Lesson 11: Earthquake Drills, Plans, and Supplies.

Recent earthquakes such as the 7.9 magnitude 2008 Sichuan Earthquake and the 7.6 magnitude 2005 Kashmir Earthquake demonstrate that many communities do not have earthquake-resistant schools. Many of the schools that collapse and kill children are modern and are sometimes situated near older buildings that withstand earthquakes. The collapse of schools in earthquakes can be attributed to poor construction and maintenance (discussed in Lesson 9). However, most injuries and deaths are often caused by falling of non-structural elements (discussed in Lesson 10). In Lessons 9 and 10 students learned to identify structural and non-structural hazards in their school and home, and how to mitigate damage. In this lesson, students learn to recognize the importance of advance planning for their school's emergency response and to prepare an emergency response plan for their school. In addition, students get to test, evaluate, improve, and present their emergency plan to appropriate authorities. Planning, reviewing, training and testing are critical components of an effective emergency response plan that can quickly return a stricken community to a normal state of affairs. The ultimate goal of this lesson is to highlight the importance of advanced earthquake planning and practicing.

Note! This lesson provides guidance for conducting and preparing an emergency response plan and drill regimen in a school. However, contributing factors such as a school's locality and its structural strength play an important role in determining the most effective emergency response plan for the school. For this reason, this lesson by no means provides a complete or appropriate guidance to emergency plan preparation for every school. Whenever possible, have the emergency response plan developed in this lesson reviewed by appropriate school authorities, emergency specialists, research scientists, administrative planners, and other members of the community (e.g., fire chief and pubic health administrators).

Note! It may be best to conduct this lesson before or after school, when there are few other school students present to disrupt or distract from the activities. In some cases, this lesson may be completed during class time when there are no students in the hallways, but it must be done quietly. The drill should be coordinated with the knowledge of school officials to prevent falsely alarming other students or educators that may be present.

Allow 2 two-hour blocks for this activity.

Materials

Basic maps of the school (roughly one map per 3-6 students)
Colored pencils
Notes from lessons 7-10 (specifically, the students' list of non-structural hazards)
Video camera equipment (optional)

Introduction

1. Begin by asking students to think about the best ways to respond rapidly to a dangerous situation (e.g., fire breakout, severe weather, poisoning, etc.). Explain to

students that detecting and recognizing the early signs that a dangerous situation is developing, in conjunction with practicing a well-developed response plan numerous times, are the best means of ensuring a safe, rapid, and appropriate response. Ask students to list some early signs of an earthquake. Some early signs may include light shaking of sensitive objects such as hanging lights or glassware, sounds such as rumbling or the movement of joints within the surrounding building, or in some cases erratic behavior by animals with a keen sense of hearing such as dogs or horses. Explain to students that recognizing early signs of an earthquake and initiating an immediate response is critical since the ultimate intensity of an earthquake cannot be determined before or during its early stages.

2. Tell students they are going to develop and test an emergency response plan and an earthquake drill for their school in this lesson. Ask students to explain the difference between an emergency response plan and a drill. Explain to them that an emergency response plan is a comprehensive plan that incorporates as much information about what to do in an emergency as possible, including safe routes to follow, structural and non-structural hazards, helpful resources, meeting places, and key emergency personnel for a particular location such as a school. The purpose of this comprehensive plan is to describe and support as many practical responses as possible for a variety of circumstances, and to serve as a guide for conducting earthquake drills. An earthquake drill is one set of simulated emergency circumstances, designed to test the ability of school members to make the most appropriate decisions to ensure their safety. The school members should understand the emergency response plan sufficiently to react appropriately during the drill.

Explain to students that with careful planning, it is much safer to over-react to a minor tremor than it is to under-react to a major earthquake, since a minor tremor provides a convenient opportunity to test drill response times, gathering locations, efficiency of movement, ability to handle secondary hazards (i.e., fires, broken pipes, non-structural hazards, etc.) and emergency supply availability. The goal of any drill regimen should be continuous practice, assessment and improvement.

