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SEISMIC SLEUTHS

AMERICAN GEOPHYSICAL UNION

S E I S M I C   S L E U T H S

EARTHQUAKES

A Teacher's Package for Grades 7-12

Produced by

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AGU/FEMA EARTHQUAKE CURRICULUM

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A special note of thanks to Katharyn E. K. Ross, whose comprehensive Fourth Edition of *Earthquake Education Materials for Grades K - 12* contributed greatly to the unit resource lists in this package, and to Sean Cox, teacher, Salem High School, New Hampshire, who provided the appendix to Unit Six.

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AGU

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Dear Colleague,

The American Geophysical Union (AGU) and the Federal Emergency Management Agency (FEMA) are pleased to present *Seismic Sleuths—A Teacher's Package for Grades 7–12*. Apprehension about what will happen during and after an earthquake can be alleviated with education and preparation. The goal of *Seismic Sleuths* is to provide the tools to prepare students for earthquakes and other natural disasters that may interrupt their lives and to help them get their lives back to normal after the event.

This package was developed as a joint effort of classroom teachers, research scientists, pedagogical specialists, AGU, and FEMA. The team approach was taken to ensure that the materials developed would be appropriate for classrooms, have correct and current content information, and reflect national science education reform efforts. In the introductory pages you will find matrices designed to help you match *Seismic Sleuths* materials with the National Science Teaching Standards content section. You will also find a matrix that indicates which lesson in *Seismic Sleuths* includes instruction material relative to discipline content.

Seismic Sleuths take a broad approach in preparing students for earthquakes. Hands-on/minds-on inquiry driven activities are balanced by library research and visits with disaster planning officials. Emphasis has been placed on cooperative learning and the constructivist approach to teaching. Students not only study the causes of earthquakes, they also study building construction and forces that damage buildings, then construct model buildings to test their knowledge. Students explore how their community is preparing for emergencies and are empowered with tools to bring about change in community disaster preparedness. Some of the activities may also be shared with others in your building, such as the social studies, language arts, mathematics, and industrial arts teachers.

A common thread connects the six units of *Seismic Sleuths*, but individual activities can be adapted to enhance your lessons already in place. The general introduction and overview of units sections will give you an idea of the content and layout of *Seismic Sleuths*. Each unit in turn has an introduction that gives you specific information about the unit's contents. Lessons and activities are written to give you complete procedures, material lists, and master pages for the students. Lessons are flexible and designed to be adapted to your teaching style and your students' learning ability.

When you choose a lesson or topic to include in your schedule, study it carefully to determine the activity's nuances. You will recognize some of the lessons as adaptations from other sources that have been rewritten for the *Seismic Sleuths* project. Many of the lessons are especially designed for *Seismic Sleuths*, and you will need to carefully follow directions to make them work in your classroom. While detailed instructions for students may be necessary in some cases, many of the activities can be adapted as a jumping off place for student exploration of the topic. In all cases, use the lessons as a departure for further study.

With desktop publishing technology these materials can easily be modified and new editions produced. While field testing and rewriting of lessons has been extensive, there will always be room for improvement. It is our wish to provide you with the most usable materials possible with current information. If you have comments or suggestions for future editions please forward them to my office.

My sincere thanks and congratulations to all the individuals involved in the project. A special thanks goes to FEMA for the forethought to fund the production of these vital teaching materials.

M. Frank Watt Ireton, Ph.D.
AGU/FEMA Earthquake Project Director

The American Geophysical Union encompasses the Earth and space sciences:
Geodesy, Seismology, Atmospheric Sciences, Geomagnetism and Paleomagnetism,
Ocean Sciences, Hydrology, Volcanology, Geochemistry, and Petrology,
Tectonophysics, Planetology, Solar-Planetary Relationships

Earthquakes are mystifying events. They are as unpredictable as they are powerful, and not even seismologists fully understand the forces within the Earth that set them in motion. As an educator, you can capitalize on that mysterious appeal to engage your students' interest.

Ultimately, however, the purpose of these lessons is to demystify earthquakes, and to counter the fatalism that frequently accompanies ignorance about natural phenomena. Interactive lessons invite students to discover what is known about quakes—the considerable body of knowledge that deals with their causes, the patterns of their occurrence, and what human beings can do to minimize their catastrophic effects on themselves and their communities.

The units in this package follow a pattern of zooming in and out, beginning with concerns closest to home, moving to general principles and global perspectives, then homing in again to engage students in evaluating their personal preparedness and that of their families, schools, neighborhoods, and communities. Look for the magnifying glass symbols opposite the text, which indicate essential vocabulary and helpful hints (Teaching Clues and Cues).

Units 1 and 6 deal most specifically with the personal and local, but every unit contains a mixture of general information and specific, local applications. A healthy respect for the power of earthquakes requires both kinds of understanding. Units 4 and 5 feature interactive lessons in architecture and engineering, topics seldom dealt with in grade 7-12 curriculum materials.

You may not find time to teach every lesson in this package. For teachers who must pick and choose, most of the lessons are designed to stand on their own. Take time to familiarize yourself with the outline, however. Read the unit introductions; take advantage of the background readings provided and of the unit resource lists. The Teacher Preparation section in each lesson outlines things you need to do before class begins, in addition to assembling the items on the materials list. Plan ahead now for the cooperation you will need in Unit 1, the materials you will need in Unit 4, and the field trips you will make in Unit 5. You'll see a burst of learning to reward your efforts and a wealth of ideas to enrich your science and social studies teaching.

Theory takes a back seat to hands-on experience in most of these lessons. As its name implies, this Seismic Sleuths package focuses on discovery. Ideally, the process of discovery will ripple through the town or city outside your classroom. Beginning in Unit 1, students will be interacting with a wide range of public officials. Please initiate and encourage these relationships. They will benefit the students, the school, and the community.

Through interacting with adults in positions of responsibility, students will develop a realistic sense of how their community functions day to day and how it would function in the aftermath of an earthquake or other natural disaster. Most will find it enormously reassuring to learn that emergency plans are in effect. Moreover, they will be empowered by the knowledge that their individual and collective actions can make a difference. Cultivating relationships within their community will also expose students to a variety of careers they might never have considered and provide a motivation to stay in school. In the long range, these activities will prepare today's students to be tomorrow's concerned and informed participants in democracy.

The school will benefit from these relationships by widening the pool of local adults who take an active interest in education, share their expertise and experience, and serve as role models for students. The community at large will benefit greatly, whether or not it is in an area known to be seismically active. Most of the kinds of emergency planning that students will learn about, and model in Unit 6, would be appropriate not only in the event of an earth- quake but also in case of flood, hurricane, or other large-scale disaster. In just the last few years, almost every section of the country has experienced destructive natural events.

Unit 1. This three-part introductory unit sets the stage for what follows. Every teacher should take time to include some of the materials contained in this unit. The introductory lesson assesses students' knowledge of earthquakes. In lesson two students describe their own experiences and tell how they would prepare for an earthquake. Lesson three requires students to make contact with emergency personnel in their community to ascertain emergency preparedness plans. Lessons in this unit are referred to in future units.

Unit 2. This five-part unit moves students beyond their personal survival into the causes of earthquakes. This unit sketches the big picture, building on students' knowledge from earth science or other science classes. The unit begins with students modeling stress buildup in the crust, followed by lessons on how earthquakes and other evidence tell scientists about the structure of the Earth. In the third lesson, students contrast historic time with the vastness of geologic time and simulate techniques of paleoseismology. The unit concludes with lessons on some potential side effects of earthquakes, such as tsunami, liquefaction, and landslides. Students study how the geology of an area influences the destructive effects and how high population density at unsafe sites can increase the amount of damage during an earthquake.

