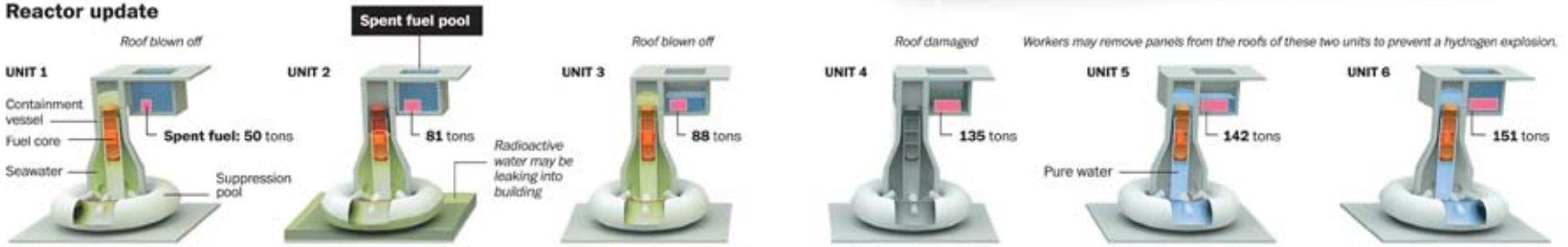


SOURCES: USGS; NOAA; Robert Stern, professor of geoscience at the University of Texas at Dallas; Bruce Shaw, geophysicist at Columbia University; Kyodo News, GoogleEarthPro, Incorporated Research Institutions for Seismology

Nuclear crisis deepens

The chairman of the Nuclear Regulatory Commission told Congress that the situation at the Fukishima Daiichi complex is worse than the Japanese have indicated. A look at where things stand at the plant's six reactors, and what one worst-case scenario could look like:

Reactor update



The reactor continues to receive seawater/boron injections. The **fuel core** is probably damaged.

Damage to the **suppression pool** is preventing the core from being fully submerged in water. The **fuel core** and **containment vessel** are probably damaged. The water in the **spent fuel pool** is reportedly decreasing.

NRC Chairman Gregory Jaczko said the **spent fuel pool** has been compromised and that there may have been a "zirc-water interaction." The reactor's **fuel core** is probably damaged.

Jaczko said the NRC believes there is no water left in the **spent fuel pool** and **radiation levels** are "extremely high."

On Wednesday, water levels in the **spent fuel pool** dropped 16 inches in five hours.

Engineers are diverting water to unit 5 to help refill its spent fuel pool.

• *Originally Published March 17, 2011*

An Integrated Curriculum For The Washington Post Newspaper In Education Program

VOLUME 10, ISSUE 7

An Integrated Curriculum For The Washington Post Newspaper In Education Program

Thousands evacuated as radiation leaks from plant are detected

Authorities screen for exposure, which poses range of health risks

BY ROB STEIN
Washington Post Staff Writer

• *Originally Published March 13, 2011*

Thousands of people living around the Japanese nuclear power plant most seriously damaged by the earthquake evacuated Saturday as authorities detected radiation leaks from the crippled facility, began screening evacuees for radiation exposure and announced plans to distribute pills to protect against thyroid cancer.

Government officials stressed that the amount of radiation that had been released by the Fukushima Daiichi Unit 1 reactor after an explosion at the facility appeared to be relatively low, and international authorities said the situation had not yet become a major public health threat.

To try to assess the extent of the exposures, workers at evacuation centers — wearing white masks and protective clothing — used handheld scanners to check everyone for radiation exposure as an estimated 170,000 people fled a evacuation zone that had been doubled to a 12-mile radius around the plant. The number of people possibly exposed to radiation could reach 160, the Japanese nuclear safety agency said.

"They must be planning for a worst-case scenario, which would be the core partially melting down or melting down," said John Boice Jr., scientific director of the International Epidemiology Institute in Rockville.

CONTINUED ON PAGE 25

KYODO NEWS VIA REUTERS

People make their way among the debris from destroyed homes in Sendai. Japan is confronting devastation along its northeastern coast.

CONTINUED FROM PAGE 24

Three of those known to have been exposed had been chosen for random testing from among 90 patients and staff members at a hospital two miles from the plant who were awaiting evacuation by helicopter and needed to be decontaminated, officials said. None had yet shown physical symptoms of radiation poisoning, officials said.

As authorities in Japan know better than those in any other nation, the extent of the risk from a nuclear power plant ultimately depends on how much and what kind of radioactive material is released, where it travels and how many people are exposed for how long, experts said.