Note! There are few standard guidelines to producing a well-developed earthquake response plan, since circumstances and hazards vary substantially by region, city, and building or location when an earthquake strikes, but one cardinal rule is: ACT EARLY, ACT FAST, DON'T PANIC!

Tabletop Exercise – Emergency Response Coordinator Team

Before beginning this exercise, please have a basic, unmarked map of the school prepared for the students. There should be at least one map for each group of students that will be helping to write the emergency response plan. The map should include a basic layout of the school including hallways, rooms, doors, windows, and escape structures such as emergency ladders (if any). It will be the students' responsibility to use this map to outline an emergency response plan.

The students have just graduated from university and earned jobs as Emergency Response Coordinators (ERCs) for their country, specializing in emergency response at schools. As part of their job, they have the opportunity to travel from school to school all across the country, developing effective earthquake drills that take into account the particular hazards that students at the school might face during an earthquake.

Note! It may be best to conduct this final activity before or after school, when there are few other school students present to disrupt or distract from the activity. In some cases, this activity may be completed during class time when there are no students in the hallways, but it must be done quietly.

Question 1: What are some university disciplines that might be helpful for completing this kind of work? Why might a government choose to pay for Emergency Response Coordinators versus responding to earthquakes after they have occurred?

Possible Answers: Many different disciplines are helpful for supporting the work of Emergency Response Coordinators. ERCs need technical specialists such as people with a background in geosciences, engineering, or architecture so that the latest geohazards data can be interpreted in the context of earthquake hazard detection and quantification. Trade specialists such as carpenters or nurses understand how earthquake response plans and mitigation techniques affect the management of emergency supplies and earthquake-resistant structures. ERCs may also need linguists who can translate the work into multiple languages if there are many ethnic groups in seismically active areas across the country. Almost all government groups require accountants and planners to ensure that government money does not go to waste through poor planning. Finally, earthquake education specialists may be required to effectively communicate the causes, effects, and mitigation techniques of earthquakes to all parts of society, including children, working parents, and the elderly, who may not otherwise have any contact with earthquake planning efforts.

A government may choose to pay for ERCs because prevention is the best way to save lives and avoid costly property damage before an earthquake happens.

The ERCs have traditionally functioned as small teams that work independently, and then gather to discuss their conclusions and approaches to create the earthquake drills. Each team is assigned the same task: create an earthquake response plan that outlines the safest actions that students should take during an earthquake, and then conduct at least one drill to test the response plan in action.

Question 2: What advantages might there be for teams to do the same work independently and then compare their different findings and plans? What are some of the disadvantages?

Possible answers: With small teams working for the same goal, each team can take a different approach that fits the group's experience, and in so doing they might come to a different conclusion or emphasize a different area of importance compared to other teams. When the teams compare their results at the end of the activity, the input from these different perspectives can make the final earthquake drill more comprehensive, effective, flexible, and complete.

Some disadvantages might be that small groups of people lack the number of people necessary to tackle the volume of work expected, or it may not have participants with sufficiently diverse skill sets.

The ERCs (the students) should now be broken into 3-4 teams. Each team will work independently, using information from lessons 7-10, to develop an earthquake response plan for their school. The first task will be to research whether or not the school or community already has an earthquake plan. Assign one team to investigate this possibility and summarize the findings to the other teams before beginning their own earthquake response plan activities.

The remaining teams, meanwhile, should be assigned to work independently to develop a comprehensive earthquake plan. This drill must be specifically developed for the school, and should take into account its geographical and geological location, structural and non-structural hazards, surrounding environment (nearby structures, trees, power lines, etc.), and resources available within the community. To do this, the teams must be allowed to inspect the classroom and school to identify all hazards present (within the classroom and along any foreseeable evacuation routes), if this has not already been done in previous lessons. The teams should then figure out all possible earthquake responses and walk them out, mark them on a map of the school, taking note of any hazards that might be present along the way such as loose pipes or electrical fixtures, furniture, or even points where the flow of students from other classrooms may cause some students to be trampled. Encourage the team to use their imaginations to foresee the greatest number of possible hazard scenarios, and to develop simple response solutions that reduce the risk associated with these scenarios as much as possible. Hazards, evacuation routes, and helpful supplies should all be color-coded and marked on the map using colored pencils.

