

## **The CISM Education Plan** (updated August 2006)

### **The CISM Education Mission**

The CISM Education Mission is to recruit and train the next generation of space physicists and imbue them with an understanding of the Sun & Earth as a system.

### **CISM Education Objectives**

In order to accomplish its education mission, CISM has the following objectives:

1. Provide graduate students with opportunities for broad-based research in CISM related fields and with professional mentoring and role models.
2. Provide undergraduates (2 and 4 year) with research opportunities (academic year and summer) as well as mentoring and role models.
3. Provide graduate and undergraduate students with opportunities to develop professional relationships with peers and working scientists in CISM related fields.
4. Provide space weather resources and professional development for 6-14 teachers and provide information about space weather to the general public.

### **The CISM Education Program Elements**

The CISM Education Program has four core elements that are designed to meet the CISM Education Objectives in substantial, measurable ways. Three of these are highly specific to CISM. The fourth uses CISM content to engage the broader education and public communities through a variety of means, often leveraged with other efforts. We will use appropriate methods of assessment for all elements of the CISM Education Program, and ensure alignment with national standards where applicable. The four elements are listed in order of the seniority of the students they serve.

#### **1. Building a CISM Graduate Student Community**

The graduate student retreat, all-hands meetings, graduate student Access Grid (AG) sessions, the graduate student e-Newsletter, and cross-institutional interdisciplinary research interactions provide CISM graduate students with a strong sense of community and a unique, holistic view of the Sun-Earth system. Through these close interactions the students are forging the foundation for career-long professional relationships and developing expertise that will provide a core of space weather researchers to carry forward the CISM legacy.

Status: The CISM graduate student community is strong. Graduate student retreats are held annually, in conjunction with the CISM all-hands meetings. These retreats foster a sense of community that is now exhibited through other graduate community activities including: a student-run e-Newsletter, graduate specific Access Grid meetings, and graduate luncheons at professional meetings.

This element is under the leadership of Jeffrey Hughes but requires and receives broad support from all CISM research institutions.

## **2. The CISM Summer School**

The CISM Summer School is aimed primarily at students entering graduate school in space or solar physics, or at the end of their first year of graduate study. However some undergraduates, a high school teacher, and particularly professionals entering the field have also benefited from attending. In two weeks the school provides an overview of the space environment, space weather hazards, and models that are used to understand, specify, and predict the space environment. Hands-on use of space weather models is a core component of the school. The goal is to provide students with a comprehensive overview of the Sun-Earth system, space weather, and the various types and uses of models in order to provide the context for their subsequent more detailed and theoretical study in graduate school.

Status: The summer school is established and successful. The innovative nature of the pedagogy has proven to be highly effective.

The CISM Summer School is organized by, and held at Boston University. CISM researchers from throughout the project serve as faculty.

## **3. Enhanced Undergraduate Research**

Undergraduate researchers bring a great breadth of experience and expectations, including different levels of academic preparation, type and clarity of goals, and involvement in other activities. To effectively support their diverse needs, CISM enhances the core undergraduate research experience in two ways. First, we use the Center's breadth to actively facilitate research opportunities tailored for individual students. Such opportunities include summer research at other CISM institutions, and academic year collaborations involving different groups. Second, the Center provides a larger scientific context for individual undergraduate research and a broader network for peer interactions, mentoring, and experiencing the human aspects of collaborative research. This includes electronic meetings on topics selected by undergraduates, web-based peer communication, contacts and support for graduate school application, and support for career decision making. These activities provide a mix of "menu" activities from which students can choose, and actively facilitated opportunities that are developed by CISM personnel familiar with individual student capabilities and desires.

Status: Many of these activities are in place. CISM faculty at several institutions are directing undergraduate research. Several undergraduates from both inside and outside CISM have participated in summer research programs at CISM institutions. Students who participated in undergraduate research have entered CISM graduate schools; others have entered graduate schools in space science at non-CISM institutions.

