

### 3. EDUCATION PROGRAM

#### 3.1 Strategic Education Plan, Methodologies, Milestones, and Deliverables

The Education Program is designed to introduce, stimulate, cultivate, and educate undergraduate and graduate students with the knowledge that will enable them to contribute to the earthquake-engineering profession from a variety of disciplines and perspectives. The Program attracts students dedicated to earthquake engineering early in their academic career and, ideally, retains them through their course of graduate study. While the principal audience and focus of the Education Program are undergraduate and graduate students, K-12 students benefit indirectly from some of the Education Program's activity. PEER's Education Committee, composed of representatives from all eighteen core and affiliated universities, is charged with the planning and implementation of the Education Program.

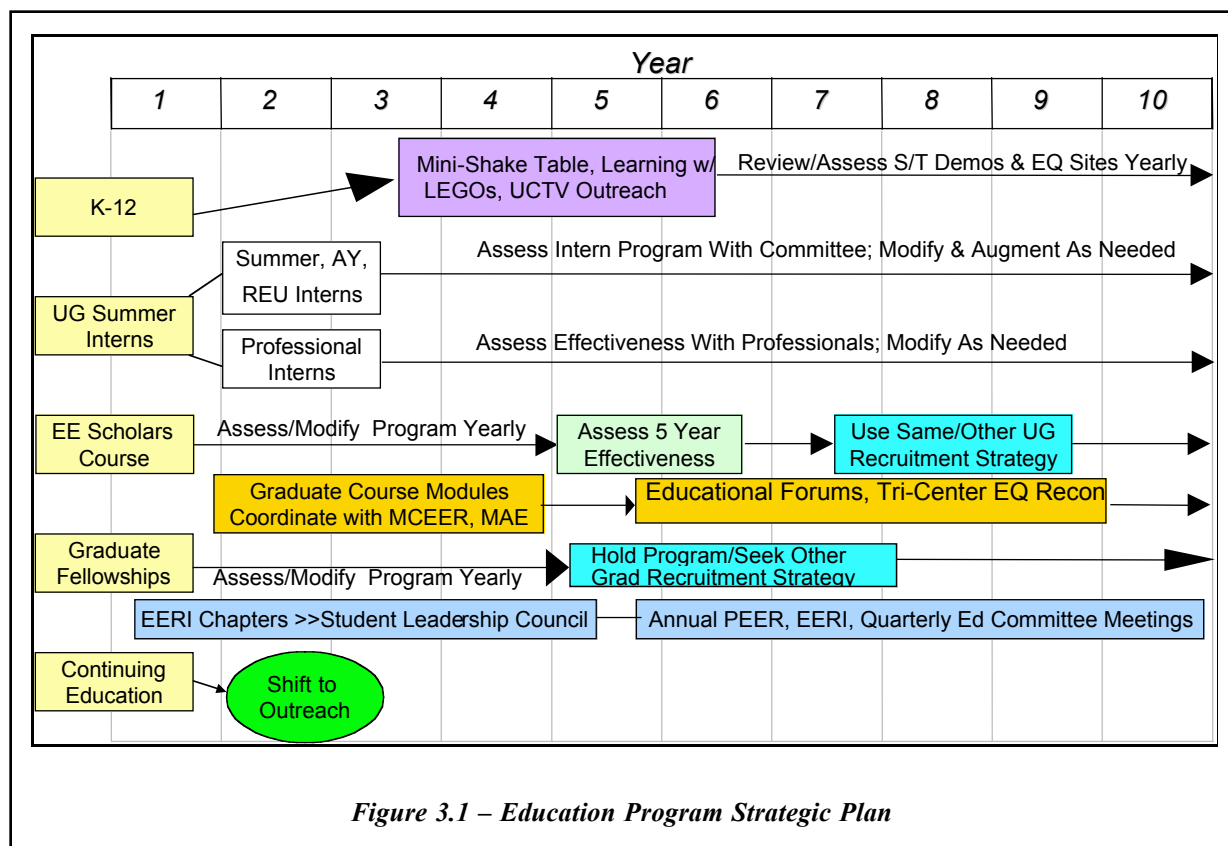


Figure 3.1 – Education Program Strategic Plan

Several specific programs have been instituted to provide undergraduate and graduate students with the opportunities to meet the Education Program's goals of education, cooperation, and service.