"Anything having to do with health effects has to do with the amount of exposure the population receives, and that's just an unknown," Boice said. "That's determined by many factors, including which way the wind is blowing."

Radiation from nuclear power plants poses a host of health risks, ranging from severe toxic effects in workers exposed to high doses to long-term increased rates of many cancers, experts said.

Most of what is known about the risks of radiation comes from studying survivors of the atomic bombings of Hiroshima and Nagasaki during World War II, the 1986 Chernobyl nuclear disaster in Ukraine and radiation exposures for medical purposes.

In Chernobyl, about 30 firefighters who were exposed to very high doses of radiation while trying to douse the blaze at the plant died within a month.

"They had huge exposures," Boice said. "These were the kind of doses that just knocked out the blood system, the gastrointestinal system."

One worker at the Daiichi plant had died from injuries after becoming trapped in the exhaust stack of the plant, according to the World Nuclear Association. At least four other workers were reportedly injured in the explosion and had been hospitalized.

Beyond the deaths of firefighters in Chernobyl, the most well-documented health effect was an increase in thyroid cancer, primarily among children, due to exposure to iodine-131. An estimated 6,000 to 7,000 excess cases of thyroid cancer have occurred because of Chernobyl, mostly among people who were children at the time.

"At Chernobyl, the biggest problem was it got on the grass and the cows ate it and the milk from the cows was given to the kids," said Fred Mettler, a radiation expert at the University of New Mexico.

Japanese officials announced plans to distribute potassium iodide pills, which block radioactive iodine from accumulating in the thyroid glands, causing thyroid cancer, to people living around the Fukushima Daiichi facility and another damaged plant about seven miles away.

Of the radioactive elements released in a nuclear plant leak, radioactive iodine has a relatively short "half-life" of eight days, which means that it essentially disappears within about 80 days, Mettler said. In comparison, another radioactive substance released by nuclear power plants, cesium-137, has a half-life of about 30 years, meaning it poses a much greater risk because it gets into the food chain.

In the Hiroshima and Nagasaki atomic bombings, which provide some of the best data about the risks of radiation, about 80,000 people died from the blasts and exposure to very high doses of radiation. Studies of the survivors found that rates of a variety of cancers, including leukemia and cancer of the breast, lung and colon, remained elevated for decades.

"The Japanese have been studying radiation since they dropped the bomb over there," Mettler said. "They have been following the atomic bomb survivors for 60 years. They are the world experts on radiation effects. So nothing is lost on them."

KOICHI NAKAMURA/YOMIURI SHIMBUN VIA ASSOCIATED PRESS

A young girl is scanned for radiation exposure in Koriyama, northern Japan.

Excess cases of leukemia begin to show up within two years of exposure and peak within five to 10 years; other cancers do not start to appear in excess for at least a decade, and their risk can remain elevated for decades. But even in Hiroshima and Nagasaki, only about 9,000 survivors have died from cancer. That's about 500 more cases than would have been normally expected, Mettler said.

Studies have also found adverse psychological effects from nuclear accidents, such as the Chernobyl fire and the 1979 Three Mile Island meltdown in Pennsylvania. For example, there was an increase in suicides in Estonia and among cleanup workers after Chernobyl. Abortions also increased in some places.

"It turns out there wasn't increases in birth defects or malformations in the surrounding populations, but there was an increase in elective abortions because people were so concerned," Boice said. ■

An Integrated Curriculum For The Washington Post Newspaper In Education Program

Hunt for necessities overshadows nuclear anxieties

In tsunami-devastated northeastern Japan, desparate residents forage for food, batteries, candles, mobile phone chargers and gasoline

BY ANDREW HIGGINS

• *Originally Published March 20, 2011*

SENDAI, Japan — Five of her relatives are confirmed dead, and others are missing; her leg is battered from a frantic flight to higher ground; her home lies just a few dozen miles from a haywire nuclear power plant burping radiation into the air.

On Saturday, however, Keiko Oikawa could barely contain her joy. "I'm so lucky, really, really lucky," the ecstatic housewife said. The source of her glee: 10 fresh eggs in a crumpled cardboard box.

"I can't believe my luck," said Oikawa, explaining that she'd stumbled on a farmer selling eggs while hunting for somewhere to charge her mobile phone. She doesn't have any electricity at home.

Eight days after a 9.0 magnitude earthquake sent a merciless wall of water crashing onto Japan's northeastern coast, a city once noted for its jazz festival and expansive joie de vivre is reduced to foraging for basic necessities.