This element is led by the Education Coordinator. Activities are distributed across all CISM institutions, providing research opportunities for undergraduates both in the summer and throughout the academic year.

#### **4. Grade 6-14 Education and Increasing Science Literacy**

CISM pursues specific contributions to grade 6-14 education and science literacy, both through targeted training for educators and high visibility exhibits and information for the general public. These activities are: the Stanford Space Weather Monitor, the Solar Planetarium show, the new Windows to the Universe section on space weather, the Physics of Ham Radio course at Rice University, the collaboration between Berkeley/Stanford and the San Francisco Exploratorium, secondary curriculum development, and teacher workshops. Several of these activities are highly leveraged by ongoing related efforts, enabling high impact for modest investment. These activities are integrated through shared content and resources.

Status: Several of these activities are thriving. Upcoming activities will reinforce the connections between different elements, for example, organizing teacher workshops around the use of the space weather monitor. The Education Coordinator will work with CISM researchers to identify synergies and ensure that these diverse activities are executed to reach effectively a broad audience within our limited resources.

This element comprises several specific, focused activities, under the leadership of several CISM institutions. Overall coordination and balance of these activities is a key responsibility of the Education Coordinator. The activities include: The Stanford Space Weather Monitor (Stanford); the Solar Planetarium Show (Rice), the new Windows to the Universe section on space weather (NCAR), the Physics of Ham Radio course (Rice), the collaboration with the San Francisco Exploratorium (Berkeley & Stanford), secondary curriculum development, and teacher workshops (FIT, NCAR, Rice, Stanford).

## Connecting Program Elements to Objectives

The four core elements of the CISM Education Program support the four objectives of the CISM Education Goals as shown in the table below.

<b>Program Element</b>	1. Build Graduate Community	2. CISM Summer School	3. Enhanced Undergraduate Research	4. Grade 6-14 Education & Science Literacy
<b>Objectives</b>				
1. Graduate research, mentoring, and role models	<b>X</b>	<b>X</b>		
2. Undergraduate research, mentoring, and role models		<b>X</b>	<b>X</b>	
3. Graduate & undergraduate prof. & peer relationships	<b>X</b>	<b>X</b>	<b>X</b>	
4. Resources for grades 6-14 and general public		<b>X</b>		<b>X</b>

### **Measures of Success: Outcomes and Assessments**

Our metrics for success in the CISM education program are based on the following desired outcomes for each of our education objectives.

<b>Objective</b>	<b>Outcome</b>
Provide graduate students with opportunities for broad-based research in CISM related fields and with professional mentoring and role models.	A thriving, diverse community of graduate students actively engaged in CISM research and related activities.
Provide undergraduates (2 and 4 year) with research opportunities (academic year and summer) as well as mentoring and role models.	A thriving, diverse community of undergraduate students actively engaged in CISM research and related activities
Provide graduate and undergraduate students with opportunities to develop professional relationships with peers and working scientists in CISM related fields	Both CISM and non-CISM students interacting with peers and working scientists thorough CISM provided means
Provide space weather resources and professional development for 6-14 professional educators and information about space weather to the general public.	Teachers using CISM materials in their classes. Teaching professionals participating in CISM sponsored activities. Members of the general public participating in CISM sponsored programs and accessing CISM provided materials.

The preceding sections have laid out CISM's Education Mission, the Objectives supporting that mission, the Program Elements to achieve these Objectives, and the desired Outcomes. We will rely upon the following Assessments of the Outcomes. as measures of our success.

**Outcome 1:** *A thriving, diverse community of graduate students actively engaged in CISM research and related activities*

**Assessments:**

- Number of graduate students engaged in CISM research each year.  
Goal: 20 each year, including 8 women and 4 underrepresented.
- Number of CISM PhDs. Goal: 5 after five years;  
25 after 10 years, including 12 women and 5 underrepresented.
- Number of graduate student first-author presentations at professional scientific meetings related to CISM research. Goal: 12 per year.
- Number of graduate student first-author papers in scientific journals.  
Goal: 5 per year.
- Graduate student enrollment in Summer School. Goal: 24 each year.
- Formative evaluations of Summer School.  
Goal: an average of "4" on a five-point Likert scale.
- Summative evaluations by graduate students of the Summer School contribution to professional development. Goal: "4" on a 5-point scale.