- The **Earthquake Engineering Scholars' Course** (EESC) is designed to introduce PEER's top undergraduate students to earthquake engineering and recruit the participants to PEER core institutions graduate programs. Students submit an application form and short statement of purpose to formalize their candidacy. Each core campus is able to send three participants except UCI and Caltech who each send two. Five students attend representing

the affiliate campuses. The Course is offered annually and evaluated both by student participants and by campus hosts.

- The ***Undergraduate Summer*** and ***Academic-Year Internship Program*** is advertised within the consortium and the ***Research Experience for Undergraduates Program*** (REU) is publicized across the country. Interested students submit an application form and statement of purpose to the PEER Education Office. An Education subcommittee reviews the applications and recommends awards. The undergraduate internship programs are evaluated annually. In an effort to recruit traditionally under-represented groups, MESA directors at several UC and CSU campuses were contacted about this opportunity and encouraged to have their students apply to the program.
- ***Education Forums*** are subawards to PEER schools to fund undergraduate and graduate student seminars. The Education Committee reviews the effectiveness of the Forums annually and discusses options for future projects.
- PEER's ***Student Leadership Council*** (SLC) formalizes PEER's efforts to encourage undergraduate and graduate student involvement in PEER research and education activities. Council representatives volunteer to participate in the group. The needs of the group as well as the success of its activities are discussed at quarterly SLC meetings and reported to the Education Committee.
- In response to NSF concerns expressed last year, the Education Program has begun to strengthen the ties between ***PEER students and BIP members***. Though we are just beginning this effort, in accordance with our adopted strategic plan we have made progress on two fronts. At this year's annual meeting, a special poster session was held exclusively for PEER students and BIP members, providing the opportunity for one-on-one discussions between our practitioners and students. In addition, PEER has begun a Professional Fellowship Program. Though started informally at Stanford earlier this year with visits from Norm Abrahamson (PG&E) and William Holmes (Rutherford & Chekene), our first formal PEER Professional Fellow is Maury Power of Geomatrix Consultants. He visited UC San Diego on June 6, 2002, where he gave a seminar, listened to short presentations about student research, and shared lunch with students. This was very well received by the students, and we anticipate the program to grow next year.

### **3.2 Current Education Projects, Curriculum Innovations, and Accomplishments**

During Year 5, the Education Program is sponsoring eight ongoing projects. The PEER Undergraduate Internship Program, Earthquake Engineering Scholars' Course, Tri-Center Earthquake Reconnaissance Program, and Graduate Modules are discussed in this section; PEER's Research Experience for Undergraduates Summer Internship Program, Graduate Fellowship Program, Student Leadership Council, Education Forums, and Learning with LEGOs are discussed in Section 3.3.

PEER's ***Undergraduate Internship Program*** is intended to interest, attract, train, and retain promising undergraduates who have expressed an interest in earthquake-engineering research.

Over a period of ten weeks, students work under the direction of a PEER-faculty mentor on a PEER-funded research project during the summer months and submit a report detailing their research experience during the fall term. In order to open the internship opportunity to more students, the Education Committee expanded the eligible PEER projects to include current- and past-projects funded by PEER, as well as PEER proposals in preparation. PEER sponsors the interns' attendance at the Earthquake Engineering Research Institute (EERI) Annual Meeting. During the past three years, students who participated in the PEER Internship Program attended the EERI Annual Meeting in St. Louis, Monterey, and Long Beach. Prior to the Friday evening reception, students presented posters about their summer research experience in an informal setting, while interacting with renowned specialists in the field of earthquake engineering. Students also had the opportunity to socialize with their peers from MAE and MCEER, as well as converse with graduate students from each of the three Centers about their academic and professional interests and goals. Both the PEER and REU Internship Program research projects mainly focus on documenting the effects of seismic activity on both natural and man-made structures so that earthquakes can be better understood and the loss of life and damage to structures prevented. PEER's internship opportunities provide students with experience in hands-on, individualized laboratory and field research, and increases their competitive value in their academic careers and eventual searches for employment.

The students who participated in the PEER Summer Internship Program during Summer 2001 submitted their final research reports on November 1, 2001. The interns' papers are being compiled into a compendium document for distribution to PEER's community of faculty and students. The Education Program is currently recruiting fifteen students to participate in PEER's Internship Program during Summer 2002. As part of our recruitment effort, UC San Diego's MESA Director has contacted MESA Directors at several other UC and CSU campuses in order to recruit traditionally under-represented groups to the program.

