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Earth2Class – Fall 2005

Lesson Plan – 125th Street Fault Field Trip

Course and Grade Level: Earth Science – 9th Grade
Unit: **Plate Tectonics**
Topic: **Earthquakes and Faults – Introduction to Hazards**
Question: What can we learn from the surface of a fault?
Objectives:
Students will explore the surface of a fault in New York City.
Students will observe the fault, and draw a conceptual model of the fault.
Students will expand their conceptions of the size of a fault.

Time Frame: 3 hours plus travel time.

NYS standards: Earth Science **2.1n**, **2.1p**

Introduction:

This lesson will take place after discussion of faults in class. Students will have had instruction on plate tectonics, and have learned about faults, and modeled different types of faults in class. This lesson will bring a real life connection for the students to help the gain the size and scale of a fault. The 125th Street fault is somewhat limited because it is only visible from the surface, but this will be an example of how geologists can learn by deciphering clues. This will also provide a real-life connection because of the 2001 earthquake that took place here. This will lead into a discussion about earthquakes and then other hazards included in the Earth Science curriculum.

Background Information:

In this experience, students would have the opportunity to visit a fault within that urban environment. Not only is the fault visible, but it has also been active recently. This experience is designed to peak students' interest, help them understand the size scale of a fault and expand their understanding about plate tectonics.

This field experience is the chance to visit an active thrust fault in New York City. The Manhattanville or the 125th Street fault is an active fault, with the last earthquake occurring in January of 2001. This seems to be a great opportunity to connect both faults and introduce earthquakes into a unit on plate tectonic motion. In a unit on plate tectonics, several concepts would be covered prior to this field experience. For example, students would have learned that there are three major components of the lithosphere, that core radioactivity provides energy for the motion of the plates, that divergent and convergent plate boundaries create zones of activity, and that the rates of the plate motion is on a geologic time scale. The students will then learn about faults, including modeling several types of faults including thrust, normal, and strike-slip. This sets up a solid foundation to explore a fault in the field. This experience will also introduce the idea of magnitudes of earthquakes, which will lead to the next lessons on measuring earthquakes.

This field experience also connects to the curriculum and the unit because the students will be applying prior knowledge learned in the unit on plate tectonics and skills learned in earth science to complete the handouts. For example, students will use their observation skills and scientific drawing skills to record observations about the fault zone. Students will apply their knowledge of reading maps, particularly geologic maps in interpreting the 125th Street Fault. Students will apply what they have learned about faults in general to this particular location in order to expand their conceptions. Additionally, students will apply their knowledge of plate motion and faults to an engineering problem of the above-ground 125th Street subway station.

Misconceptions:

Students have many misconceptions about earthquakes. Researchers have found that students sometimes connect earthquakes to weather or disasters such as volcanoes or tornadoes (Ross & Shuell, 1993). Students often think of earthquakes as the ground splitting open, and often equate earthquakes with shaking and trembling of the earth or ground (Ross & Shuell, 1993). Students also misrepresent the interior of the earth in an earthquake, implying that the core somehow crashes into the crust to cause an earthquake (Ross & Shuell, 1993). These misconceptions indicate that although students understand that earthquakes can cause damage above ground, and may cause the ground to tremble, they do not understand the process of an earthquake as building of stored potential energy due to friction of the plates moving slowly over long periods of time. The scales of the motion and the interior of the earth are confused. This experience is designed to peak students' interest in the field trip by introducing the 2001 earthquake and have students further investigate thrust faults. The students should be confronted with their misconceptions about earthquakes and the motion of the plates on this field experience. These differences can be further fleshed out in subsequent classes.

Plate tectonics has been found to be difficult for students to learn for many reasons. Very few components of the theory of plate tectonics are directly observable (Gobert, 2000). Students cannot directly observe the convection of the mantle, or the building of mountains. Additionally, the size scale is often difficult for students to understand (Gobert, 2000). Students see many diagrams in their textbooks of plates, and the interior of the earth, but it is difficult to comprehend the size of a fault or the core for example. They are both large, so perhaps indistinguishable to students. This experience intends to expand students experience with size by having students walk a portion of a fault. This should help student to conceive of the surface of the earth, at least. Students also do not comprehend the time scales of geologic processes, since it surpasses our reference of a human lifetime (Gobert, 2000). This is also true for faults and earthquakes because gradual motion leads to a large short term event of an earthquake. The physical science concepts of friction, forces and reactions seem complex to students in applying them to earthquakes. Finally, learning plate tectonics requires the integration of many types of information including spatial, causal, and dynamic information. Faults are complex systems that are usually represented by simplistic models in classrooms. This experience is intended to expose students to a portion of the complexity of a fault.

Teaching plate tectonics concepts in earth science requires the synthesis of many different types of knowledge and skills. This experience is intended to expand students thinking about faults in hopes of building a more complete understanding of earthquakes, something that applies to everyday life. In addition, this experience is designed to fit within a plate tectonics unit, and develop students' skills as observers in the field.