The descent of a vibrant metropolis toward a state of simple survival has helped numb the population to a further agony. Many here are too preoccupied with day-to-day needs to focus on unseen dangers leaking from the Fukushima Daiichi nuclear power plant down the coast.

PAULA BRONSTEIN/GETTY IMAGES

More than a week after the earthquake and tsunami, volunteers help rescue workers search for bodies in Rikuzentakata, Japan.

"Instead of worrying about things I can't see, I worry about things I can see," said Oikawa, showing off her newly purchased eggs.

As the major city nearest the crippled power station, Sendai is not blasé about the potential risk, just distracted. Weather reports on television are watched anxiously to see which way the winds will be blowing — and which way radioactive material might travel in the event of Chernobyl-style catastrophe. Saturday was a beautiful sunny day with cloudless skies, but blustery winds kept shifting.

The southern outskirts of Sendai lie within a 50-mile zone that the United States has advised its citizens to avoid because of the radiation risk, but "we worry about food, about getting stuff to put in our mouths," said Yuji Sugawara, a steelworker who, with his wife, has taken refuge in a shelter providing regular meals.

Japan has declared a more-limited 20-mile evacuation zone, and Sugawara is alarmed by what he sees as his government's obfuscations. "I can't trust

CONTINUED ON PAGE 27

CONTINUED FROM PAGE 26

them anymore. All we need is accurate information," he said.

But he spends far more energy worrying about when he and his wife will be able to move back into their waterlogged home and what they'll do for food when they do. Most shops, their stocks exhausted, shut down days ago.

"Batteries, candles, mobile phone chargers, food and anything edible are all sold out," reads a handwritten sign on the shuttered doors of Sunkus, a Japanese chain of convenience stores.

Without power or gas for trucks, the city's government-run abattoir, which used to slaughter up to 200 cows and 900 pigs a day, hasn't killed an animal for eight days. Everyone is "very concerned by what they will have to eat," said the abattoir's chief, Jun'ichi Sato, who lost his house to the tsunami and now lives with an uncle, along with his wife and seven other homeless relatives. Sato has two sets of clothes: a suit he was wearing for a business meeting when the tsunami struck and his slaughterhouse uniform.

Trained as a physicist, he described radiation risk as "no big deal" because levels so far are not that high. But, he added, if efforts to regain control of the six-reactor complex south of the city fail, "I'll be worried too."

Long lines on Saturday snaked from the Don Quixote supermarket and other stores that still had something to sell. A desperate shortage of gasoline has left the city's wide, clean boulevards eerily empty of traffic.

KYODO NEWS VIA ASSOCIATED PRESS

Survivors of Japan's natural disasters fill bottles with hot water at a shelter in Miyagi prefecture.

But authorities have managed to halt some of the rot, at least in parts of the city pulverized by the tsunami. Crunched cars that earlier in the week lay scattered across a wasteland of flattened buildings have been moved and placed in neat lines by the side of roads swept free of rubble.

Electricity and water supplies are slowly being restored. Phones are mostly back up. To speed deliveries of food and other supplies, a four-lane toll highway leading west to the city of Niigata is closed to all but emergency convoys and the vehicles of Japan's Self-Defense Force, which has borne the brunt of relief efforts.

Local television, meanwhile, tries to lift spirits by broadcasting the names of people who survived the tsunami and have taken refuge in shelters. But the death toll continues to mount. Nationwide more than 7,000 people are now confirmed dead, and nearly 11,000 have been reported missing. The bulk of these lived in Miyagi prefecture, of which Sendai is the capital.

Oikawa, the woman who managed to buy eggs, said she feared the worst for her own missing relatives, who lived north of Sendai in a coastal town that took a particularly brutal blow. Exhausted by worry and the daily struggle to find food she said: "I wish I were a bird and could fly away from all this." ■

An Integrated Curriculum For The Washington Post Newspaper In Education Program

An emperor comes down to earth

As Japan's Akihito gives his first televised speech, the messenger is the message

BY MONICA HESSE

• *Originally Published March 21, 2011*

Here is a man. A small man — at 77, an old man — in a dark suit with an unremarkable voice, frequently glancing down at the sheaf of papers on his desk, which hold an address of plain words. It is the emperor of Japan.

To see him is not to see a president or prime minister, who trade in television appearances and winning turns of phrase. Until Emperor Akihito addressed his people Wednesday, he had never before delivered a televised speech. Not once in his two-decade reign.