PEER's Undergraduate *Earthquake Engineering Scholar's Course* (EESC) is a program implemented to showcase the graduate programs at PEER core institutions and introduce undergraduate students to four topics in the field of earthquake-engineering research including seismology, geotechnical engineering, structural dynamics and public policy. The Fall 2001 version of the EESC was a multi-campus program that provided instruction to thirty students from twelve PEER universities during four weekend retreats at PEER core-university campuses. The EESC is intended for graduating seniors who have demonstrated a sincere interest in earthquake engineering or an earthquake-related field and who have achieved a high level of academic scholarship. In the Fall 2001 the scholars were hosted to four weekend retreats each focusing on a different theme of earthquake engineering: UC Davis (Geotechnical Earthquake Engineering), Stanford University (Structural Dynamics), University of Washington (Public Policy), and USC (Seismology) from early September until late November. These individual topics were the primary focus of each of the four weekends; however, the students commented on the faculty's success in developing a connection between the four topics which united the course overall and provided the students an opportunity to explore many facets of the earthquake-engineering profession. The host schools were responsible for presenting a base level of course content along its given theme. The schools also utilized the opportunity to conduct

tours and “show off” their laboratories and facilities. The students valued the unique opportunity to interact intellectually and socially with many faculty members and graduate students. An objective of the course is to recruit new talent to the field of earthquake engineering and, in particular, to recruit students to graduate study at one of the core universities. Most students who participated in the EESC in 1999 and 2000 have gone on to pursue graduate study at a PEER institution.

The Education Committee has enthusiastically endorsed another Scholars’ Course for Fall 2002. Retreats will be held at UC Irvine (Seismology), UC Berkeley (Structural Dynamics), UC San Diego (Geotechnical Earthquake Engineering) and UCLA (Public Policy). As an addition to this year’s program specifically designed to increase student/practitioner interactions, the Education Committee is inviting PEER BIP members to be present during at least two of the retreats.

***The Tri-center Earthquake Engineering Reconnaissance Program for Students*** is a new effort focusing on earthquake reconnaissance experience for PEER students starting in May 2002. It is intended that each summer this project will bring students from MAE, MCEER and PEER together for the opportunity to conduct post-earthquake investigations for the purpose of improving the science and practice of earthquake engineering and earthquake hazard reduction. This program is intended to provide students with an opportunity to conduct post-earthquake investigations during a two-week summer camp at some non-US site. The “new blood and experience” that will be gained from such a program may then be used in the future for the many formal (EERI Learning From Earthquake) and informal reconnaissance programs that already exist following an earthquake.

MAE, MCEER and PEER will each send four students, plus a young faculty member, to a pre-determined site for approximately one week. The participating students will be drawn from a variety of institutions and disciplines. A formal reconnaissance report will be required of each student following the field investigation. The Education Directors for the three EERCs have agreed that a non-US site (Taiwan, India, Japan, El Salvador, etc) would be more meaningful to the reconnaissance team than, say, a US location such as Seattle. The Education Directors have extended an informal invitation to EERI to fund four (non-EERC) students, plus a young faculty member, as part of its endowment program. Such a reconnaissance program should provide a forum of tri-center and non-center students to network for future post-earthquake reconnaissance. In May 2002, three PEER students took part in the Taiwan Field Study, our first Tri-Center Reconnaissance Program. The Education Program will evaluate the program once the student’s finalize their reports.

The Education Program has actively sought to foster relationships with MAE and MCEER as well as other earthquake-related centers such as the Southern California Earthquake Center (SCEC) and the Center for Earthquake Research and Information (CERI). The ***University Consortium for Instructional Shake Tables*** (UCIST) is one example of PEER’s cross-center activities completed in 2001. The tri-center collaborative effort was spearheaded by the MAE Center but received much support from PEER and MCEER. Specifically, eight universities from MAE and MCEER and 17 universities from PEER committed \$6,000 each toward the cost of the

mini shake tables and associated experiments. MAE, MCEER and PEER are cooperatively developing experiments that will enable the introduction of earthquake engineering to the undergraduate classroom curriculum, which will foster a greater understanding of structural dynamics and earthquake response. This project will also reinforce theoretical concepts through the use of “hands-on” laboratory experiments at both introductory and advanced levels. The Education Program is excited that this tool can also serve as a means of outreach to pre-college students, non-engineering students and the general public about the potential consequences of earthquakes and the dynamic behavior of civil engineering structures.