Works Cited:

Gobert, J. D. (2000). A typology of causal models for plate tectonics: Inferential power and barriers to understanding. *International Journal of Science Education, 22*(9), 937-977.

Ross, K. E. K., & Shuell, T. J. (1993). Children's beliefs about earthquakes. *Science Education, 77*(2), 191-205.

Key Concepts/ Terms:

Thrust fault
Earthquake
Magnitude
Slip

Procedure:

Students will travel to the 116th Street stop on the 1 train. They will take a walking tour of the fault, have lunch in Morningside Park, and head back to school. They will walk from the 116th street stop through Columbia campus to Amsterdam Avenue. From there, they will walk North on Amsterdam, recording their observations at several stops. They will walk to 118th Street, and turn left. They will walk down the hill in Morningside Park to Morningside Ave. They will stop in Morningside Park for lunch. They will walk North to 125th Street and down the street. They will view the 125th Station, and leave from there. See map below.

Student experiences: Students will answer questions in a packet in groups of three. Students will draw, and expand their thinking about geologic processes by experiencing the size scale of a fault.

Assessment: Students will be assessed based on the completion of the packet.

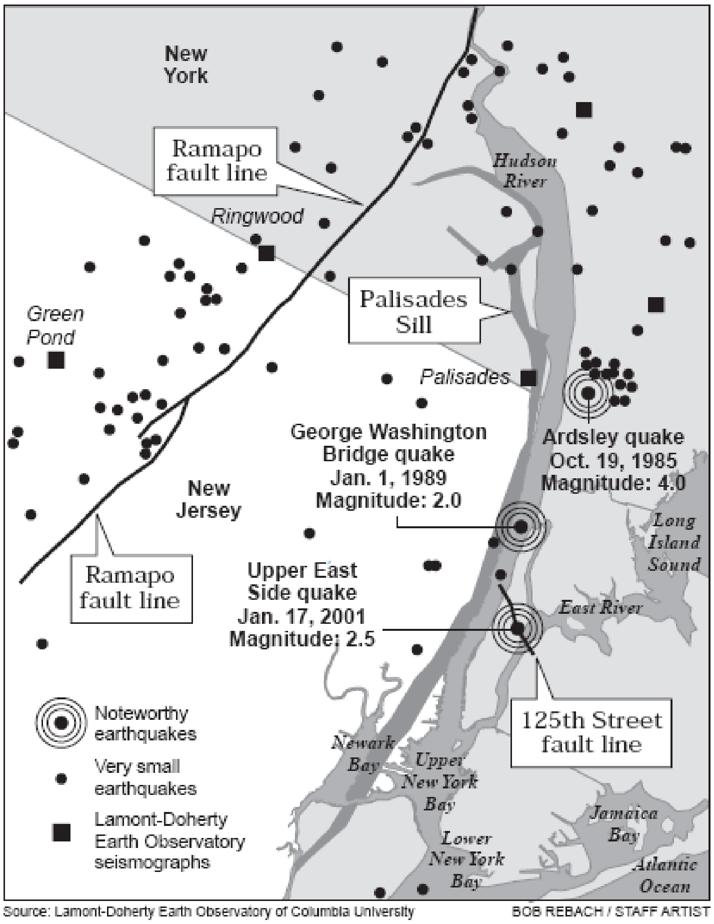
Student Materials:
See attached.

Name ___________________________ Class _________________________ Date ___________

Field Trip Packet – 125th Street Fault

Step I. On the TRAIN:
In groups of two answer the following two questions.

There was an earthquake at the 125th Street Fault in 2001 as shown in this diagram below:



1. What magnitude was the earthquake? _____________________________

Magnitude	Earthquake Effects	Estimated Number Each Year
2.5 or less	Usually not felt, but can be recorded by seismograph.	900,000
2.5 to 5.4	Often felt, but only causes minor damage.	30,000
5.5 to 6.0	Slight damage to buildings and other structures	500
6.1 to 6.9	May cause a lot of damage in very populated areas.	100
7.0 to 7.9	Major earthquake. Serious damage.	20
8.0 or greater	Great earthquake. Can totally destroy communities near the epicenter.	One every 5 to 10 yrs

2. Based on this scale, what does that mean?

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Step II: On Amsterdam and 118th St.
Here, you should look North, down the hill. What can you observe here? How far can you see? Please write your observations. (Option: sketch on the back of the page what you observe about the landscape)

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From the questions above, you know there was a small earthquake here in 2001. The mechanism causing an earthquake cannot be directly observed. What evidence do you think we can observe of the mechanism of an earthquake at 125th St?

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Can you see any movement? Why not? Is this area moving?

