CALIFORNIA EARTHQUAKE PREPAREDNESS EDUCATION

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ABSTRACT

Californians are increasingly aware of the threat of a major earthquake, yet few are prepared to adequately respond should the disaster strike today. This paper focuses on the action of the California State Department of Education in response to the efforts of State Legislature to address this problem. It surveys the extensive variety of curricula developed by state, public, and private agencies that are aimed at enhancing earthquake awareness and preparedness, both in the schools and in the community. The reader will notice the interconnections of earthquakes and tectonics integrated with several thematic strands that are described in the draft of the new *California Science Framework.*

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INTRODUCTION

Scientists agree that California has better than a 50% chance to experience a major earthquake sometime in the nest ten years.[1] The Federal Emergency management Agency (FEMA) estimates that a catastrophic earthquake of more than 8.0 on the Richter scale could leave 3,000 to 14,000 people dead and another 12,000 to 52,000 seriously injured[1].

Experts agree that many Californians are unprepared to cope with the damage that will occur if such an event should occur. Even earthquakes with less intensity have caused widespread destruction. In October, 1987, the 5.9 Whittier-Narrows earthquake caused an estimated $358 million damage with over 27,000 residents and business owners registering for disaster assistance[1]. In the 6.5 Coalinga earthquake, 75% of the downtown area was totally destroyed[1]. Studies show that Californians are increasingly aware of the threat of a major earthquake, yet only a few of the residents are doing something to prepare their homes, schools, or businesses. California still has an urgent need for continued educational efforts in Earthquake Preparedness Education.

LEGISLATIVE ACTION

In order to give the California State Legislature some direction to address the aforementioned threat, the California State Department of Education (CSDE), has recently compiled a "Report of the Earthquake Preparedness Taskforce in compliance with Assembly Bill 3730, Chapter 1352, Statues of 1988, authored by Assemblywoman Roybal-Allard." This document will provide school districts with specific "quake-safe" actions for their schools and surrounding community. The Office of the State Architect, who is responsible for enforcing the strict California building codes, assisted with this draft.

For many years, the CSDE has worked closely with the California Seismic Safety Commission to develop guidelines and policy for insuring earthquake-safe school programs. Funding has been supplied by the CSDE to districts and individual schools to encourage individualized response plans.

For several years, California schools have been striving to comply with the Katz bill (Chapter 1659, Statues of 1984) which requires all public schools, and private schools with over 50 students, or more than one classroom, to establish an earthquake emergency system. Two federal publications have assisted school districts in achieving this goal. In 1986, FEMA provided schools with a guide and workbook for developing individual earthquake safety programs that go beyond "response plans." This publication, The Guidebook for Developing a School Earthquake Safety Program, aided schools by including strategies for hazard assessment, earthquake drills, community-wide coordination plans, training exercises, and classroom discussion topics and activities.

[1]Governor's Office of Emergency Services, *California Earthquake Preparedness Month (1988 Campaign Activities Guide)*, 1988.

Another very helpful publication produced by National Science Teachers Association (NSTA) and supported by FEMA, Earthquakes: A Teacher's Package for K-6 is a hands-on K-6 curriculum which not only delivers excellent background information, but also, well planned, integrated classroom activities. This resource was created by a special writing team from six states and then field tested in 11 states. The activities are contained within six units, each divided into three learning levels: Grades K-2, 3-4, and 5-6. The first five of the six units develop a thorough understanding of "what," "why," "where," and "when" earthquakes occur, while the last unit focuses on protective survival strategies that should be done before, during, and after an earthquake. The activities use cooperative learning and other creative approaches throughout to encourage student involvement and to enhance student comprehension. Teachers will have little problem in obtaining the materials and supplies utilized in the activities as the majority are commonly found on school campuses.

Lastly, the entire month of April was designated as Earthquake Preparedness Month by Governor Dukemejian. To that end, the California Earthquake Education Project (CALEEP) created a classroom packet for Grades 5-9, "Earthquake Preparedness Materials" (1987), for the Southern California Association of Science Supervisors (SCASS) and Los Angeles County Office of Education to accomplish the following goals:

- Create preparedness before and after an earthquake;
- Participate in hypothetical situations involving earthquakes;
- Apply scientific processes to infer results from collected data;
- Experience an earthquake drill; and
- Identify non-structural hazards in schools, homes and neighborhoods.

NEW FRAMEWORK IDEAS

Throughout the new California *Science Framework Field Review Draft* information about earthquakes and tectonics are integrated with several major thematic strands. The interconnections of earthquakes and tectonics are highlighted within the following three themes of energy, evolution, and patterns of change.

Energy is a central concept of the physical sciences that is well illustrated by the flow of energy within the earth. Naturally, the *Framework* guides educators to discuss the origin of earthquakes and other related geophysical processes such as mountain building, continental drift, and volcanic activity.

Taught within the context that evolution is represented by "change trough time," the *Framework* encourages districts to study the changes in the earth's crustal formations caused by earthquakes and other tectonic activity.