Started in the second year of the PEER Center, the ***Graduate Course Modules*** formalize the transfer of information, gained through PEER research activities, into web-based graduate curricula in a niche topic area in the field of earthquake-engineering research and education. Each module should not exceed a semester in length. Seven modules have been developed cooperatively with MAE and MCEER to avoid duplication and maximize the transfer of information and expertise between the centers. The web-based premise provides students and faculty with free access to interactive information in modular form so the participants remain active and aware of the exchange of information. Each module is developed as a first-level course with references for further study available.

### 3.2.1 Human Resources Development of EERC Students

PEER is continuing to develop a team-based research/educational culture for both its undergraduate and graduate students. For example, the Education Committee has devoted a significant effort to support the PEER Undergraduate Internship Program. Students from all eighteen core and affiliated universities are invited to participate. PEER’s graduate student researchers and faculty mentors closely monitor undergraduate students during their summer internship so that the experience will be worthwhile and rewarding for the intern.

Other examples of the team-based research/educational culture include the ***Research Experience for Undergraduates Summer Internship Program*** (REU), which has sponsored PEER students working at an institution other than their home campus, or students from campuses outside the PEER consortium for the past three summers. Students work as interns on a PEER-funded research project mentored by a PEER faculty member. The REU Program offers a Communications Workshop for the interns to assist them with the oral and written report requirements of the project. PEER and SCEC have teamed up over the past two summers to sponsor this activity jointly. Interns from both centers attend a one-day workshop at USC. They are provided with the basics of thoughtful and successful oral and written communication skills. The meeting affords them the opportunity to



***Figure 3.2 – REU students at tri-center meeting***

discuss their ongoing research experience. The impact of the workshop is evident in the superior quality of the REU students' oral presentations and written reports submitted during the fall term following their internship.

Another activity PEER provides the REU interns is the opportunity to meet the REU students from the other earthquake centers. In August 2001 REU students from MAE, MCEER and PEER came together in Salt Lake City for a tri-center undergraduate forum. In 1999 and 2000, the REU Earthquake Engineering Symposium for Young Researchers was held in Memphis, where faculty and staff from CERI were instrumental in making the meeting a success. Faculty from CERI conducted tours of their facility, at the University of Memphis, for all of the REU participants and conducted a presentation about the \$100 million retrofit of the Interstate 40 bridge entitled, *Insuring Against Economic Loss Due to Earthquakes*. The REU students' exposure to the methodologies of earthquake-engineering research in mid-America was truly an eye-opening experience for the PEER students.

The Symposium provides MAE, MCEER, and PEER students with the opportunity to interact with their peers and see how earthquake engineering is perceived in other parts of the country. The Symposium afforded the nation's EERC's a forum in which to ignite a discussion of ethics in engineering among these young and enthusiastic students. The topic inspired heated and pointed discussion, which many of the students had not been exposed to at their home institution. The undergraduates from each Center also made short PowerPoint presentations relating their summer research experience to the group.

PEER Education is currently recruiting students, focusing on those from groups historically under-represented in the field, for the Summer 2002 REU Program. After coordinating three successful symposia in Memphis and Salt Lake City, the three earthquake centers will host the Summer 2002 symposium in Keystone, Colorado.

PEER's educational experiences are enriching, inspiring students to continue their involvement in PEER activities. Over the past two years, a handful of undergraduate students who participated in PEER's summer internship program also have been included in the select group of students who participated in the Scholars' Course during the fall term following their internship. The nature of the Earthquake Engineering Scholars' Course has successfully melded a cohesive group from the outset of each offering. Anecdotal information indicates that many of the students have continued correspondence on both an intellectual and personal basis beyond the course's completion. Many of PEER's interns and scholars are reunited in graduate school since many choose to attend a PEER institution. Given the academic caliber of the Education Program participants over the past few years, it is not far-fetched to expect that the interns and scholars will meet in the future as successful earthquake engineering professionals.

One of the goals of the Education Program is to encourage traditionally under-represented groups to participate in PEER, in hopes that this will encourage them to make future contributions to the earthquake engineering profession from a variety of disciplines and perspectives. In past years, the Education Program has aggressively recruited Hispanic, African American and Native American students to PEER's ***Graduate Fellowship Program***. The Program provided funding in the amount of \$20,000 for up to three Ph.D. students each year to

study at a PEER institution. All students accepted into the program and who remained in good standing received financial support for a maximum of three years. Currently three students are being funded through this program and two are graduating this year with their Ph.D. degrees. More recently, the program has come under some external scrutiny because of concerns that it may violate University policy that uses race and ethnicity as a basis for special opportunity programs. To avoid potentially negative outcomes resulting from this external review, we have discontinued this program until further notice. However, the Education Committee is currently seeking other means to recruit traditionally under-represented groups to graduate programs in earthquake engineering.