"I hope things will take a turn for the better," he said to a nation that had just suffered a massive earthquake and nuclear plant disasters. "It is my hope that many lives will be saved." His entire address was about five minutes long.

The screen-watching world has been particularly attuned this year to the speeches of kings, or at least the speeches of a king who is played by Colin Firth in Oscar-winning movies. *The King's Speech* helped even monarchy-ignorant Americans understand that it meant something when a royal spoke. That's all royals seem to do anymore, anyway: they mean things. They symbolize things, decoratively, all pomp and pageantry and figureheads. But in times of crisis, they could genuinely mean something.

The Japanese monarchy is the oldest hereditary dynasty in the world, going back more than 2,000 years. Until World War II, emperors were considered to be arahitogami — incarnate deities, living gods. There were forms of speech

MICHAEL CARONNA/REUTERS

A FIRST: Emperor Akihito had never given a televised address to his country before last week. It was also the first by an emperor since his father, Hirohito, announced Japan's surrender to the Allies in 1945.

that only emperors could use. *Chin*, an emperor would say, for "I," and it was an "I" that was for no one else.

When Japan surrendered to the Allies in 1945, Akihito's father, Emperor Hirohito, was forced to refute his divine status. As part of postwar negotiations he was allowed to retain his title, but only on a ceremonial basis. He became just a man, an emperor with no empire.

This is the throne that Akihito inherited in 1989 — an ancient title in a modern era. "He cannot decide anything," says Ben-Ami Shillony, an Israeli author who has written two books on the Japanese monarchy, and who was honored by the emperor in 2010 for his contributions to Japanese studies. Akihito "cannot say anything of a political or controversial nature," Shillony says. "He really has no powers at all."

His actions are controlled by the Imperial Household Agency, the government institution whose purpose is overseeing the emperor. He gives an annual address to open Japan's parliament, but the government has written it for him. He stands on a balcony on his birthday, and he waves to the cheering crowds.

What he has is symbolism. Meaning.

Throughout Akihito's reign, the imperial couple has symbolized the modernity that was foisted upon them, and that they, in turn embraced. Akihito is not a soldier, but a scholar, Shillony notes; he writes about fish for journals

CONTINUED ON PAGE 29

CONTINUED FROM PAGE 28

of biology. In times when the country believed that disabled individuals should be hidden from public view, the emperor and his wife, Empress Michiko, championed the Paralympics.

Michiko was the first commoner to marry into Japanese royalty; she met her husband on a tennis court when she was 23, and they married two years later and had three children. In an unprecedented move, the empress took up her own causes, championing children's literacy. "She has been the most active empress in all of Japan," says Kenneth Ruoff, a Portland professor who has written several books on the imperial family.

In recent years, Japan fretted that the royal lineage might end with Akihito's oldest son. In an absurd tragedy, Crown Prince Naruhito's wife, Crown Princess Masako, has a Harvard education but is primarily known for her failure to give birth to a male heir. For awhile, there was speculation that the government might consider amending the constitution to allow female emperors. A son born to Naruhito's younger brother, Prince Akishino, made that debate unnecessary, but, Ruoff says, Empress Michiko's active role might have paved the way for future generations of female power.

And, because progress so often involves looking back, Akihito has spent his reign apologizing for his father's legacy, making amends with the neighboring countries that suffered brutality at Japanese hands during the Second World War.

Wars and catastrophes are when decorative monarchs shine or fade. Even without power, they are viewed as guideposts of behavior or beacons of hope.

There was King George VI's speech, of course, at once halting and intimate, both on screen and in real life. And there were the actions of other monarchs of his era. King Haakon VII of Norway hinted that he would abdicate the throne if the Norwegian government acquiesced to the demands of the Germans: "The responsibility for the calamities that will befall people and country is indeed so grave that I dread to take it," he told the cabinet, and was eventually forced into exile. His brother, King Christian X of Denmark, refused to leave the city of Copenhagen during the war. While the Nazis occupied the city, he daily rode his horse, Jubilee, unprotected through the streets.

More recently: One day after Emperor Akihito's speech, Britain's Prince William visited New Zealand, also hit by a recent earthquake, and delivered messages of reassurance to the nation, a member of the British Commonwealth: "With the queen's heartfelt good wishes, and those of the prince of Wales and other members of my family, I say it to you now: 'Kia kaha.' Be strong."