There are some general procedures that everyone in every community should follow, and these should serve as the basic guiding principles of any earthquake emergency response plan:

1) Don't panic
2) Move away from windows, heavy objects, shelves, etc.
3) Grab any nearby earthquake emergency kits and hold on to them
4) Don't use any elevators
5) Evacuate the building in a single file whenever possible

Note! Your school or classroom may only have one possible or practical earthquake response, depending on your school's location and hazards along the evacuation route. Alternatively, the most practical response for some students in some locations may be to

shelter-in-place. The most important aspect of conducting and evaluating an effective earthquake response plan is to consider all possibilities, and then to instill in students the reasoning behind selecting the course of action that is most likely to ensure their survival.

Question 3: Why is it so important for the team to 'walk out' multiple escape routes, and identify hazards along the way for each route? Why shouldn't they just identify one escape route and fully develop it? What are some advantages and disadvantages of this approach? Are there earthquake response plans that do not involve evacuation; why or why not?

Possible Answers: Each team must 'walk out' all evacuation routes because oftentimes the students are so familiar with these routes in their day-to-day lives that they overlook the true hazards that can arise during earthquakes. For example, in many schools there are pipes with steam or hot water running overhead that the students hardly notice. During an earthquake, a broken steam pipe can render an evacuation route unusable. Walking the route and looking specifically for these hazards can be a very eye-opening activity. The routes should also be compared by how much time it takes to reach a safe, designated meeting point.

Teams should develop multiple routes in case an unexpected hazard or circumstance has rendered the selected route unusable. But even then, it is not advised to merely tell the students what the best route is and expect them to do it; this misses the entire point of planning. Students must understand <u>why</u> a route is the preferred route, and what the alternatives are should the route be unusable. Having the students determine the best possible route, and provide the reasoning behind the selection of the best route, empowers the students through inclusion in the decision-making process and trains them to use their best judgment when evaluating emergency situations, simulated or real.

Some advantages of this approach are that more possibilities are discussed and evaluated, students are empowered to make the decisions that may save their lives, and systematic vulnerabilities to earthquake hazards can be discovered, reduced or eliminated with little or no cost to the school. However, there are also some disadvantages to this approach. Developing, evaluating, and selecting among many possible routes can be time-consuming and confusing if the drills are not conducted regularly to train the students to make fast decisions; however, it is the only way to avoid advocating an unrealistic 'one size fits all' policy of earthquake response since circumstances vary so much from city to city and building to building.

Some earthquake responses, such as shelter-in-place, do not involve evacuation. These responses may be necessary for earthquakes that are so powerful or disruptive that walking or running is not possible, or for buildings that are strong enough to withstand an earthquake, but there may be many non-structural hazards along the evacuation route. This is the case in most schools in California where "Drop, Cover and Hold" is a common procedure. For this procedure, students take shelter underneath their desk or table and hold on to the leg of that desk or table, with the other hand on the back of their neck to protect it from debris. Students should be prepared to move with the table or the

object as necessary during the emergency. If this is a necessary strategy for a classroom, it should be practiced multiple times during the earthquake drill Tabletop Experiment below.

For shelter-in-place scenarios, the teams should critically evaluate any shelter-in-place resources (such as tables) as to whether such resources can realistically provide shelter from structural, non-structural, and secondary hazards. If the resources are not sufficient, it may be worth examining whether the appropriate resources can be put in place before an earthquake strikes. For example, a number of small, flimsy tables might be exchanged for sturdy, stable, and larger tables that are being used elsewhere in the school (for no extra cost) that can shelter all students.

After the ERCs have 'walked out' all of their possible escape routes and surveyed the school, ask the ERCs to consider the possibility that a student, group of students, or an adult have become trapped underneath debris (structural or non-structural) during an earthquake (if they have not done so already).

Question 4: What actions do the ERCs suggest to prepare for the possibility that some people may become trapped underneath debris during an earthquake?