Unit 3. In this four-part unit, students learn about the different wave motions during an earthquake and how these motions are studied. A historical piece on the development of seismology adds background to students' knowledge. Students study and simulate the measurement of earthquakes using the Richter and Mercalli scales to find out how seismologists arrive at earthquake measurements. This unit concludes with activities that plot the distribution of earthquakes worldwide, then focuses in on local earthquakes, first in Japan, then in the United States. It offers a variety of lessons in science, mathematics, and social studies.

Unit 4. This five-part unit is designed to allow students to construct an understanding of how buildings respond to earthquakes. Lessons on building design and how earthquake forces act on various designs provide students with information on how to build earthquake resistant structures. Students then apply this knowledge by constructing testing devices and testing their designs. This unit is critical for developing students' understanding of why buildings collapse and what can be done to make buildings safer.

Unit 5. This five-part unit focuses students' attention on what to do before, during, and after an earthquake. By studying historical earthquakes as reported in the press, students learn how people have responded to earthquakes in the past. Students then learn what their response should be during an earthquake by planning and practicing earthquake drills. Students conduct safety assessments of their home, classroom, and community and see how secondary disasters associated with earthquakes can also be alleviated.

Unit 6. This concluding four-part unit offers a variety of summing-up and assessment activities. Writing activities, a fast paced quiz game, and a high pressure simulation allow students a chance to show off what they have learned in this curriculum. An extensive resource list provides detailed instructions for conducting a community-wide disaster simulation that becomes realistic and dramatic with the involvement of community disaster officials.

SEISMIC SLEUTHS MATRICES FOR THE NATIONAL SCIENCE EDUCATION STANDARDS

A *Seismic Sleuths* development team has put together the matrices on the following pages to use in correlating the *Seismic Sleuths* materials with the National Science Education Standards. The National Science Education Standards, under development by the National Research Council since 1993, will be released in late 1995. The Standards have been developed through consensus building among K-12 teachers, teacher education faculty, scientists, and other education specialists. Through this process a document that represents the broad thinking of the science education community is being developed as to what students should know, how they should be taught, and how they should be assessed. The Standards are meant to be descriptive rather than prescriptive and designed to be a tool to strengthen science education.

Using the *Seismic Sleuths* Standards matrices

The development team, working with the November 1994 draft of the National Science Education Standards, examined *Seismic Sleuths* section by section identifying correlations to the Science Content areas listed in the Standards. Two criteria were used: the section made a strong and direct connection to that content area, or the section made an indirect connection. A strong, direct connection is shown in bold faced type.

The following matrices are provided. Below is a summary of *Seismic Sleuths* and the content areas listed in the Standards. This page shows at a glance the correlations between *Seismic Sleuths* and the Standards. The next six pages describe more detailed correlations between *Seismic Sleuths* and the Standards using wording from the Standards. In some cases the development team felt that where a particular concept was not listed in the wording of the Standards a possible connection could be shown in parentheses.

When using the matrices it should be kept in mind the descriptive nature of the Standards. The connections shown in these matrices are suggested connections based on the development team's experience working with *Seismic Sleuths.* Many other correlations can be made and will become evident as the curriculum materials are used. Additionally, connections can also be made between *Seismic Sleuths* and *Benchmarks for Science Literacy,* (AAAS, 1993), *Content Core,* (NSTA, 1992), and *Earth Science Content Guidelines Grades K-12*, (AGI, 1991). The user is referred to these documents for further connections.

SEISMIC SLEUTHS SECTIONS	SCIENCE AS INQUIRY	PHYSICAL SCIENCE	EARTH AND SPACE SCIENCE	SCIENCE AND TECHNOLOGY	SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES	HISTORY AND NATURE OF SCIENCE	UNIFYING CONCEPTS AND PROCESSES
1.1	■	□	□	□	■	□	□
1.2		□		□	■		□
1.3				□	■		
2.1	■	■	□		□		□
2.2	□	□	■	□	□	□	□
2.3	□	□	■		□	□	□
2.4	□	■	■		■	□	□
2.5	□		□	□	■		□
3.1	■	■	□	■	□		□
3.2	■	□	■	■	■	■	■
3.3	■	■	■	■	■	■	□
3.4	■	■	□				■
4.1	□	■		■	■		■
4.2	■	■		■	■	□	□
4.3	■	■		■	■	■	■
4.4	■	■		■	□	□	■
4.5	■	■		■	■	□	■
5.1	■			■	■	■	□
5.2		□		■	■		
5.3		□		■	■		
5.4		□		■	■		
5.5		□		■	■		
6.1		□		■	■		■
6.2		□		■	■		
6.3						■	□
6.4	■	□	□	■	■		■

■ **Direct connection** □ **Indirect connection**

UNIT 1: What's It All About? Pre-assessment of student's knowledge of earthquakes and hazards preparedness.

SEISMIC SLEUTHS SECTIONS	SCIENCE AS INQUIRY	PHYSICAL SCIENCE	EARTH AND SPACE SCIENCE	SCIENCE AND TECHNOLOGY	SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES	HISTORY AND NATURE OF SCIENCE	UNIFYING CONCEPTS AND PROCESSES
1.1 What Do You Know About Earthquakes? Students explore their conceptions of earthquakes by writing about a hypothetical earthquake as seen through the eyes of a reporter, a scientist, and a member of the general public.	***Abilities related to scientific inquiry*** Understanding about scientific inquiry	Motions and forces	Structure of the Earth system Energy in the Earth system	Abilities of technological design	***Personal and community health*** ***Natural and human-induced hazards*** Risks and benefits Science and technology in local, national, and global challenges	Science as a human endeavor Nature of scientific knowledge	Evidence, models, and explanation Change, constancy, and measurement
1.2 It Could Happen Here Students consider their needs in an emergency and their preparation for an emergency.		Motions and forces		Understanding about science and technology	***Personal and community health*** ***Natural and human-induced hazards*** ***Risks and benefits***		Order and organization
1.3 Investigating Community Preparedness Students investigate their community's preparedness.				Abilities of technological design	***Personal and community health*** ***Natural and human-induced hazards*** ***Risks and benefits***		

UNIT 2: What Happens When The Earth Quakes? An exploration of earthquake processes, including causes and measurement.

SEISMIC SLEUTHS SECTIONS	SCIENCE AS INQUIRY	PHYSICAL SCIENCE	EARTH AND SPACE SCIENCE	SCIENCE AND TECHNOLOGY	SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES	HISTORY AND NATURE OF SCIENCE	UNIFYING CONCEPTS AND PROCESSES
2.1 Stick-Slip Movement Students model movement along a fault.	***Abilities related to scientific inquiry*** ***Understanding about scientific inquiry***	***Motions and forces (friction and energy)***	Energy in the Earth system (Dynamic crust)		Natural hazards		Evidence, ***models***, and explanation
2.2 Shifting Plates and Wandering Poles A three-part exploration about how scientists determine if the Earth's crust is in motion.	Abilities related to scientific inquiry Understanding about scientific inquiry	***Properties*** & changes in matter ***(magnetism)*** ***Motions*** and Forces	***Structure of the Earth system*** ***Energy in the Earth system*** ***Origin and evolution of the Earth system***	Understanding about science and technology	Natural hazards	Nature of scientific knowledge	Evidence, ***models***, and explanation
2.3 Earthquake in Geologic Time Students explore long time intervals and use models to study earthquakes in the past..	Abilities related to scientific inquiry Understanding about scientific inquiry	Motions and forces	***Earth's history*** ***Origin and evolution of the Earth system***		Natural hazards	**Historical perspectives**	Evidence, ***models, and explanation,*** maps
2.4 Earthquake Hazards Students use models, research, and mathematics to study earthquake hazards.	Abilities related to scientific inquiry Understanding about scientific inquiry	***Forces and motion (gravity, waves, and energy)*** ***Interactions of energy and matter***	***Energy in the Earth system***		***Natural hazards***	Historical perspectives	Evidence, ***models, and explanation*** Change, constancy, and measurement
2.5 Quake-Smart Siting Students interpret soil and earthquake related maps.	Abilities related to scientific inquiry Understanding about scientific inquiry		Structure of the Earth system	***Abilities of technological design***	**Natural hazards**		Evidence, ***models, and explanation,*** maps

UNIT 3: How Do People Learn About Earthquakes? Students explore the science and history of seismology.