"The essence of a monarchy is that it is symbolic of the nation as a whole," says Bill Purdue, the author of *Long to Reign? The Survival of Monarchies in the Modern World*. It's a link between the nation's past and present."

In times of tragedy, it can be reassuring that the face reassuring you is a face you have known for decades, as familiar as a family member's. It belongs to a person who will never retire — who is, in some ways, simply a very highly exalted public servant.

Of Wednesday's address, Purdue says, "The person who represents the essence of being Japanese was speaking to the nation at one of Japan's most important times."

The last time a Japanese monarch made such an address was in 1945 — when he was still a living god, and he had to tell his people that their country had surrendered.

In that speech, Hirohito spoke in a formal dialect — a court dialect, some have called it — full of euphemisms. "The war situation has developed not necessarily to Japan's advantage," he hedged in firm, clipped tones. It was the first time the people of Japan had heard their ruler's voice.

By contrast, Akihito's speech last week was formal, Japanese speakers noted, but no more formal than an average citizen would use for such a solemn occasion. When he used the pronoun "we," it was the "we" of any Japanese citizen.

In those five minutes were no quotable lines, no fourscore and sevens, no "I had a dream," no "I will fight no more, forever." It didn't overpromise, or even promise. It was humble. It offered hope, but tentatively. It wasn't really a good speech, linguistically speaking; what made it good was the fact that it was given. The messenger was the message.

"I've been unable to stop watching TV news since the 11th," writes Yoko Hasegawa, a professor of Japanese linguistics at Berkeley, via e-mail. She has been particularly attuned to a Web site that allows people to comment on a news stream as it is broadcast.

Before the emperor's speech, Hasegawa recalls, there were comments speculating that the emperor had fled the country, or that he didn't care about the disasters, because the palace was probably equipped with its own fallout shelter. But after the address, the negative comments stopped. She hasn't seen any appear since.

One could imagine many reasons why this would be so. The most romantic interpretation is that the small, understated address meant something very big, and what it meant was what Colin Firth's George VI said his speech meant, in a time of confusion and yet-incalculable suffering:

"The nation believes that when I speak, I speak for them." ■

hessem@washpost.com

An Integrated Curriculum For The Washington Post Newspaper In Education Program

In Ishinomaki, news comes old-fashioned way: Via paper

BY ANDREW HIGGINS

• *Originally Published March 22 2011*

ISHINOMAKI, Japan — Nobody tweeted or blogged or e-mailed. They didn't telephone either. Bereft of electricity, gasoline and gas, this tsunami-traumatized city did things the really old-fashioned way — with pen and paper.

Unable to operate its 20th-century printing press — never mind its computers, Web site or 3G mobile phones — the city's only newspaper, the *Ishinomaki Hibi Shinbun*, wrote its articles by hand with black felt-tip pens on big sheets of white paper.

But unlike modern media, the method worked.

"People who suffer a tragedy like this need food, water and, also, information," said Hiroyuki Takeuchi, chief reporter at the *Hibi Shinbun*, an afternoon daily. "People used to get their news from television and the Internet. But when there is no light and no electricity, the only thing they have is our newspaper."

HIROTO SEKIGUCHI/ASSOCIATED PRESS

As snow falls on the wrecked town of Onagawa, Yoshikatsu Hiratsuka weeps beside a pile of debris under which his mother's body is buried.

While recent political ferment across the Arab world has trumpeted the power of new media, the misery in Japan, one of the world's most wired nations, has rolled back the clock. For a few days at least, the printed and handwritten word were in the ascendant.

After writing and editing articles, Takeuchi and others on staff copied their work onto sheets by hand for distribution to emergency relief centers housing survivors of Japan's worst-ever earthquake and deadly tsunami that followed.

"They were desperate for information," said Takeuchi, who has slept in the office for the 10 days since the tsunami flooded the ground floor of his house.

With electricity now restored to about a third of the northeast city's 160,000 residents, Takeuchi's newspaper has put away its pens and started printing. Internet is still not available. Monday's printed

CONTINUED ON PAGE 31

CONTINUED FROM PAGE 30

front page cheered a "miraculous rescue drama" — the story of an 80-year-old woman and her 16-year-old grandson plucked from their ruined Ishinomaki home Sunday.

Down the coast in Sendai, a once-thriving city of more than 1 million, the digital juggernaut has also come to a halt. "In conditions like these, nothing has power like paper," said Masahiko Ichiriki, president and owner of *Kahoku Shimpo,* the city's main newspaper. With most shops shut, people can't buy batteries to power radios.

