

**Expedition 9 - NOVA - Japan's Killer Quake**

**Complete by Saturday at 11 PM**

**Expedition Objectives:**

- Learn about the 2011 Tohoko earthquake and tsunami, including the application of science to study this natural event, and its implications for the coastal areas of the western U.S.
- Learn about an international scientific program, called NanTroSEIZE, to drill a major undersea fault that has generated very large earthquakes in the past, resulting in major tsunamis and the loss of thousands of lives in Japan.
- **Homework** - post one multiple choice question on how scientists are studying the 2011 Japan earthquake and subsequent tsunami and a second multiple-choice question on ocean drilling of the major fault off Japan in the NanTroSEIZE program your Expedition 9 Learning Group Discussion in Canvas,

*Public Broadcasting Service, Oregon Public Broadcasting, NOVA - Japan's Killer Quake*  
first aired on March 30, 2011 (55 minutes-long)

**I. Part I (nearly 14 minutes-long) - <http://youtu.be/SMgSOYaTI1g>**

**1. Introduction - What is the subject matter of this NOVA program?**

**2. Scientific Objectives**

What is Roger Bilham trying to measure?

a. \_\_\_\_\_

b. \_\_\_\_\_

**3. The earthquake**

Where was the earthquake located? \_\_\_\_\_

Why was the Fukushima reactor still a danger even though it was shutdown?

\_\_\_\_\_

Why were seismologists surprised by the great size of this earthquake?

Describe the plate tectonic setting of this earthquake?

How long had energy been building up, and stored in the crust, prior to the earthquake?

How long did the earthquake shaking last in Tokyo? \_\_\_\_\_

What happened to the ground beneath the tourist (this is especially common in water-saturated soils along coastlines)?

Did Japan's earthquake warning system work? \_\_\_\_\_

What was the magnitude of this earthquake? \_\_\_\_\_

Why did the people of Japan know that the earthquake was only the beginning of the threat?

Describe how the upper plate of the subduction zone behaves as the plate boundary fault slips and how this results in a tsunami?

**II. Part 1B (14.5 minutes long) - [http://youtu.be/2ob9dl\\_EknU](http://youtu.be/2ob9dl_EknU)**

**4. The tsunami**

How fast does a tsunami travel? \_\_\_\_\_

How high is the tsunami in the open ocean? \_\_\_\_\_

What factor controls the speed of a tsunami? \_\_\_\_\_

Why does the wave "break" as it approaches the shore?

\_\_\_\_\_

What happens typically happens to the ocean along the shoreline near before the tsunami arrives?

Why does the tsunami arrive at different coastal locations at different times and with different strengths?

What is the best early warning system if the earthquake is nearby?

How does the shape of the land surface influence the spread and advance of the tsunami?

How had one coastal city prepared in advance for a tsunami, given its history of tsunamis in the past?

How high was the tsunami in this city? \_\_\_\_\_

Why did the tsunami breach the coastal defenses such as the 30 foot-high tsunami walls?

What type of sensors indicated the drop of the land in this region?

What happened at the Fukushima power plant?

What happened to the building debris and displaced automobiles after the tsunami stops advancing landward?

**III. Part 2 (25 minutes-long) - <http://youtu.be/oPSlOi05OzA>**

### **5. Tsunami Across the Pacific**

What did the deep ocean sensors show about the tsunami?

What happened in Hawaii?

How did the early warning system work in Hawaii and why?

How important is the tsunami warning system if the earthquake is close by?

Why does the energy of a tsunami decrease as it travels across the Pacific Ocean?

How long after the earthquake did the tsunami take to reach California?

What happened to the height of the tsunami wave in some areas of California and why?

How well did the warning system work in California?

## **6. Earthquake and Tsunami Damage Back in Japan**

Back in Japan, how far did the effects of the tsunami reach inland and how did this occur?

How much did the land sink in the coastal region?

How did the rising water reach even greater heights in some regions?

What was the tsunami composed of, once it reached the urban areas?

What is the importance of the Japan earthquake and tsunami for science, both now and in the future?

What happened at the Fukushima power plant?

**7. What does 2011 earthquake imply for the seismic risk on other fault zones in the region?**

Where had scientists forecasted a major earthquake to occur and how might 2011 earthquake have affected the potential for this earthquake in the future?

What is Dr. Chris Goldfinger's statement about the effect of the 2011 earthquake on stress in the crust in this region?

What is the threat to Tokyo posed by this future earthquake?

When might this earthquake happen?

What is the recommendation of Dr. Costas Synolakis of the Univ. of Southern California?

What is the recommendation of Dr. Simon Boxall, in terms of what science can provide?

**8. What does 2011 earthquake imply for the seismic and tsunami risk along California?**

What does the Japan earthquake tell scientists about the potential for a similar event in the Pacific Northwest of the U.S? Explain.

What would happen if there was a great earthquake (M=9) along the Cascadia subduction zone?

How does the preparation level in Japan compare to that along the western U.S. coast and what does this portend for the future along the west coast of the U.S?

**Part IV - Another Threat to Japan and Current Scientific Research on Underwater Fault Zones (9 minutes of video)**

**9. Drilling Deep for Earthquakes - Harold Tobin talks about NantroSEIZE and JFAST (4 minutes-long) at:**

<http://youtu.be/e6D2Az6lgQg>

What is an earthquake and why do they happen?

Where do the biggest earthquake occur and how are Tobin and more than 100 international colleagues studying earthquakes before they occur?

How deep are these holes being drilled through the seafloor off Japan?

Why are these holes being drilled so deep?

Besides collecting rock samples in the fault, how else is the drilling being used to monitor the conditions in the fault over time?

How is this research changing the scientific view on movement on the megafault and the ability to generate large tsunamis?

How do the scientists know where to drill?

How can this work potentially lead to an early warning system?

**10. Drilling during NanTroSEIZE - Integrated Ocean Drilling Expeditions 314, 315, and 316 at (5 minutes-long):**

<http://www.youtube.com/watch?v=CQqPqMx33Lo>

Here is some background information on the NanTroSEIZE drilling program along the Nankai Trough.

What is the objective of this ambitious, international, multi-billion dollar, decade-long program?

Why are rock and sediment samples being collected by drilling the faults?

**Check Canvas for any required reading assignments for this expedition that are posted online**

- **Homework** - post in your expedition 9 learning group two multiple choice questions with answers (e.g. a, b, c, d, and e); the first multiple choice question on how scientists are studying the 2011 Japan earthquake and subsequent tsunami and a second multiple-choice question on ocean drilling of the major fault off Japan in the *NanTroSEIZE* program your Expedition 9 Learning Group Discussion in Canvas,

You will also be asked to peer review the posted questions of other students in your learning group.