Though "change through time" is one pattern of change, cyclical patterns are also evident in geophysical tectonic cycles of mountain building, plate movement, and subduction. Students will learn that earthquakes are the result of interaction of the aforementioned geophysical processes.

Earthquake-Related Themes

A thematic approach helps students learn about earthquakes within the paradigm of plate tectonics. Students will develop deeper understanding of complex geologic processes such as plate tectonics because they study the lines of evidence derived from a variety of science disciplines, including rocks that show reversals in the earth's magnetic field, geophysical data of matching mountains ranges, continued monitoring of crustal "hotspots," underwater topographic features revealed by sonar, and the paleontological evidence of ancient distributions of plants and animals. Within the various content sections of the *Framework*, this evidence is integrated and reinforced throughout all grade levels. The following content areas contain examples of multi-grade integration on the subject of earthquakes and tectonics:

Sound: An earthquake is always felt as at least two shocks separated by some time. Both p-waves (for pressure) and s-waves (for shear) are used to calculate the distance of the observer from the epicenter.

Geology and Natural Resources: This section of the *Framework* presents detailed explanations of plate tectonics and its role shaping the evolution of the earth. In grades K-3, students learn that changes beneath the earth's surface (along with the movement of the earth) cause great stress and strain on the crustal rock. This "pressure" is periodically relieved by earthquakes and volcanoes. Moreover, students learn the mechanisms responsible for mountain building. In grades 3-6, the general composition of the earth is taught in order to show both the relative thickness of the crust at the plate boundaries and the energy release, through earthquakes, that occurs along associated faults. The students also learn that many landforms have risen and subsided due to cyclical processes of uplift and erosion. In grades 6-9, several lines of evidence are explored to aide in understanding plate tectonics including structural evidence (e.g. faults), geophysical evidence (e.g. earthquakes and earthquake waves), and paleontological data (e.g. continental drift). The principle driving force of tectonics is slow convection in the earth's mantle. The resultant geological processes, such as earthquakes and landslides, affect how people now plan cities, dams, bridges, landfills, aqueducts, and the uses of these resources. In grades 9-12, students explore manifestations of tectonic processes including earthquakes, volcanoes, plate-plate boundaries, continental drift and seafloor spreading. Tectonic processes and metamorphism are also responsible for altering sedimentary rock (e.g. compressed, fractured, etc.). Through time, the movements of plates and the changes in the configurations of bodies of water have had profound effects on the evolution of the life on earth and dramatic changes in climates of marine and continental areas.

Meteorology and Oceanography: the discipline of seismology is intimately interconnected with oceanography and meteorology as evidenced by the water on the earth's surface which resulted from tectonic processes that released and combined hydrogyn and oxygen within the earth to form the original oceans and atmosphere. Students in grades 3-6, learn that there is evidence that a giant supercontinent (Pangea) comprised nearly all the continents, but continental drift separated them, allowing new oceans to form and new species to fill them. In grades 6-9, students focus on the continental margins to study subduction and focus on the mid-oceanic rises to study

sea-floor spreading. In grades 9-12, subduction is shown to be the cause of difficulty in reconstructing the ocean histories before 200 million years despite the fact that the marine life of the past is the best represented sector of the fossil record.

CURRICULUM DEVELOPMENT

A wide variety of earthquake education materials has been developed by California Earthquake Education Project (CALEEP) as a major activity of the Lawrence Hall of Science (LHS), University of California, Berkeley. CALEEP is a cooperative effort between the LHS and the California Seismic Safety Commission whose goals were focused on the development of educational materials for school and community groups on earthquake science and earthquake preparedness. In 1987, the "CALEEP Sampler" was published by LHS. This document was thoroughly field tested with upper-elementary and middle-junior high school students. The CALEEP teacher's manual has been organized for flexibility in approach and allows the instructor to quickly grasp the background, content, and extensions for each activity. LHS provides leadership institutes and training sessions in the use of their education and preparedness activities. A sample activity is the "Bedroom Hazard Hunt" developed by CALEEP to engage students in personal inspections of their own bedroom in order to make them safer in earthquakes. Another activity that encourages people to take preparedness action is the activity: "Improve Your E.Q. (Earthquake Quotient)." It helps students identify their level of preparedness after a simulated earthquake strikes.

The Governor's Office of Emergency Services (OES) supplies information about the effects of earthquakes in local communities and the steps needed to prepare for earthquakes. Brochures are available for distribution to parents and staff by calling (916) 427-6660. Speakers are sometimes available through regional OES offices whose phone numbers are listed in the front section of California public phone directories in the "State Government Offices" section under "Emergency Services Office."

The Bay Area Regional Earthquake Preparedness Project (BAREPP) is supported by the OES. BAREPP promotes comprehensive earthquake preparedness planning for local government agencies and other public and private organizations, including schools, within the greater San Francisco Bay area. BAREPP provides regional training and age appropriate informational materials for schools and community organizations. BAREPP has a large lending library of videos and slide/tape programs.