SEISMIC SLEUTHS SECTIONS	SCIENCE AS INQUIRY	PHYSICAL SCIENCE	EARTH AND SPACE SCIENCE	SCIENCE AND TECHNOLOGY	SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES	HISTORY AND NATURE OF SCIENCE	UNIFYING CONCEPTS AND PROCESSES
3.1 The Waves of Quakes Students explore waves and discover how waves transfer energy. During this exploration, students connect this understanding to primary and secondary waves.	***Abilities related to scientific inquiry*** ***Understanding about scientific inquiry***	Motions and forces ***Interactions of energy and matter***	Structure of the Earth system		Natural and human-induced hazards		Change, constancy, and measurement
3.2 Pioneering Ideas Students explore the early work of three scientists.	***Understanding about scientific inquiry***	Forces and motions Interactions of energy and matter	***Energy in the Earth system*** ***Origin and evolution of the Earth system***	***Understanding about science and technology***		***Science as a human endeavor*** ***Nature of scientific knowledge*** ***Historical perspectives***	***Evidence, models, and explanation***
3.3 Sizing Up Earthquakes: The Mercalli Scale, Calling Station KWAT In this simulation of a radio talk show after an earthquake, students learn how seismologists establish earthquake intensity based upon damage people observe and report.	***Abilities related to scientific inquiry*** ***Understanding about scientific inquiry***	***Motions and forces*** Interactions of energy and matter	***Energy in the Earth system***	***Abilities of technological design***	***Natural and human-induced hazards***	***Science as a human endeavor*** ***Nature of scientific knowledge***	Change, constancy, and measurement
3.4 Distribution of Earthquakes Three activities on plotting the locations of earthquakes on map and making a 3-D model.	Abilities related to scientific inquiry Understanding about scientific inquiry		Structure of the Earth system Energy in the Earth system		***Natural hazards*** ***Risks*** and benefits	Historical perspectives	Evidence, ***models, and explanation***

UNIT 4: Can Buildings Be Made Safer? Students construct an understanding of how ground shaking during an earthquake can damage buildings and how buildings can be made better able to withstand this shaking.

SEISMIC SLEUTHS SECTIONS	SCIENCE AS INQUIRY	PHYSICAL SCIENCE	EARTH AND SPACE SCIENCE	SCIENCE AND TECHNOLOGY	SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES	HISTORY AND NATURE OF SCIENCE	UNIFYING CONCEPTS AND PROCESSES
4.1 Building Fun Students investigate the physical properties of building materials and design while considering how these might affect the way a structure withstands forces.	Abilities related to scientific inquiry	***Properties & changes in matter (physical)*** Motions and Forces		***Abilities of technological design***	***Natural and human-induced hazards***		***Evidence, models, and exploration***
4.2 Structural Reinforcement: The Better Building Students learn how additional structural elements strengthen a structure to carry forces resulting from earthquake shaking.	***Understanding about scientific inquiry***	***Forces and motions***		***Abilities of technological design*** ***Understanding about science and technology***	***Natural and human-induced hazards***	Nature of scientific knowledge	Evidence, models, and explanation
4.3 The BOSS Model: Building Oscillation Seismic Simulation Students investigate how energy enters a structure and discover the phenomenon of resonance. They measure the natural frequencies of the different height rod assemblies of the BOSS Models and correlate these motions to those of buildings and earthquakes.	***Abilities related to scientific inquiry*** ***Understanding about scientific inquiry***	***Forces and motions*** ***Interactions of energy and matter***		***Understanding about science and technology***	***Natural and human-induced hazards***	***Nature of scientific knowledge***	***Evidence, models, and explanation***
4.4 Earthquake in a Box In cooperative groups, students construct an inexpensive shake table for testing structures they have built.	***Understanding about scientific inquiry***	***Forces and motions*** ***Interactions of energy and matter***		***Abilities of technological design*** ***Understanding about science and technology***	Natural and human-induced hazards	Nature of science	***Evidence, models, and explanations***
4.5 The Building Challenge Students design and construct a structure then test it for the ability to withstand forces that could be encountered in an earthquake. This can be used s a performance assessment of the entire unit.	Abilities related to scientific inquiry ***Understanding about scientific inquiry***	***Properties & changes in matter (physical)*** ***Forces and motions*** ***Interactions of energy and matter***		***Abilities of technological design*** ***Understanding about science and technology***	***Natural and human-induced hazards***	Science as a human endeavor	***Evidence, models, and explanations***

UNIT 5: What Should People Do Before, During, and After An Earthquake?

SEISMIC SLEUTHS SECTIONS	SCIENCE AS INQUIRY	PHYSICAL SCIENCE	EARTH AND SPACE SCIENCE	SCIENCE AND TECHNOLOGY	SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES	HISTORY AND NATURE OF SCIENCE	UNIFYING CONCEPTS AND PROCESSES
5.1 Predicting Earthquakes Students explore the tantalizing possibilities of earthquake prediction.	Abilities related to scientific inquiry ***Understanding about scientific inquiry***			***Understanding about science and technology***	Personal and community health ***Natural hazards***	***Nature of science*** Historical perspectives	***Evidence, models, and exploration***
5.2 Starting Here, Starting Now Students learn how to react in the event of an earthquake.		Motions and Forces		***Understanding about science and technology***	***Natural hazards***		
5.3 Find and Fix the Hazards Students study home construction and retrofitting techniques.		Motions and Forces		***Understanding about science and technology***	***Natural hazards***		
5.4 Rapid Visual Screening in the Community Students evaluate the potential earthquake damage to various structures in their community.		Motions and Forces		***Understanding about science and technology***	***Personal and community health*** ***Natural hazards***		
5.5 Are the Lifelines Open? Students assess their community's vulnerability to earthquake damage.		Motions and Forces		***Understanding about science and technology***	***Personal and community health*** ***Natural hazards***		

UNIT 6: Now You Know It, Can You Show It? A variety of summing-up and assessment activities that showcase students' knowledge.

SEISMIC SLEUTHS SECTIONS	SCIENCE AS INQUIRY	PHYSICAL SCIENCE	EARTH AND SPACE SCIENCE	SCIENCE AND TECHNOLOGY	SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES	HISTORY AND NATURE OF SCIENCE	UNIFYING CONCEPTS AND PROCESSES
6.1 Preparing for the Worst Students assume the roles of emergency planning officials in a hypothetical community.		Forces and motions		***Abilities of technological design*** ***Understanding about science and technology***	***Personal and community health*** ***Natural and human-induced hazards***		Order and organization ***Evidence, models, and explanation***
6.2 Earthquakes Simulation: Putting Plans into Action An emergency simulation exercise.		Motions and forces		***Understanding about science and technology***	***Personal and community health*** ***Natural and human-induced hazards*** Science and technology in local, national, and global challenges		
6.3 What's Your E.Q., I.Q.? A quiz show format for assessment.						***Nature of scientific knowledge***	Evidence, models, and explanation
6.4 Hey, Look at Me Now! An assessment activity that repeats the writing exercise in 1.1.	Abilities related to scientific inquiry ***Understanding about scientific inquiry***	Motions and forces	Structure of the Earth system Energy in the Earth system Origin and evolution of the Earth system	***Understanding about science and technology***	***Personal and community health*** ***Natural and human-induced hazards*** ***Science and technology in a local, national, and global challenges***		***Evidence, models, and explanation***

