School Earthquake Safety Initiative

High School Curriculum Overview

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Last Modified on 07/27/2016 by Sandra Fuentes

BACKGROUND

The Earthquake Engineering Research Institute (EERI) is taking an active role in advocating for the safety of the community by developing the School Earthquake Safety Initiative (SESI). SESI is a collaborative network of diverse, expert, and passionate professionals who are committed to creating and sharing knowledge and tools that enable progressive, informed decision making around school earthquake safety. Its goal is to leverage our extensive expertise and reputation to conduct regionally appropriate actions that make a tangible and positive difference in communities around the world, by protecting the lives of all who inhabit school buildings.

GOALS

SESI is comprised of subcommittees to carry its goals. One of the subcommittees is Classroom Education and Outreach. The goal of this subcommittee is to: Use education in the classroom to create on ongoing dialog with parents, teachers, and administrators and to develop advocates for earthquake school safety. Bring together EERI regional and student chapters to collaborate on delivering the activities and serving as expert resources for stakeholders.

This curriculum has been developed for student chapters and teachers to be able to implement and deliver the material with the purpose to educate students, parents and the community about earthquake safety. This curriculum can serve to supplement up to date standards already in place in various disciplines with lectures on applications of material covered by the latest power standards and a hands-on project for students to put what they have been taught in class and earthquake engineering to action.

STANDARDS

Next Generation Science Standards dictate that there is a focus on scientific practices:

> These include developing and using models, planning and conducting investigations, analyzing and interpreting data, using mathematical and computational thinking, and constructing explanations; and to use these practices to demonstrate understanding of the core ideas. Students are also expected to demonstrate understanding of several engineering practices, including design and evaluation.

This curriculum incorporates all those practices and more specifically is tailored to meet the following standards in physics.

CURRICULUM

Earthquake Engineering Design Lesson
Summary & Curriculum Mapping

Lesson Summary

The FIRST TWO lessons (each 50 minutes) introduce earthquakes, engineering process, and design elements in relation to standards which are then tested by the students to develop ideas for strengthening buildings.

This experience provides support for:

- Engineering is driven by needs and wants
- Learning about realistic model development as part of design process as work with tools to construct a structure and shake table
- How to construct a "fair" tests [controlled variables, multiple runs],
- Learning to observe "failure points" as a source of information
- Drawing specific evidence-based conclusions about design element testing
- Analyzing and interpreting data from element testing using logical reasoning
- Earthquakes are introduced as a natural Earth process with impacts for humans
- An example of a map that shows patterns in Earth's features is part of the first lesson.

The SECOND TWO lessons (each 50 minutes) provide students with the challenge of designing an earthquake resistant building and presenting their data to make a group decision about how to select among different parts of approaches to reach a design solution.

This experience provides support for:

- Analyze complex real-world problems by specifying criteria and constraints for successful solutions. (HS-ETS1-1)
- Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems. (HS-ETS1-4)
- Design and evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-2/3)
- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (HS-ETS1-1)

A research assignment is incorporated as a review of vocabulary for design elements using actual building materials, visual and verbal review of the results of the design element testing, group work on design challenges and conclusions, prompts for team work and evidence-based conclusions, and guidelines for discussion.

Earthquake Engineering Curriculum Mapping

This four-lesson series was developed to guide high school students through the process of engineering design while introducing some key idea and skills in the current and proposed Next Generation California State Science Standards. Students will act as a design group, working collaboratively to learn structural vocabulary, defining specific criteria and limitations for an earthquake-resistant building, testing and refining their designs, collecting data, and communicating their findings.

Grade Level:	9th -12th
Timing:	Four 50 minute lessons

Student Learning Objectives:	**Students will:**
	• Learn that earthquakes are a natural hazard and engineers help design buildings to reduce damage.
	• Discover what building elements affect building stability.
	• Generate and compare multiple solutions to enable a model building to resist shaking.
	• Understand that study of failure mechanisms can be used to improve design.
	• Experience the engineering design process, including:
	  • defining design problems,
	  • using fair tests to collaboratively produce data,
	  • comparing alternate solutions with design criteria, and
	  • communicating evidence-based recommendations.

Related Next Generation Science Standards proposed for California	**9th -12th – Physics** **HS-PS2-1** Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration **HS-PS2-3** Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision **HS-PS4-1** Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media

	<u>9th -12th – Engineering Design</u> **HS-ETS1.1** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants **HS-ETS1.2** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. **HS-ETS1.3** Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

All curriculum material can be downloaded here.

Material includes:

- Teacher Documentation
- Power Point Presentations
- Training Videos
- Construction Methods
  - Material Lists
- Testing Procedures
- Supplemental Materials
- Earthquake Safety Materials

FEEDBACK

We are looking for ways to improve our curriculum and training material. Once you have completed the curriculum please provide us with feedback through our survey. Please encourage students to complete the survey as well.

For EERI chapter volunteers.

For teachers.

For students.

SUMMARY

This curriculum has been developed to foster advocates for earthquake school safety while maintaining the integrity of the classroom and keeping teachers' time in mind. We appreciate any feedback from participants and will take it to consideration in the improvement of the curriculum. We also encourage participants to make this curriculum their own and apply it different ways.