The collapse of the region's electrical system has shut down Sendai's computers and television sets, but Ichiriki's Sendai newspaper has published throughout. It even put out a single-page flash edition on the evening of the tsunami.

Information-starved residents, said the proprietor, "depend on our newspaper for a lifeline." It not only provides news about a catastrophe but also mundane, vital information: which shops have food, which roads have been cleared of rubble, which banks have cash and which branches of a popular liquor store have reopened.

In Ishinomaki, which is smaller than Sendai and sustained more damage, the *Hibi Shinbun* didn't publish for two days after the tsunami. One of its six reporters was swept away in his car while returning from an assignment. He survived and, after several days in a hospital, is back at work.

REUTERS

Rescue workers carry Jin Abe, 16, in northeastern Ishinomaki City. The teen and his 80-year-old grandmother, Sumi Abe, were found alive under rubble. Their dramatic airlift was shown on national TV.

Takeuchi, the chief reporter, was in the office when the earthquake struck at 2:46 p.m. on March 11. He had just finished work on that day's edition, which featured a front-page article about Ishinomaki's "hidden charms" and officials' promises to improve hospital and other facilities.

The quake shook the newspaper's two-story building so hard that fluorescent lights fell from the ceiling and filing cabinets skidded across the floor.

The first handwritten edition, prepared March 13, featured a pledge to "try and get information as accurate as possible." It reported on the arrival of rescue teams from across Japan and on the extent of the ruin. Houses and businesses along Ishinomaki's waterfront were destroyed. More than 30,000 people took refuge in shelters. "We now know the full extent of the damage," read a headline.

The next day, the paper wrote the names and ages of 34 area residents whose bodies had been identified. It also reported on a robbery in a supermarket, a sign of the city's desperation.

But the paper has tried to lift rather than dampen people's battered spirits, Takeuchi said. "We look for things related to hope. This is our philosophy," he said. The paper stopped publishing the names of the dead because "the number just kept growing." More than 1,300 corpses have been identified.

All of these efforts have helped fill that void left by the absence of electronic media. "Living with no electricity or water and not much food is hard enough," said Yutaka Iwasawa, 25, of Ishinomaki."But the worst thing was that there was no information." He said he missed e-mail and surfing the Web. ■

higginsandrew@washpost.com

Effects of radiation

A blast of radiation often causes immediate, obvious symptoms, but damage from low levels of exposure — generally 100 mSv or less — may not appear for decades, if ever. Japanese officials have set a dose limit of 250 mSv for nuclear workers during emergencies.

HIGH EXPOSURE

A high dose of radiation over a few minutes or hours can cause acute radiation syndrome, which begins immediately.

SHORT TERM

All over: Fatigue, dehydration.

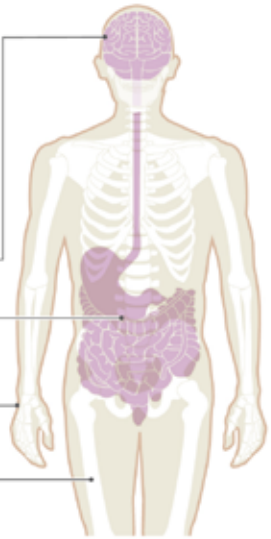
Hair: Falls out within a week.

Brain: Confusion, seizures.

Stomach/intestines: Nausea, vomiting, diarrhea, loss of appetite, damage to intestinal lining.

Skin: Burns, which can lead to infection.

Bones: Marrow cells begin to die, leading to bleeding and infection.



LONG TERM

Cell damage, which makes people susceptible to leukemia and other cancers and can cause sterility and other problems.

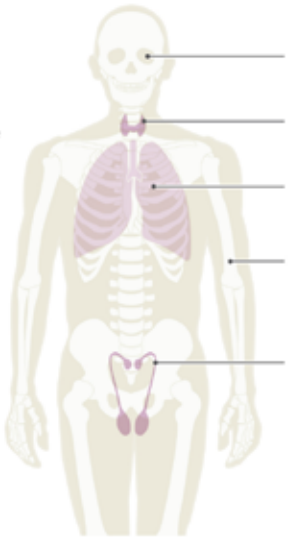
Who's affected: Likely only people very close to a source of radiation, such as reactor workers.

LOW EXPOSURE

A person who is exposed to a small dose rarely shows immediate symptoms, and often the body repairs or ignores cell damage.

Who's affected: Potentially, people in surrounding or downwind areas and on those who inhale or ingest dispersed particles.