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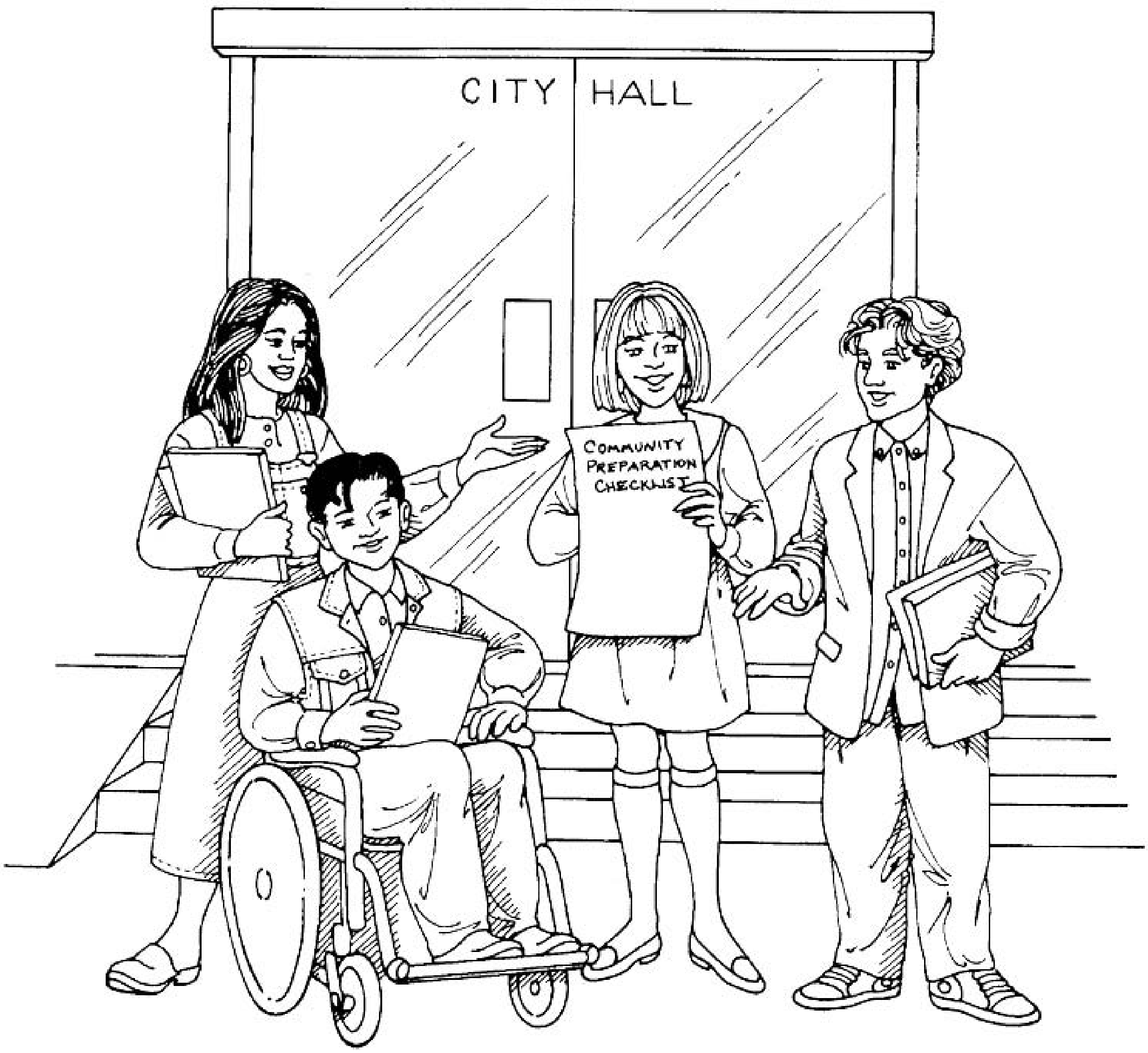
UNIT ONE



What's It All About?

Every teacher, no matter how busy, should take time to cover some of the material in this three-part introductory unit. Through brainstorming and new contacts within the community, students move from planning for their own safety to learning firsthand about critical facilities and lifeline systems that serve large numbers of people.

Please read through all the lessons well in advance, especially noting the Teacher Preparation section at the beginning of each Procedure. In this unit you will build a foundation for the units and lessons ahead by enlisting the cooperation of your school's administrators, your fellow teachers, and emergency personnel throughout the community and even beyond. Take time to scan the rest of the units too. You may want to let parents know now that you will be asking for their help in the Unit Five field trips and home safety activities. If you plan to involve the school community and outside experts in the culmination of Unit Four, also include this information in the initial contacts you make during this unit.

Lesson one, which students may complete either individually or in small groups, provides an assessment of what students already know about earthquakes plus experience with both scientific and popular ways of describing them. The worksheets provided will make this activity easier for students who aren't thoroughly comfortable with writing. In lesson two, students distinguish between luxuries and necessities, describe their own experience with natural hazards and how they and their families obtained the necessities, and come to see how preparedness can help individuals and families cope effectively in the event of an earthquake or other natural disaster. In the following units, students will learn some strategies for risk reduction.

Lesson three, which requires the cooperation of a number of emergency personnel in the community at large, calls for some extra effort on the part of your students. Teachers who have tried it report that the outcome is worth the effort. The contacts you and your students make now will be vital through the units that follow and even after this curriculum is completed. Your students, their families, and your entire community will be empowered to prepare wisely for the possibility of an earthquake or other destructive natural phenomenon.

1.1

What Do You Know about EARTHQUAKES?

RATIONALE

This preassessment activity is designed to focus your students on what they are about to learn, assess their current knowledge, and later provide them and you with a gauge of what they have learned from this earthquake curriculum.

FOCUS QUESTIONS

What do you know about earthquakes and earthquake preparedness?

What would you like to learn from these lessons?

OBJECTIVES

Students will:

1. Use various writing styles to describe a hypothetical earthquake.
2. Anticipate what they will learn in this study of earthquakes.

MATERIALS

- Writing paper and pens
- Student copies of Master 1.1a, Writing Outlines (three pages)
- Classroom computers (*optional*)
- Pictures or slides of earthquake damage (*optional:* See Unit Resources.)

PROCEDURE

A. Introduction

Show a selection of images to familiarize students with the kind of damage earthquakes can cause. Tell students that they are going to draw on the knowledge they already have about earthquakes to invent a specific quake and imagine themselves in it. Distribute copies of the writing outlines, Master 1.1a, and ask each student to note the date and time of their quake, its location, how much damage it caused, and other basic information at the top of page 1.

TEACHING CLUES AND CUES

At the end of this activity, collect the assignments and hold onto them until you have done the last lesson you plan to teach from this curriculum before the postassessment activity. You will use them again in postassessment.

B. Lesson Development

Now tell students that each of them is going to write about his or her hypothetical earthquake from three different points of view: that of a news reporter, a scientist, and an individual directly affected by the quake. Each of the three accounts will describe the same earthquake, but the styles of the three will vary.

News Reporter—a short, concise article describing the who, what, where, and when of the earthquake and providing information the public needs.

Scientist—a scientific account stating what is objectively known about the earthquake: its causes, its effects, its magnitude and/or intensity, and the likelihood of its recurrence, if known.

Eyewitness—a personal letter to a friend telling about being in an earthquake. This will describe what happened to the student, to the building in which the student was, to family members and pets, and to the family home during the earthquake. Have students describe what they had done before the earthquake to be prepared, how effective their preparations were, what life was like in the two weeks following the earthquake, and what they would do differently in preparation for the next earthquake.