**Outcome 2:** *A thriving, diverse community of undergraduate students actively engaged in CISM research and related activities*

**Assessments:**

- Number of undergraduates engaged in CISM research each year.  
Goal: 20, including 10 women and 5 underrepresented.
- Number of CISM undergraduates entering graduate school in Space Weather related programs. Goal: 3 each year.
- Number of undergraduate co-authored presentations at professional scientific meetings related to CISM research. Goal: 5 per year.
- Number of undergraduate co-authored papers in scientific journals.  
Goal: 5 per year.

**Outcome 3:** *Both CISM and non-CISM students interacting with peers and working scientists thorough CISM provided means*

**Assessments:**

- Number of student first-author presentations *with co-authors from other institutions* at professional conferences. Goal: 8 each year.
- Number of students representing different institutions attending the CISM all-hands meeting. Goal: 12 students representing 6 institutions each year.
- Students from most CISM institutions participating in regular CISM AG sessions. Goal: students from 6 institutions.
- Number of students attending the graduate retreat. Goal: 12.

**Outcome 4:** *Teachers using CISM materials in their classes. Teaching professionals participating in CISM sponsored activities. Members of the general public participating in CISM sponsored programs and accessing CISM provided materials.*

**Assessments:**

- Teachers trained in use of CISM curriculum modules (such as the Space Weather Monitor System) at middle school, high school and community college level. Goals: 20 teachers trained per year. Space Weather Monitor suitable for widespread classroom use developed and tested with teacher interns and students by end of year 3. 100 Space Weather Monitor systems (SIDs) and 15 research-quality monitors (AWESOME) distributed, with at least 80% incorporated into classroom curriculum or activities, by end of year 5.
- Presentations and workshops on CISM science, classroom relevance, and pedagogical approaches at professional meetings for educators and scientists. Goal: 10 per year.
- Teachers report using CISM curriculum modules in the classroom. Goal: 25% of previous year's cohort after 5<sup>th</sup> year
- CISM content accessed by the public via the web or in person. Goal: 1 million visitors per year after 5<sup>th</sup> year

## **The Education Coordinator**

CISM's full-time Education Coordinator is Dr. Nicholas Gross. The Coordinator reports to the CISM PI and coordinates education activities throughout CISM, working closely with the education leads at the CISM institutions, and obtaining regular progress reports from all elements of the CISM Education Program. In addition to coordinating the entire CISM education program, the Education Coordinator takes personal responsibility for the following tasks (which are organized by education program element):

### Graduate Student Activities:

Be a resource for graduate students to help them organize themselves. Work with CISM faculty to organize professional development sessions over the AG in various areas (Under the hood with the codes, Mentoring undergraduates, etc.)

### Summer School Activities:

Coordinate the collection and distribution of summer school lecture and laboratory materials. Work with CISM summer school faculty to update, test, and rewrite selected labs; help run the summer school.

### Undergraduate Student Activities:

Coordinate the inter-institutional community of CISM undergraduates by identifying and organizing activities that add value to their individual research experiences, such as: conducting electronic professional development sessions in various areas (Basic research skills, Intro to IDL and CISM\_DX, Scientific writing, Applying to grad school, etc.), facilitating inter-institutional research opportunities, assisting CISM faculty in mentoring students, and facilitating communication within the group.

### 6-14 Education and Increasing Science Literacy:

Coordinate these diverse activities to ensure that they are executed to reach effectively a broad audience within our limited resources. Organize a means to collect visualization and other resources produced by CISM researchers and educators and to ensure that those resources are used effectively in the science literacy efforts.