Death occurs with an extreme dose (likely 5,000 to 12,000 mSv).



AMONG THE POSSIBLE SYMPTOMS

Eyes: Cataracts

Thyroid: Radioactive iodine collects in the thyroid and causes cancer.

Lungs: Inhaled plutonium particles can cause lung cancer.

Bones: Radioactive strontium can damage marrow and causing leukemia or bone cancer.

Reproductive system: Genetic damage can be passed to children.

Whole body: Radioactive cesium can contaminate the environment, causing various types of cancer when ingested or inhaled.

BONNIE BERKOWITZ, PATTERSON CLARK, LARIS KARKLIS, TODD LINDEMAN, ALICIA PARLAPIANO, LAURA STANTON AND KAREN YOURISH/THE WASHINGTON POST

SOURCES: Kenneth D. Bergeron; Rod McCullum, Nuclear Energy Institute; International Atomic Energy Agency; Tokyo Electric Power Company; The National Academies Press; U.S. Nuclear Regulatory Commission; Environmental Protection Agency; Japan Nuclear Energy Safety Organization; CDC; NRC; Health Physics Society; Physicians for Social Responsibility; satellite imagery provided by DigitalGlobe

• *Originally Published March 17, 2011*

An Integrated Curriculum For The Washington Post Newspaper In Education Program

Tokyo tap water unfit for infants; radiation warning on 11 vegetables

BY DAVID NAKAMURA

• *Originally Published March 24, 2011*

TOKYO — Fears over Japan's food and water supply escalated Wednesday after authorities announced they had discovered radioactive material above the legal limit in 11 types of vegetables and radioactive substances in water produced at a Tokyo purifying station.

Officials warned residents not to eat the vegetables produced in several prefectures near the badly damaged Fukushima Daiichi nuclear facility and recommended that infants not ingest tap water in Tokyo.

Tokyo officials said they would distribute three 550-milliliter bottles of water to every household in the capital where an infant was living — about 80,000 households.

Meanwhile, emergency work to repair the Daiichi plant was halted again when smoke was seen blowing from the complex Wednesday afternoon, prompting the second evacuation of workers in three days.

Crews have been attempting to restore electrical power to four of Daiichi's six nuclear reactors, which are in various states of overheating.

The situation at Daiichi still warranted "serious concern," said Graham Andrew, technical adviser to the director general of the International Atomic Energy Agency, although radiation readings at the site were declining. He added that since partial power was restored to the facility, IAEA had been receiving better data from Japanese authorities regarding the status of each stricken reactor. Andrew said IAEA experts were analyzing temperature and pressure readings from the reactors and would send advice on proposed actions to Japanese authorities.

Some of the reactors have spewed radioactive particles into the air, leading to the contamination of crops, milk and water.

The March 11 earthquake and tsunami have left 9,487 dead and 15,617 missing, the National Police Agency reported. And the Japanese government said Wednesday that the escalating catastrophes have caused up to 25 trillion yen ($309 billion) in damages. That estimate is far higher than the $235 billion figure suggested by the World Bank this week.

The Japanese government's warning on tap water sparked fears among many mothers of young children in Tokyo, including Mitsue Watanabe, 39, who said she was "really worried." She said she called a couple of stores to try to find bottled water, but the stores were sold out.

"They say they don't know when they will get more," Watanabe said. "I breast-feed, but my child is starting solids, and I have to cook her meals using tap water. I have been exchanging e-mails with mum-friends with babies sharing concerns and to get tips on what to do."

The list of contaminated vegetables includes broccoli, cabbage, turnips, parsley and other green leaf vegetables, the Health, Labor and Welfare Ministry said. This week, government officials found elevated radiation levels in raw milk and spinach in several prefectures near the Daiichi plant.

CONTINUED ON PAGE 34

PAULA BRONSTEIN/GETTY IMAGES

People buying groceries in Ichinoseki, Japan, and elsewhere are cautioned about vegetables.

CONTINUED FROM PAGE 33

Though officials had said the radiation in milk and spinach was not high enough to be harmful to humans, the latest tests show contamination that is high enough to be unsafe if the vegetables are consumed on a regular basis. Eating 100 grams for 10 days would be equivalent to the amount of radiation a person receives from the natural environment for a year, health officials said.

Concerns about Japan's agricultural exports spread to the United States Tuesday, when the Food and Drug Administration banned the import of dairy products, fruit and vegetables from four prefectures — Fukushima, Ibaraki, Tochigi and Gunma. Japanese seafood will be allowed into the U.S. market after being screened, the agency said.