Tell students to feel free to make up information, quotations, etc., but to keep the basic facts consistent from one essay to another. Since, in real life, compositions of the second and third type are likely to be written later than news accounts, however, some discrepancies in details are to be expected.

C. Conclusion

Ask students to talk about the experience of writing the accounts. Ask:

- Did you feel you had enough information to do the job in each case?
- Did some of you wish you knew more? Is there anything specific you'd like to find out?
- Was one point of view more comfortable than the others? Were some accounts easier to write?

Discuss the validity of the different points of view. Emphasize that each kind of account is valuable in its own right.

ADAPTATIONS AND EXTENSIONS

1. If time is short, form groups of three students each. Have each student develop one point of view and share it with the group.

2. If this assessment reveals that students have very little basic information about earthquakes, you may want to spend class time with some of the books or videos in the Unit 2 resource list before proceeding.

3. Invite students to write about an earthquake from a premodern point of view, such as that of a Native American in North America before Columbus. Alternatively, students may write from the viewpoint of a traditional culture with which they are familiar.

TEACHING CLUES AND CUES

The newspaper accounts on Master 5.1a are examples of how news articles are written.

This activity is purely diagnostic. Explain to students that you do not expect professional scientific writing—only their best try on the basis of what they already know.

4. Invite students to bring in samples of writing about earthquakes and classify them as journalistic, scientific, or informal. This could make a long-term bulletin board display. ▲

TEACHING CLUES AND CUES

If you have access to enough computers, encourage students to compose their accounts on a classroom computer and save the files. This will make it easy to rewrite them later as a postassessment activity.

Writing Outlines

Name ____ Date ________________

Just the facts:

Date and time of the hypothetical earthquake______________________________________

Location (city, state, country)____

Estimated strength and impact

Richter magnitude_______________ Deaths_____________

Injuries_________________________ Property damage $____________

Maximum Mercalli intensity if known (I-XII)_______________

Date of last earthquake in this region______________________________

Use these same facts in each of the three variations that follow.

1. Newspaper account: intended for the general public, who need practical information. May appear immediately after the quake, while aftershocks are still occurring and emergency conditions are still in effect.

Dateline (place and time of filing story)_____________________

Lead sentence—must be catchy, attention-grabbing. May be a particularly startling fact or a quotation (make it up) from a person in authority, an expert, or an eyewitness.

Rest of lead paragraph—must answer what, where, when, who was affected, and how. (May use quotations.)

One or more body paragraphs—provide background. Add more details on effects, quotations from more people, possible explanation, analysis. (Think of what people need to know—what to do, where to go, what to watch for.)

Final sentence—the clincher; ends story with a punch. (Possibly a warning about aftershocks?)

2. Scientific account: intended for specialists; will probably appear well after the dust has settled.
Lead paragraph—must answer what, where, when, who was affected, and how. Likely to be heavy with data instead of quotations. (Make them up too, but keep them consistent with the basic data at the top of page 1.)

One or more body paragraphs—provide background and analysis, more details on effects, maybe quotations from experts, scientific explanations, and hypotheses. (Will probably compare original and revised estimates of severity and effects, compare earthquake to other quakes.)

Final paragraph—summarizes what scientific knowledge has been gained or what plans are underway to gather information as a result of the earthquake.

3. Informal account: intended for a friend, usually also written after the worst is over; may include humor or exaggeration.

[inside address]
Name
Street no., Apt. no.
City/State/Zip

Date
Dear [name],

Your friend,

____

1.2

It Could Happen Here!

RATIONALE

Students will consider the range of their needs and the state of their personal preparedness for an emergency.

FOCUS QUESTIONS

What do people need to survive?

What kinds of natural events can prevent people from meeting their basic needs?

How does society cope with these events?

OBJECTIVES

Students will:

1. Distinguish between luxuries and necessities.
2. Describe their own experience with severe weather or natural disasters, and how they and their families fared.
3. Explain why preparedness can help individuals and families cope effectively in the event of an earthquake or other natural disaster.

MATERIALS

- Chart paper
- Felt markers
- Student copies of Master 1.2a, Three-Day Survival Pack
- Transparency made from Master 5.5b, A Chain of Disasters *(optional)*
- Overhead projector *(optional)*
- Materials for assembling the Three-Day Survival Pack *(optional)*

PROCEDURE

A. Introduction

Ask students to consider which of all the things they use and consume every day are really essential to their survival. Discuss, and develop a class listing on chart paper. (Answers may include variations on water, food, clothing, and shelter.)

VOCABULARY

Earthquake: a sudden shaking of the ground caused by the passage of seismic waves. These waves are caused by the release of energy stored in the Earth's crust.

Natural hazard: any of the range of natural Earth processes that can cause injury or loss of life to human beings and damage or destroy human-made structures.

Ask: How do you meet these needs? (Answers will include faucets, restaurants, grocery stores or parents' refrigerators, school cafeterias, clothing stores, parents' homes.) Now ask students to name some natural occurrences that could cut them off from these sources, and describe their own experiences with snowstorms, hurricanes, floods, or earthquakes. Beyond their own experience, what events of this type have they heard or read about in the last two years? Develop a list of events.

B. Lesson Development

1. Elicit a definition of natural hazards from the class. Emphasize that earthquakes, volcanoes, floods, hurricanes, tsunami, and similar events are the result of natural processes in the life of our dynamic Earth. These processes have shaped our Earth and created the beauty of mountains, valleys, lakes, and rivers. Be sure students understand the difference between natural events and those caused by human activity.

2. Ask: If an earthquake occurs in an uninhabited region, and has no impact on human beings or human property, is it a disaster? (Not for human beings, though it may be for other life forms.) Are we able to control natural events, or accurately predict when they will occur? (No, but students may be aware of instances in which human activity has influenced natural events, as in the relationship between dams and floods, and of our relative success in predicting some meteorological events.) Lead students to the conclusion that because our ability to control natural events, or even predict when they will occur, is still very limited, people have a responsibility to plan how they would cope if an earthquake or other destructive event struck their community.

3. Ask students how they and their families coped with any destructive events they have experienced. Were their homes equipped with everything they needed? Did they have to leave their homes? Were the roads open? Were the stores open? Who provided help? (If personal experiences are lacking, discuss recent news accounts of earthquakes, floods, and storms.)

4. Look again at the list of vital necessities and widen the discussion to include the needs of communities as well as individuals. Ask: If a major earthquake occurred in or near your community, what necessities would have to be added to the first list? (Answers may include medical care, electrical power and other utilities, and essential transportation—for hospital workers, police, firefighters, and people who supply food, water, and other necessities.)

Emphasize that a damaging earthquake would disrupt all or most of the community's lifelines—its supplies of water and power and its transportation and communications systems. Emergency services, such as police, fire departments, and emergency medical technicians, would be severely taxed and unable to answer all calls for assistance. For this reason, individuals, families, and neighborhoods must be prepared to be self-sufficient for at least 72 hours.

TEACHING CLUES AND CUES

Please save the lists students develop in this lesson. You will use them again later in this lesson and in Unit 5, lesson 5.

To help students understand why electricity, natural gas, and other services would be disrupted by an earthquake, you may want to project a transparency made from Master 5.5b, A Chain of Disasters.

Many scientists prefer the term *natural hazard* to *natural disaster* because proper preparation can avert disaster, preventing or minimizing injury and damage. This curriculum encourages students to take a proactive role in preparing themselves and their community to survive destructive natural events.

C. Conclusion

Distribute student copies of Master 1.2a, Three-Day Survival Pack. Explain its purpose. The Federal Emergency Management Agency (FEMA) and law enforcement authorities recommend that every family assemble a pack like this and keep it handy in their home for emergencies, checking it periodically to keep it up to date. (Batteries may need replacing, family needs may have changed.) Compare this list with the lists students have developed. If your school is in a high-risk zone, you may want to prepare a variation of the survival pack to keep in your classroom.