Possible Answers: One possible answer is that a small survival tube may help victims of an earthquake trapped in a building. The tube could have a whistle, sterile water packet and a chemical light stick and a mask. The whistle can make sounds much louder than a voice without placing strain on the throat, and can also make noise while the trapped person conserves air in a confined place. The tube should be small so that students can carry it in their school bags or attach it under their desks or large tables so that they are quickly within reach.

One of the most important questions to consider is whether or not students should help an injured or trapped person during or immediately following an earthquake. This is a difficult question to answer since there can be so many different circumstances and levels of danger that an injured person may be facing. The first task should be to call for help, or to send a nearby person to find help while one person stays to comfort the injured person. If the injured person is in immediate danger and there are no other emergency personnel around, only then should a decision be made to move or attempt to provide care for an injured person. ERCs may want to consider providing additional training to students on emergency first aid techniques from qualified personnel if emergency response workers are not expected to be nearby if an earthquake occurs.

Finally, the teams should now discuss and compile all results from conducting their earthquake response assessment, so that the earthquake response plan can be developed and finalized. The teams should take turns outlining each possible response, marking the path of that response on a master earthquake response map and identifying all hazards, exits, and useful resources that may exist along the route of the plan. All response plans should conclude by identifying and planning to meet at an unambiguous designated meeting point outside the school. If certain resources are necessary or helpful for

coordinating a response (i.e., whistles for emergency rescue, or medical supplies for small wounds sustained during an earthquake), have the teams produce a list of these resources as part of their earthquake response plan. If the school already has an earthquake response plan, have the students compare their independent assessment with the school's plan.

After the ERCs have compiled and finalized their emergency response plan, the plan is presented to the school administrator. The school administrator decides to put together emergency safety kits to place around the school. The school administrator asks the ERCs for help to gather materials for these kits.

Question 5: What are some of the items that should be placed in a family or community emergency safety kit? Where should the safety kits be placed?

Possible Answers: Immediate human needs are for food, water, and shelter. Any kit should include (at minimum) water, water purification tablets, canned or dried food (or any food that does not require a refrigerator), and some emergency blankets. Other very helpful needs are for information, lighting, and medical supplies. If possible, the kit should also include a battery-powered radio, flashlight, extra batteries, cash, a first aid kit, and family or class photos that can be used to identify or convey vital information about missing family or community members. Students or community members with special medical needs (such as vital medications) should take it upon themselves to ensure that their medical needs can be met with the items in the safety kit. Kits should be checked periodically to ensure the freshness and quantity of supplies.

The kits should be in easy-to-find locations that are at safe distances from structural and non-structural hazards. These should be locations that are also unlikely to be covered with rubble or debris should a strong earthquake occur.

Note! Remind the students that most disaster response organizations recommend that plans are made to provide complete care (i.e., food, water, clothing, and medical supplies) for a minimum of 72 hours following a disaster. Have them discuss whether this minimum amount of time is sufficient for the location of their school/community, given the accessibility of major forms of transportation, local climate, and availability of critical natural resources of the area such as fresh water. Let the students know that it may be constructive to petition the school to provide these resources for all students. Plan to eventually have the students present the results of their assessment, including the earthquake response plan and any critical resources or supplies necessary to carry out their plan, to local community safety personnel (i.e., fire, police, or other city or school officials) to receive feedback and guidance as to the appropriate people to contact and the appropriate steps to take after students have safely responded to the earthquake.

Tabletop Experiment: Earthquake Drill

Now that the earthquake assessment plan has been developed, the students are going to evaluate their plan by conducting at least one earthquake drill. There are two main reasons why drills are important. The first is that a planned response to an earthquake never quite matches an actual response. If any point of the plan was unclear to some students, then critical time may be lost during an earthquake emergency as students figure out what to do. Conducting drills should expose these problems and allow ERCs to correct them. The second is that certain critical brain functions do not function well during emergency situations. If an activity has been conducted numerous times before an emergency occurs (such as running down a hallway or escape ladder), then the brain is more likely to initiate that series of actions automatically under conditions of reduced brain capability. This helps to prevent paralysis due to overwhelming fear.