TYLER SIPE FOR THE WASHINGTON POST

Yurie Tanaka feeds her 3-year-old son, Somo, as daughter Mao, 2, looks on at a shelter in Soma. The March 11 tsunami destroyed the family's home.

The Japanese government has said it will offer subsidies to farmers whose crops have been affected by the nuclear fallout, but some farmers fear their livelihoods will be severely threatened as consumers change their eating habits.

The dangers associated with food that has been contaminated by radioactive material was highlighted in the wake of the Chernobyl nuclear accident in 1986, when thousands of children who ingested milk developed thyroid cancer.

Tokyo resident Jinko Sato, 39, who is pregnant with her third child, said she doesn't know what to do now that she cannot use water to cook.

"What to me was something that was happening far away," Sato said, "has all of a sudden become an immediate concern." Also Wednesday, the Department of Energy released radiation data collected from 40 hours of flights near the Daiichi facility. The flights found more radiation to the northwest of the plant than elsewhere. The maximum radiation recorded by the team was 300 microsieverts per hour; by comparison, a round-trip flight from Tokyo to New York exposes passengers to about 200 microsieverts of radiation from cosmic rays.

Meanwhile, wisps of radioactivity from the facility were detected in Washington state and California, the Environmental Protection Agency reported. While the EPA's monitors detected a few radioactive isotopes that likely originated at Daiichi, the amounts detected "are hundreds of thousands to millions of times below levels of concern," the agency said in a statement. ■

nakamurad@washpost.com

Staff writer Brian Vastag and special correspondent Akiko Yamamoto contributed to this report.

Academic Content Standards

This lesson addresses academic content standards of Maryland, Virginia and the District of Columbia.

Maryland

Science: Develop explanations that explicitly link data from investigations conducted, selected readings and, when appropriate, contributions from historical discoveries.
b. Interpret tables and graphs produced by others and describe in words the relationships they show. (Skills and Processes, Grade 8)

Science: The student will explain changes in Earth's surface using plate tectonics
- Sea floor spreading (age evidence, mantle circulation, outer core circulation, seismic activity
- Theory of Plate Tectonics (crustal plate composition, mantle circulation, divergent/convergent/transform fault boundaries, subduction zones, trenches, seismic activity (Earth/Space Science, 2.4.3)

Economics: Analyze how technological changes have affected the consumption and production in the contemporary world (Indicator 3)
- Identify factors that have influenced economic development in various regions, such as individuals, corporations, natural resources, technology, military power, population growth, international organizations, infrastructure and public health issues

The Maryland Voluntary State Curriculum Content Standards can be found online at http://mdk12.org/assessments/vsc/index.html.

Virginia

Earth Science: The student will investigate and understand that oceans are complex, interactive physical, chemical and biological systems and are subject to long- and short-term variations.
d) features of the sea floor (continental margins, trenches, mid-ocean ridges, and abyssal plains) as reflections of tectonic processes (ES.11)

Physics: The student will investigate and understand that energy can be transferred and transformed to provide usable work.
a) transformation of energy among forms including mechanical, thermal, electrical, gravitational, chemical, and nuclear

Economics: The student will demonstrate knowledge that many factors affect income by
d) describing how changes in supply and demand for goods and services affect income. (EPF.4)

World History and Geography, 1500 A.D. to the Present: The student will demonstrate knowledge of cultural, economic, and social conditions in developed and developing nations of the contemporary world (WHII.16)

Standards of Learning currently in effect for Virginia Public Schools can be found online at www.doe.virginia.gov/testing/sol/standards_docs/index.shtml

Washington, D.C.

Science: Recognize that the environment may contain dangerous levels of substances that are harmful to human beings. Therefore, the good health of individuals requires monitoring the soil, air, and water, as well as taking steps to keep them safe. (The Human Body, 4, 7.7, Grade 7)

Earth Science: Plate tectonics operating over geologic time has altered the features of land, sea, and mountains on the Earth's surface
5. Explain why, how, and where earthquakes occur, how they are located and measured, and the ways that they can cause damage (directly by shaking and secondarily by fire, tsunami, landsliding or liquefaction). (ES.7, Plate Tectonics)

English: Analyze the techniques used in media messages for a particular audience, and evaluate their effectiveness. (Media. 11.M.2)

Learning Standards for DCPS are found online at http://dcps.dc.gov/DCPS/In+the+Classroom/What+Students+Are+Learning