Another mechanism to encourage graduate student participation in PEER's research program was the development of EERI Student Chapters. Caltech, San Jose State, Stanford and the University of Washington are currently pursuing efforts to establish a chapter on their respective campuses. They will join the chapters at Oregon State, UC Berkeley, UC Davis, UC Irvine and UC San Diego that were previously established. PEER's development of EERI Student Chapters within the consortium and focus on student participation has led to the formation of the **PEER Student Leadership Council (SLC)** and **PEER Student Association (PSA)**. Both undergraduate and graduate student representatives on the SLC, from each core and affiliated campus, serve as an active and valuable voice for all PEER students. Over the past three years, PEER's SLC has been an influential student voice to the PEER Education Committee and PEER administration concerning the needs of undergraduate and graduate students interested or currently participating in Education Program offerings. The SLC president attends each of the education committee's quarterly meetings to provide input and feedback concerning the programs offered by PEER Education. The SLC conducts its own quarterly meetings, which are scheduled to coincide with other PEER Research and Education events to maximize opportunities for networking and discussion. PEER's Second Annual Student Day, held in May 2001, was an excellent forum for students to share their intellectual and personal experiences as participants in the PEER Education and or Research Program(s). The SLC has built upon the foundation established by the EERI Student Chapters, and PEER Education hopes to continue the implementation and support of the SLC and new EERI student Chapters.

PEER is working to improve ties between industry and the PSA. An example of this was the third annual PEER Student Day held in January 2002. The students held a special poster session attended only by BIP members and students. This offered the students one-on-one contact with our industrial partners without the distraction of the faculty members. Another way PEER is trying to improve BIP participation in the Center is through the PEER Professional Fellowship program. This started informally at Stanford University earlier this year, where BIP members Norman Abrahamson from PG&E and William Holmes of Rutherford & Chekene made presentations to undergraduate and graduate students. Our first formal PEER Professional Fellow is Maury Power of Geomatrix Consultants, who visited UC San Diego students in June 2002.

PEER's **Education Forums** are a component of the Education Program that provide a setting for multi-disciplinary discussion of issues related to performance-based earthquake engineering education and research primarily focusing on PEER's research activities and work with industry partners. Both undergraduate and graduate level students participate in the activities. PEER



faculty members sponsor these activities at their campus thereby creating a sense of community among PEER researchers and students and fostering a close-knit atmosphere even though PEER's research activities are scattered across several university campuses in the western US.

An example of PEER's outreach activities is a ***Learning with LEGO Program*** inspired by a campus initiative at UC Irvine that brought over 800 K-12 students from socio-economically disadvantaged areas to the campus for an open house and shake-table demonstration in Spring 2000. One might think that seismic simulation is a topic only for advanced graduate students, but it has caught the attention of these younger students as well. The event was a competition among local elementary, middle, and high schools for the honor of having the best seismic designs. The LEGO structures were tested on one of PEER's major earthquake simulators housed in the UCI Structural Engineering Test Hall. The event has been repeated in 2001 and 2002, currently under the leadership of Tara Hutchinson, PEER Education Committee member from UC Irvine. The Education Committee is considering expanding this effort to other PEER campuses next year.



*Figure 3.3 – K-12 students await the Lego-quake*

### 3.3 Future Plans

Some of the most significant advances that the PEER Education program has delivered from the center's inception stem from two fundamental themes:

- Development of an instructional and research environment within PEER that provides a natural growth for a student's interest in all aspects of earthquake engineering through a variety of undergraduate and graduate student opportunities.
- Cooperative efforts with the MAE and MCEER Education programs.

During PEER's five years of existence, a student-friendly environment has encouraged Summer Interns to become Earthquake Engineering Scholars who, in turn, have become active participants in the Student Leadership Council. The PEER Center Director has been a staunch supporter of these student programs, and has provided a direct and sincere communication link to the students through the Student Leadership Council and Student Association. The development of a *PEER student culture* has been evident over the past few years, as students have continued from the Undergraduate Internship Program to the EESC and subsequently graduate school at a PEER campus. It is significant to note that PEER's Education and Research Programs have motivated four active SLC members to seek academic positions at four PEER-core institutions.