Note! The drill may arouse feelings of fear or anxiety for some students. Emphasize to students that these feelings are normal and healthy, but that learning how to avoid injury will increase their chances of survival. Be aware that inappropriate optimism ("It can't happen to me") is just as unrealistic as extreme fear and anxiety.

The educator is responsible for constructing the scenarios of the drill. Multiple scenarios are the best means of evaluating the effectiveness of the earthquake response plan, since the circumstances of an earthquake can vary. For example, one scenario may be for a slight tremor, while another scenario involves a very strong earthquake that makes walking or running nearly impossible. Smaller details of the scenarios should change from drill to drill as well: in one scenario, non-structural hazards (such as large bookcases) may impede the primary evacuation route, forcing the students to utilize secondary evacuation routes. The location where the drill scenario is initiated should change too: one drill may start in the classroom; another may start in a communal area such as a library, gymnasium, laboratory, and school bus or outdoors on a playground. The educator should walk out the evacuation path to come up with potential variations of the scenarios. During the drill, every effort should be made to simulate the actual sounds expected during an earthquake, including shaking windows, moving tables or chairs, and rattling glass, using actual tables, chairs, and windows located around the classroom.

Note! It may be helpful to videotape students during the drill. This may assist students with evaluating whether or not the decisions they made during the drill are appropriate.

Teachers must be ready to guide/help students during an earthquake. They must accept responsibility to do at least the following:

1) Maintain and carry a list of all students in their care; check the list at end of activities to quickly identify missing persons
2) Maintain and carry a first aid kit
3) Prepared to choose alternative evacuation routes (due to fire, for example)
4) Know how to safely turn off gas, water, and electricity in the areas surrounding their classroom.

5) Instruct students to evacuate after the shaking has stopped
6) Lead class to the designated assembly area
7) Secure everyone from the possibility of aftershocks
8) Give first aid if necessary
9) Do not re-enter the building unless instructed by an appropriate authority
10) If the teacher is injured, two students should be pre-selected to lead the others
11) Develop and implement a school plan, coordinated with the school administration, to reunite students with family members.

Note! Use telephones only for emergency purposes, and be prepared for situations where the telephone system is not functioning. In an emergency situation, it is very common for telephone systems to become inoperable because the systems and telephone lines have suffered earthquake damage, or the system becomes overwhelmed when everyone tries to use it at once, or both.

Post-Drill Evaluation

Students should *always* review what hazards can occur after the drill has ended (i.e., aftershocks, further building collapse, landslides, addressing medical injuries or people in shock, etc.). Just because the drill scenario has ended, and the students have secured themselves in a safe location, this does not mean that the exposure to hazards has ended. The students should know the steps to take after the drill has ended, such as administering first aid and gathering information about the emergency by turning on a radio or contacting an appropriate authority for further instructions.

After conducting each drill, the students should immediately evaluate the effectiveness of the choices made during the drill. Did the students make safe decisions, given the circumstances of the drill scenario? Are there some locations along the evacuation route where students can fall, trip, or collide with other students who are trying to exit? What can be done to minimize these types of accidents? If serious problems were uncovered with the earthquake response plan in the course of conducting the drill, discuss with the students how to alter the response plan appropriately.

The final decision should be to decide when the next earthquake drill will be conducted. The date should be agreed upon, but the time should not to maintain the conditions of surprise for those participating in the drill. Repeated drills with varying circumstances over an extended period of time will prepare students and educators to deal with unexpected emergencies quickly and safely.

Note! Consider the possibility to extend the drill to families and homes, and discuss the need for developing a family plan since students are likely to be separated from their family after an earthquake. Suggest that the students designate an out-of-area telephone contact and carry it at all times. Students should know how to turn off gas, water, electricity in their homes.

The earthquake response plan and color-coded maps produced by the students should be presented to school authorities and local government administrators. Students should be encouraged to discuss their findings with public figures responsible for public safety. Whenever possible, students should also have the opportunity to frame and display their final map so that other students in the school can know their work.