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Stop III: In Morningside Park:
You just walked down a large set of stairs. Can you describe the surroundings? Why are there stairs here? Walk north along the path, and write/draw observations about what you can observe about the underground setting.

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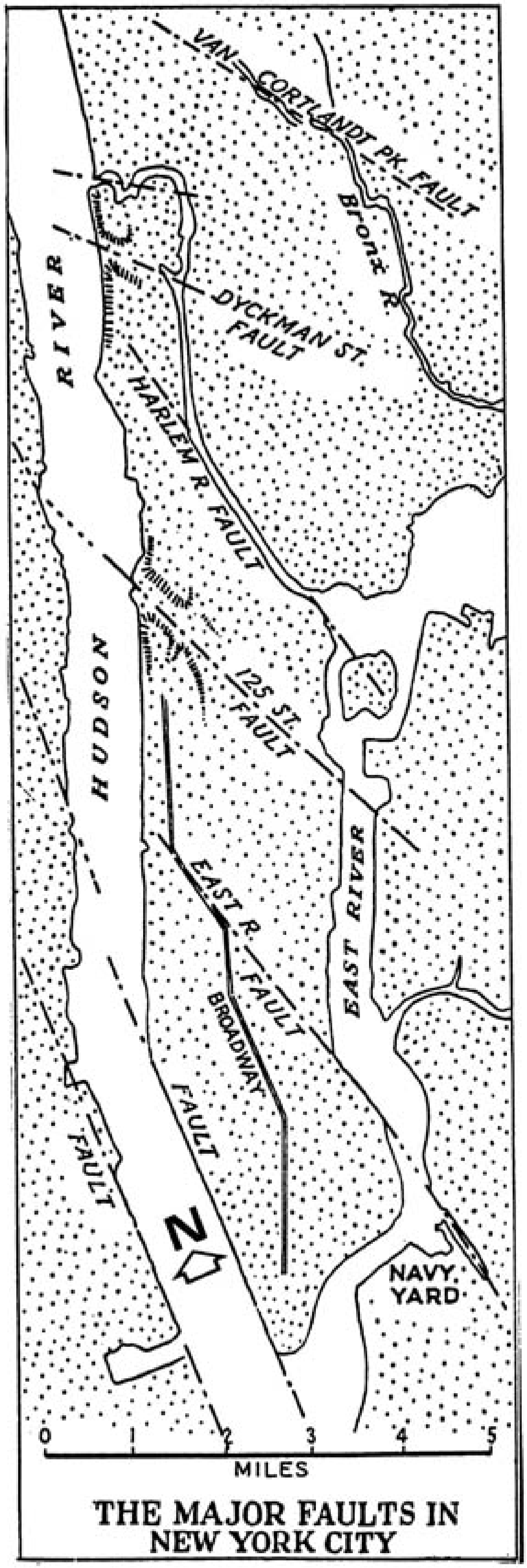

THE MAJOR FAULTS IN NEW YORK CITY

Faults can be much younger (have occurred later) than the rocks in which they appear. These rocks are being pushed in a direction. Knowing that this is a thrust fault and from the drawing, can you tell which direction these rocks are being pushed?

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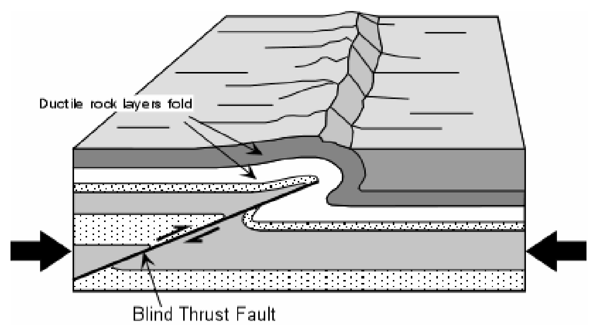
Indicate with arrows on the drawing on the left the direction of the force.



On the above drawing please draw and label two lines representing 135th Street and 118th Street. How do you know?

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You know that the Mid-Atlantic ridge is spreading at a rate of a few cm per year. How do you think this motion affects this fault?

Stop IV: The 125th St Subway.

Why is this station above ground? (Hint: look back to first page)

What are the benefits and/or hazards to this station?

Collection of Materials for this field trip:

I looked at a number of websites to piece together the history of the 125th Street Fault and the Eastern Geology. Particularly helpful:

http://www.priweb.org/ed/TFGuide/NE/ne_main.htm - The Northeast Teacher Friendly Guide from PRI (Paleontological Research Institution in Ithaca, NY)

http://www.ldeo.columbia.edu/news/2001/01-18-01_manhatten.htm - a description of the 2001 earthquake.

http://pbisotopes.ess.sunysb.edu/classes/oldclasses/GEO201/NYearthquake.htm - interesting article about eastern earthquakes

http://www.dukelabs.com/Abstracts%20and%20Papers/CMJES1997_ISRM.htm - highly technical infomation about the fault.

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