Ask students to take the sheet home and encourage the members of their household to cooperate in filling a clean trash can or other suitable container with these supplies. Make sure that everyone knows its location.

Tell students that in the following lessons they will learn more about one type of natural hazard, earthquakes. They will also research their own community's potential to survive destructive natural events, especially earthquakes.

ADAPTATIONS AND EXTENSIONS

1. In section A., Introduction, instead of a class discussion, you might ask individuals or small groups to develop lists of essentials they would need to survive 72 hours without access to power, running water, roads, stores, and so on. Then challenge each student or group to justify the items on their list, and develop a class list from the items that most students agree are essential. Compare this list with Master 1.2a when it is distributed.

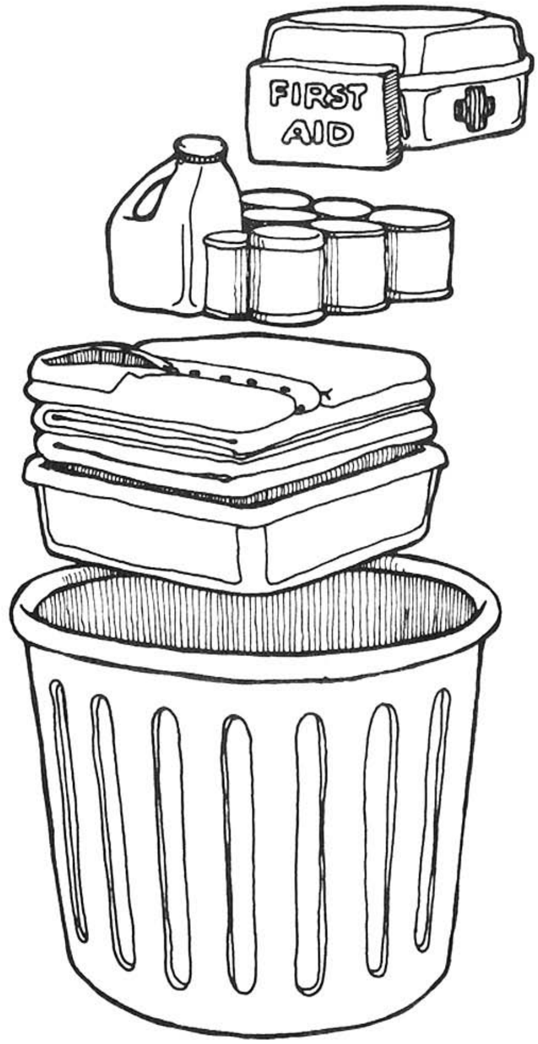
2. Make a list of the daily activities that involve electricity, water, natural gas, telephone, and transportation. Then enlist the cooperation of parents in an at-home recovery simulation. For a period of 24 hours (representing 72 hours), ask students to do without things that would not be available after an earthquake—telephone or other communication, nonessential transportation, electricity, gas, and running water. Alternatively, consider involving the administration and the other teachers in an in-school simulation. With preplanning, heat or cooling could be turned down, lessons in every subject could be earthquake-related, and lunch could feature emergency rations. ▲

TEACHING CLUES AND CUES

In assembling the survival pack, group can openers and other utensils in one container so they'll be easy to find.

Suggest that families assemble a smaller version of the pack to keep in the trunk of the car.

Three-Day Survival Pack



TOP OF THE BARREL

Flashlight and radio with batteries
First aid kit, including:

Medicines
Antibiotic ointment
Aspirin, acetaminophen, or ibuprofen
Ipecac (to induce vomiting)
Kaopectate™
Prescription medications (insulin, heart tablets)

Other Supplies
Scissors
Tweezers
Thermometer
Petroleum jelly
Rubbing alcohol
Tissues & toilet paper
Pocketknife
First-aid handbook

Dressings
Adhesive tape, 2” wide roll
Sterile bandage, 2” and 4” rolls
Large triangular bandages
Band-aids™
Cotton-tipped swabs
Sterile absorbent cotton
Ace bandage
Butterfly bandages
Gauze pads, 4” x 4”
Latex gloves

Emergency instructions
Waterproof page with phone numbers, when & how to turn off utilities, meeting places, etc.

MIDDLE OF THE BARRELL

Water (4 liters [about 1 gal] per person)
Three-day supply of food

- Choose food that does not require refrigeration.
- Date all food items.
- Write out a menu for each day.

Suggested foods (1/2 lb. per person):

Canned tuna
Canned beans
Nonfat dry milk
Powdered juice mixes
Canned juices
Graham crackers
Dried apricots
Peanut butter
Pet food if necessary

BOTTOM OF THE BARREL

Bedding
Sleeping bags or blankets
Plastic sheet or tarp

Personal supplies
Toiletries
Towel
Books
Paper and pencil
Cash

Infant supplies, if necessary

Fuel and light
Matches
Candle
Signal flare
Canned heat (Sterno™)
Extra batteries

Equipment
Can opener
Dishpan
Disposable dishes
Disposable utensils
Ax
Shovel
Bucket and plastic bag liners

Other
Water purification tablets
Chlorine bleach
Eye dropper

Clothing
One change per person

- Place pack in convenient place known to all family members. Keep a smaller version in the trunk of your car.
- Keep items in airtight bags.
- Change stored water every three months. Check and rotate food every six months. Mark dates on your calendar.
- Rethink kit once a year. Update supplies and replace batteries, outgrown clothing, and perishables.

1.3

Investigating Community Preparedness

RATIONALE

Now that students have thought seriously about individual survival in the event of a natural disaster, it is time for them to learn about their community's survival plans.

FOCUS QUESTIONS

How would your community cope in the event of an earthquake or other natural disaster?

Who are the people responsible for your community's survival and recovery?

OBJECTIVES

Students will:

1. Adopt and begin to research individual roles in community earthquake planning, management, and follow-up.

2. Set up a classroom map for further elaboration.

3. Begin a process of learning through and with the community that continues throughout this entire curriculum.

MATERIALS

- Master 1.3a, Preparedness People
- Local map
- Transparency made from Master 1.3b, U.S. Earthquake Hazard Map
- Extra transparency sheets
- Overhead projector
- A square of sturdy paper, 1 m x 1 m or larger
- Paper, pens, envelopes, and stamps for writing letters
- Markers in a variety of colors

TEACHING CLUES AND CUES

The other early lessons in Unit 1 will be revisited in Unit 6. This one will culminate in a major simulation in Unit 6, but it will also be woven throughout Units 2 to 5. The classroom map will play a major role in this continuing development, so it is worth the time you spend on it now.

PROCEDURE

Teacher Preparation

1. Look at Master 1.3a, Preparedness People, and add or subtract items as necessary to fit your community and the number of students in each class. Make a transparency from your list.

2. Find a map, or a portion of a map, that includes your students' homes and one or more local governments. Copy the map onto a transparency sheet.

3. Decide whether to assign roles, allow students to choose them, or hold elections, at least for the major roles. If the class is very large, you may want to assign more than one student for some roles.

4. Find out who is responsible for emergency response in your school building. Notify this person of your plans to teach about earthquakes. Notify the administration and fellow teachers as well, and enlist their cooperation for the long term.

A. Introduction

Ask students if they have ever heard the emergency broadcast system go into effect on radio or TV. Do they know who is responsible for emergency response in their school? If they don't know, tell them, and briefly describe the procedures that would be followed during an earthquake. (In most schools, students would drop, cover, and hold until the shaking stopped, following their classroom teacher's directions. Then the principal would direct an evacuation similar to that during a fire drill. See Unit 5, Lesson 2 for more details.)