This past year, BAREPP compiled a series of earthquake preparedness activities designed to aid child care providers in developing their earthquake plans for their centers in the publication entitled: "Earthquake Planning and Preparedness Activities for Child Care Providers," by Sandra Cherkassky.

The Earthquake Awareness and Preparedness Project is a joint effort of the Audubon nature Training Society and the Junior League of Oakland-East Bay. This project presents to elementary schools (Grades 1-6) in Alameda and Contra Costa Counties, a program which increases

public knowledge of and preparedness for earthquakes. The reference consists of curriculum materials, a detailed instructor's resource section and eight follow-up role play activities.

The Environmental Volunteers, a private, non-profit company, has developed the following school activities to meet the learning needs of different grade levels:

- "Global Plates:" An activity that discusses the division of the earth's "plates" and their dynamic movement on the mantle layer. By examining plate movement, students are able to predict where earthquakes are likely to occur.
- "Fault Features:" This activity presents the effects of earthquakes on the landscape over a period of time.
- "Stress Release:" This activity demonstrates the results of two plates grinding past each other (a transform fault like the San Andreas) to create friction, stress and strain.
- "Earthquake Drills:" This activity, co-developed by CALEEP, simulates an earthquake (or stages a surprise earthquake drill), so students discover their reactions and develop their ability to respond properly during an earthquake.
- The "HELP Curriculum" (Hands-on Earthquake Learning Package): This activity consists of an Instructor's Guide with student booklets, and lesson plans with teaching materials. A geophysicist with the U.S. Department of Interior found the information to be technically accurate, and a Master's thesis on the effectiveness of the HELP program showed a very significant increase in earthquake awareness and understanding.

The Los Angeles chapter of the American Red Cross developed an interactive computer "simulation game" which teaches students "quake-safe" action before, during, and after an earthquake. For several years, the American Red Cross (ARC) has provided a clear and concise booklet on personal, home and family earthquake preparedness, called "Safety and Survival in an Earthquake." Local chapters of the ARC provide assistance in planning an earthquake response.

Field trips to earthquake exhibits can provide excitement and unique experiences to all age groups. Both the California Academy of Science in San Francisco and the Museum of Science and Industry in Los Angeles have shake tables that can be mounted by observers in order to experience the motion of an earthquake. Though very popular, experts are worried this experience will give a false sense of security to the "survivors" of the exhibit because the motion is relatively tame compared to an actual quake.

The Southern California Earthquake Education Project (SCEEP) is a project funded by the OES. SCEEP has similar responsibilities to BAREPP but has independently developed the following educational materials:

- "Hands-on Earthquake Learning Package" (1983)
- "Guidelines for School Earthquake Safety Planning" (1982, New edition under revision)
- "Earthquake Preparedness Checklist for Schools" (1982)
- "Preschool Earthquake Preparedness Guidebook" (1988)

SCEEP uses the above materials as they consult with a school task force comprised of LAUSD, the L.A. County Office of Education, and the L.A. County School Board about their earthquake education programs and their school-site earthquake safety plans. SCEEP is currently conducting a teacher training program on earthquake safety through the U.C.L.A. extension service.

Following the Whittier, California earthquake, SCEEP worked with FEMA and the San Fernando Child guidance Clinic to develop and produce the publication, "Coping with Children's Reactions to Earthquakes and Other Disasters" (July, 1986).

To simulate earthquakes, an American version of Japan's earthquake simulators has been created in Southern California, dubbed the "Shaky-Quaky Van."

The California Division of Mines and Geology also provides a wide variety of booklets, magazines, articles, and fliers available for distribution, sometimes in large numbers. Speakers are also available.

CONCLUSIONS

To be truly effective, Earthquake Preparedness Education must involve rigorous participation by not only teachers, principals, and staff, but also students, parents and community leaders. Only then will the entire school neighborhood be prepared to be self sufficient for 72 hours or more. It is imperative that schools and community work together to develop action plans for emergency response and to raise the awareness of all its citizens.

Upon completion of the emergency response action plans, individual schools/districts must take the initiative to prepare to meet staff and student survival supply needs as well as provide training in the proper use of the emergency supplies and equipment. The Red Cross, fire departments, independent consultants, and County Offices of Emergency Services all offer courses which prepare non-medical professionals in schools for medical response in an earthquake[2]. The training should provide clear-cut divisions of authority and labor. Cross-training in more than one area will ensure sufficient staffing for unanticipated emergencies. All medical response team members should train bi-annually with other local emergency response agencies. Given the wide variety of in-depth earthquake education materials and the availability of expertise at the county, state, and federal levels, the responsibility of creating and implementing an earthquake preparedness plan lies ultimately with school districts. When the next great quake strikes, their training efforts will surely reduce the inevitable loss of life.

[2]California State Department of Education, School Facilities Planning Division, "Report of the Earthquake Preparedness Taskforce in compliance with Assembly Bill 3730, Chapter 1352, Statutes of 1988, authored by Assemblywoman Roybal-Allard."