The intra-Center and inter-Center networking opportunities provided by PEER for its students have been, and continue to be, leveraged with the cooperative programs established with MAE and MCEER such that many PEER students have begun academic and social relationships with



their peers at the two other EERCs. The cooperative efforts of the three EERCs have provided an environment enabling the students to jump-start their professional contacts – amongst themselves, EERC faculty, and industry representatives – sooner than those students who have not participated in the EERCs.

Accordingly, the PEER Education program intends to continue those programs that have best served the students, including: Summer, Academic Year and Professional Intern Programs; Earthquake Engineering Scholars' Course; Graduate Course Modules; REU Program including (Symposium for Young Researchers); Student Leadership Council, Student Association; and Education Forums.

We are currently evaluating the effectiveness of the Tri-center Earthquake Engineering Reconnaissance Program for Students. There are additional activities that PEER's Education program intends to pursue in the near future such as: LEGO Shake Table Program; Research Experience for Teachers; Earthquake Education Series on UCTV; and Undergraduate Course Module for Earthquake Engineering. These are described below.

***LEGO Shake Table Program:*** LEGO structures, like those built for the Irvine competition, are now headed for a wider event utilizing up to 10 or more mini-shake tables that PEER secured for its participating institutions as part of the UCIST effort. The activity will engage as many as 10 PEER universities within California with neighboring K-12 classrooms. The program will be a joint effort of PEER and the Structural Engineers Association of California aimed at exciting younger students about career opportunities in earthquake engineering. PEER plans to utilize its personnel and resources to make this event as successful and inspiring as the LEGO competition at UC Irvine being lead by Professor Tara Hutchison, a former SLC member.

***Research Experience For Teachers:*** PEER hopes to offer a Research Experience for Teachers (RET) Program beginning Summer 2002. The California Research Experience for Science Teachers (CREST) is a collaboration between the Pacific Earthquake Engineering Research Center (PEER) and the K-12 Alliance, a California professional development program that promotes systemic reform for science education. The CREST program seeks to extend K-12 teachers' knowledge and understanding of science and math by enabling K-12 participants to work on a PEER-funded research project. The program will provide a link between individual teacher enhancement and school-wide reform efforts, subsequently fostering ongoing professional relationships between teachers and PEER's community of researchers engaged in earthquake-engineering research and education. The ultimate goal of the program is to translate the teachers' research experience into hands-on classroom practice and experiences for students.

Ten K-12 educators, called "teacher leaders," from around the state will be recruited annually for the CREST program. Each of these teachers will have participated in one of the K-12 Alliance programs: The California Science Implementation Network (CSIN) for elementary schools; Science Partnerships for Articulation and Networking (SPAN) for middle schools; Scope, Sequence, and Coordination (SS&C) for high schools. They will have served as staff developers for these programs, working with schools to implement quality science programs. As such, these teacher leaders have strong backgrounds in science teaching and school change.

The CREST project will foster a relationship between PEER's faculty researchers, graduate student researchers and K-12 educators. CREST's teacher leaders will sponsor professional development sessions to share the information they have learned with their colleagues. CREST participants will also have opportunities to disseminate what they have learned at statewide and regional meetings sponsored by the K-12 Alliance.

***Earthquake Education Series on UCTV:*** PEER is beginning to work with UCTV on developing a Earthquake Education Series that would combine on-demand video and narrowcasting from the PEER Education Website, together with broadcasting on UCTV via satellite to reach a broader audience. The series would consist of up to 6 short documentaries on PEER Interns and Graduate Students working on Earthquake Engineering research, as well as short video clips of PEER faculty explaining key issues and concepts in Earthquake Engineering. Some of the more exciting testing being carried out by PEER researchers would be included to stimulate audience interest. The objective of this program would be two-fold: to provide on-demand resources for earthquake education targeted at middle school level students, as well as to increase the earthquake awareness of the general public through broadcasting.

***Undergraduate Course Module for Earthquake Engineering:*** During the autumn 2002 academic term, PEER will be offering its fifth version of the Earthquake Engineering Scholars Course. Based upon the "courseware" that has been developed to date, it is only logical to coalesce the different versions of the academic material for the (a) seismology, (b) geotechnical engineering, (c) structural dynamics and (d) public policy topics into an Undergraduate Course Module for Earthquake Engineering. This course module would have many of the same features of the tri-center effort for web-based, Graduate Course Modules.