Remind students that an earthquake or other natural disaster in their own area would impact large numbers of people. Tell them that in Unit 6 each of them will play the role of someone with responsibility for the community's emergency planning and survival. In this unit they will adopt that role and begin to learn about it.

B. Lesson Development

1. Project the U.S. Earthquake Hazard Map, Master 1.3b, and determine how great a seismic hazard is shown for your state or region.

2. Project the Preparedness People master, and go over the list of roles students could assume throughout this curriculum. Incorporate student suggestions in developing the final list, then distribute the roles.

3. Assign students to contact their mentors and set up interviews. Each student will interview one individual to learn what the person does and what role he or she plays in the community's earthquake preparedness plan. Students may tailor their questions to the person, but every interview should include these questions:

- What are the current emergency plans for this area?
- Have they ever been implemented?
- What is your role during an emergency?
- How many people answer to you?

TEACHING CLUES AND CUES

If you and your class determine that the seismic risk for your area is very low, you may want to expand your focus to include hazards of greater local concern, such as tornadoes or other storms or flooding. Keep earthquakes in focus as well, however. Remind students that most of them will move several times in the course of their lives and that earthquakes can happen anywhere.

Outside of class, write or call the "preparedness people" in your community to let them know that students will be contacting them and why and to enlist their cooperation.

This map is drawn along state lines for ease of use. A map drawn along geological boundaries would look quite different and might put parts of some states in another hazard category.

- What are the lines of communication during an emergency?
- What is the budget of this department or organization?
- How much of this is dedicated for emergency preparedness and actual emergencies?
- May I call you again if I have additional questions?
- Would you be willing to speak to my class?

Encourage students to take notes, to review their notes after the interview, and to make follow-up calls if they find they are missing any information.

4. Assign students to write letters thanking their mentors for the interviews. Review the format of a business letter, if necessary. Tell students that each letter must include details from the notes taken during the interview, so that both the recipient and you, the teacher, will know the time was well spent. Collect the letters and mail them from the school.

5. Fasten the large, sturdy sheet of paper to the wall and project the map transparency onto the paper. Move the projector away from the paper until the image reaches the desired size, then trace the image on the paper.

6. With the class, work out a way to represent all of the following on the large area map you have prepared:

- Hospitals and nursing homes
- Fire and police stations
- Power, sewage, and water plants
- Gas, water, electric, and sewage trunk lines
- Railroads and other mass transit systems
- Major roads and highways
- Telephone systems and other communications systems
- Schools

All of these are considered critical facilities or lifeline utility systems. Schools are important both because they may house large populations to be evacuated and because they frequently serve as centers for emergency shelter and the distribution of supplies.

C. Conclusion

Display the local map prominently in the front of the classroom. Students will add to this map, and to their role knowledge, as they gain information throughout these lessons.

TEACHING CLUES AND CUES

If more than one class is doing this activity, consider sending a group for each interview (for example, one “mayor” from each class to interview the mayor together).

ADAPTATIONS AND EXTENSIONS

1. If your city or metropolitan area is a large one, divide it into regions and assign one to each of several classes. If it is small, extend your investigation into the surrounding communities.

2. Assign students to learn as much as they can about disasters that have impacted their town or area in the past. They can begin by interviewing long-time residents and searching the newspaper archives.

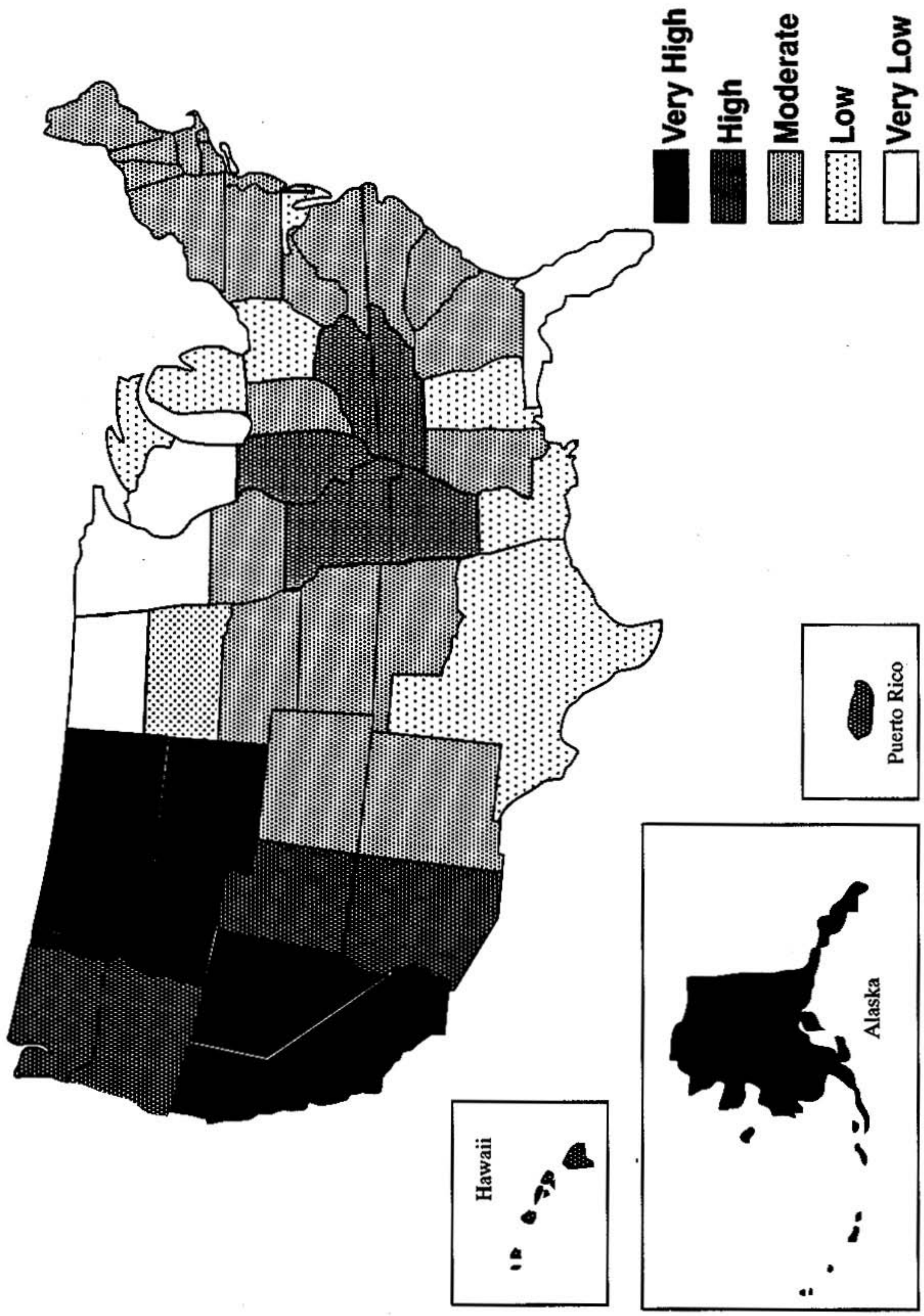
3. If you do not plan to teach all the units in order, you may want to introduce Unit 5, Lesson 5 at this time. ▲

Preparedness People

All these people and more may play a role in your community's disaster preparedness planning and response.

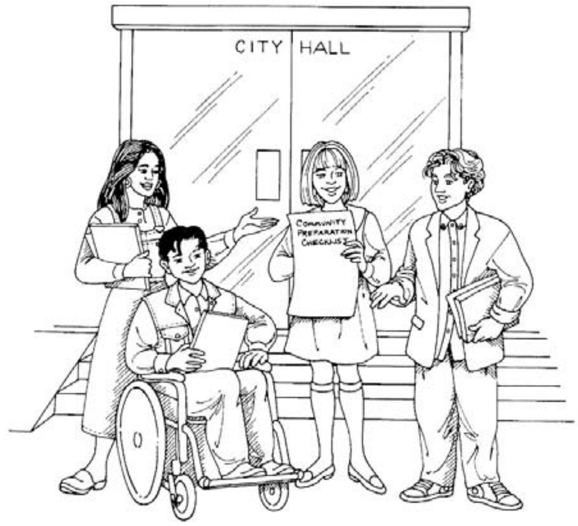
- Mayor or City Administrator
- City Manager
- Public Information Officer
- Chief of Police
- Fire Chief
- Emergency Services Coordinator
- Superintendent of Schools
- School District Risk Manager
- City Building Code Inspector
- City Council Members
- City Geologist
- City Planner
- Coordinator of Roads and Transportation
- Director of Public Health
- Director of Public Works
- Superintendent of the Sewage Plant
- Superintendent of the Water Department
- Electric Company Emergency Officer
- Gas Company Emergency Officer
- Telephone Company Emergency Coordinator
- Hospital Safety and Security Manager

U.S. EARTHQUAKE Hazard Map



Source: Based on NEHRP [National Earthquake Hazards Reduction Program] Recommended Provisions for New Buildings.

1 UNIT RESOURCES



BIBLIOGRAPHIES

National Center for Earthquake Engineering Research (NCEER) Information Service. (1995). “Teachers Packets, 9-12.” Buffalo, NY: State University of New York at Buffalo.

Seismology Resources for Teachers. Seismological Society of America, 21 Plaza Professional Building, El Cerrito, CA 94530; 415-525-5474. Includes software, databases, and video listings.

World Amateur Seismological Society. “Reference List for Amateur Seismologists.” A list of references intended to serve as an introduction to the literature of seismology.

BOOKS

American Red Cross, Los Angeles Chapter. (1985). *The Emergency Survival Handbook.* In English and Spanish. A simple, practical, and easy-to-use guide.

Federal Emergency Management Agency/National Science Teachers Association. *Earthquakes—A Teacher’s Package for K-6 (Tremor Troop).* (FEMA 159, 1992). Washington, DC: FEMA/NSTA. (FEMA Publications, 500 C St. SW, Washington, DC 20472.)

The Homeowners Guide to Earthquake Safety. Sacramento, CA: California Seismic Safety Commission (1900 K Street, Sacramento, CA 95814).

Kimball, Virginia. (1992). *Earthquake Ready: The Complete Preparedness Guide.* Malibu, CA: Roundtable Publishing, Inc., A practical, nontechnical guide to preparation and survival.

Movers and Shakers. An educational program for grades K-12 that includes a video and a two-sided classroom poster. Available free to educators by writing to Movers and Shakers (E-8), State Farm Insurance Companies, One State Farm Plaza, Bloomington, IL 61710-0001.

Plafker, George, and Galloway, John P., eds. (1989). *Lessons Learned from the Loma Prieta Earthquake of October 17, 1989.* Denver, CO: U.S. Geological Survey, Circular # 1045. Excellent photographs, maps, and illustrations.

Yanev, P. (1991). *Peace of Mind in Earthquake Country. How to Save Your Home and Your Life.* San Francisco, CA: Chronicle.

PAMPHLETS AND PERIODICALS

American Red Cross, Los Angeles Chapter. *27 Things to Help You Survive an Earthquake.* Los Angeles, CA: American Red Cross. (2700 Wilshire Blvd., Los Angeles, CA 90057; 213-739-5200.) Poster in English and Spanish lists 4 things to do during an earthquake, 6 to do afterwards, 14 survival items to keep on hand, and 3 essential things to know.

Earthquakes and Volcanoes. An attractive, nontechnical magazine published bimonthly by the U.S. Geological Survey to provide current seismological information. Washington, DC: U.S. Government Printing Office; 202-783-3238; $8/yr.

Federal Emergency Management Agency pamphlets. “Family Earthquake Drill and Home Hazard Hunt,” FEMA 113; “Earthquake Safety Checklist,” FEMA 46.

Harris, J.W. (1980). “Building a Firm Foundation—Educating about Geologic Disasters.” *The Science Teacher* 47, 9: 22-25.

“May 18th, 1980: Eyewitness Accounts by *Cobblestone* Readers.” *Cobblestone* (May 1981): pp. 20-23. By and for readers 8-14. This issue has several good features on earthquakes.

“Scientists Predict: Big Quake Will Strike Eastern U.S.” *Current Science* (Jan. 6, 1989): p. 7. For readers 10-16.

Teacher’s Packet of Geologic Materials. A collection of leaflets, booklets, and reference lists provided free by the U.S. Geological Survey, Geologic Inquiries Group, 907 National Center, Reston, VA 22092. Send request on school letterhead, indicating the subject and grade level you teach.

Westrup, H. “Giant Quake: When Will It Strike?” *Current Science* (Sept. 7, 1990): pp. 4–5. For readers 10–16.

NON-PRINT MEDIA

Earthquake Slides. Photographs of earthquake effects, copies of seismograms, and seismicity maps can be obtained from the National Geophysical and Solar Terrestrial Data Center, Code D62, NOAA/EDS, Boulder, CO 80302.

Earthquake Sound Cassette Tape. Emergency Preparedness Committee, Utah State PTA, 1037 East South Temple, Salt Lake City, UT 84102; 801/359-3875. A one-minute tape available for $2, including postage.

EERI Videotapes and Slide Sets. Oakland, CA: Earthquake Engineering Research Institute. For information, phone 510-451-0905, or fax 510-451-5411.

National Earthquake Information Center Seismicity Maps. Full-color maps available from USGS/NEIC, PO Box 25046, Federal Center, MS 967, Denver, CO 80225-0046; 303-273-8477. $5–$15 plus $2 shipping.

Nur, Amos, and MacAskill, Chris. (1991). *The Walls Came Tumbling Down: Earthquakes in the Holy Land.* Stanford, CA: ESI Productions. Video provides a tour along an active fault from the north of Israel to Jerusalem.

Steinbrugge Collection. Richmond, CA: Earthquake Engineering Research Center. Over 10,000 photographs and 5,000 slides of earthquake damage. The library will provide copies to teachers and researchers. Call 510-231-9401 for information.

USGS posters plus seismicity maps for most of the states. USGS Map and Book Distribution, PO Box 25286, Federal Center, Building 10, Denver, CO 80225; 303-236-7477.

World Seismicity Map. Large 48" x 36" wall map shows epicenters, depths of foci, and dates and magnitudes of large quakes. Ward’s Natural Science Establishment, Inc., 5100 W. Henrietta Road, PO Box 92912, Rochester, NY 14692-9012; 800-962-2660.

Note: *Inclusion of materials in these resource listings does not constitute an endorsement by AGU or FEMA.*

Earthquake Information Resource List

State Geological Survey Offices

Geological Survey of Alabama
420 Hackenberry Lane
P.O. Box O
Tuscaloosa, AL 35486-9780
205-349-2852

Alaska State Geological Survey
794 University Avenue
Suite 200
Fairbanks, AK 99709-3645
907-474-7147
FAX: 907-479-4779

Arizona Geological Survey
845 North Park Avenue
Suite 100
Tucson, AZ 85719
602-882-4795

Arkansas Geological Commission
Vardelle Parham Geology Center
3815 West Roosevelt Road
Little Rock, AR 72204
501-324-9165

California Division of Mines & Geology
801 K Street
Mail Stop 14-33
Sacramento, CA 95814-3532
916-323-5336

Colorado Geological Survey
1313 Sherman Street
Room 715
Denver, CO 80203
303-866-2611
FAX: 303-866-2115

Geological Survey of Connecticut
Dept. of Environmental Protection
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Source: American Geological Institute

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Source: Federal Emergency Management Agency