

**THEMIS—TIME HISTORY OF EVENTS and MACROSCALE INTERACTIONS
DURING SUBSTORMS**

**Education and Public Outreach Evaluation
GEONS Teacher Interviews—FY05**

SUBMITTED—MARCH 2005

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BACKGROUND—THEMIS E/PO AND ITS EVALUATION ACTIVITIES

The THEMIS (Time History of Events and Macroscale Interactions during Substorms) Mission will determine the onset time and location of magnetic substorms of Earth's space environment, a prerequisite to understanding space weather.

The Education and Public Outreach (E/PO) effort associated with the THEMIS Mission has as its goals to...

- share THEMIS discoveries with teachers, students and the general public through ground-based magnetometer stations and a web site,
- develop high quality lesson plans,
- share THEMIS science in the context of other NASA Missions,
- facilitate scientists' involvement in E/PO,
- use existing infrastructure to avoid duplication of effort,
- partner with Tribal Colleges and SACNAS in order to reach minority and underserved groups, and
- provide teachers with professional development opportunities.

In order to achieve such ambitious objectives, a unique array of both formal education activities and informal education and public outreach initiatives was developed. These activities include...

- **GEONS—Geomagnetic Event Observation Network by Students**—ten ground-based magnetometer stations located at rural schools in under-served communities across the nation. Professional development for ten teachers at these sites includes introducing them to an inquiry-based approach to THEMIS science and providing them with educational materials and products for instructing their students.
- **Teacher professional development**—THEMIS science workshops will be conducted for the GEONS teachers, participants at SACNAS Conferences, workshops associated with the Lawrence Hall of Science GEMS launch and other national and local conferences.
- **Launch of GEMS site**—a new GEMS Network site at the Carson City School District in Carson City, NV will offer professional development and resources for teachers in inquiry-based mathematics and science in addition to teacher professional development workshops in earth and space science.
- **THEMIS web site development**—a web site available to the general public to learn about the THEMIS Mission and its science. The site informs readers about how to use THEMIS science and GEONS activities in the classroom, how to understand THEMIS data and where the THEMIS public activities are taking place.
- **Northern Lights planetarium show**—Northern Lights, a Lawrence Hall of Science-produced planetarium show, will be revised to reflect THEMIS Mission science discoveries related to auroras. It will be field tested and revised before being distributed to over 100 planetariums.

Each of these E/PO components is linked with evaluation activities that are being conducted in order to provide both process and impact information. Process information or formative evaluation involves documenting the strengths and challenges of each programmatic component of the E/PO effort. These data are then fed back to the THEMIS E/PO team so that they can make necessary improvements to move forward with increased confidence that they are staying on track and reaching their goals.

Impact data or summative evaluation provides evidence of programmatic effectiveness. These data indicate or measure the extent to which the THEMIS E/PO team has been successful in actually achieving their goals.

A variety of methods are being used to gather both process and impact data. These include workshop questionnaires, telephone interviews, web site usability studies, planetarium visitor surveys and accountability logs for web site users and planetarium visitors.

This report focuses on one component of the E/PO effort—the GEONS teachers. The remainder of this document describes the findings of a FY05 survey of GEONS teachers that was conducted to gain insight into their reactions to the THEMIS program to this point. The information that the GEONS teachers shared will serve as a guide to the THEMIS team in making improvements in the project—including its workshops, curricular materials, communication strategies and installation methods.

FINDINGS—GEONS TEACHER INTERVIEWS

BACKGROUND

In January 2005, seven of the ten GEONS teachers accepted invitations to participate in telephone interviews in which they were asked to share their perceptions about their experiences in the THEMIS project. These interviews took place during the month of January—some six months after their initial introduction to the project at a three-day workshop in Berkeley, CA in the Summer 2004.

The teachers participating in the interviews were from Alaska, Nevada, Oregon and South Dakota—all of whom had had magnetometers installed—as well as Michigan, Vermont and Wisconsin who are awaiting Spring/Summer 2005 installation. Three of the ten GEONS teachers did not respond to our invitation to be interviewed.

Interviews lasted anywhere from 22 to 60 minutes—with an average interview of approximately half an hour. During this time, teachers were asked to share information and their perceptions about...

- **Demographics—School**—size of district, size of their school, grade levels included in their school, and **Personal**—grade level and courses currently teaching, educational background, years teaching
- **Initial introduction to the THEMIS project**—how did GEONS teachers hear about the project, from whom and when
- **Communication**—perceptions of communication and continued support from THEMIS team; contact with other GEONS teachers
- **Teaching materials and classroom activities**—current use of or plans for using THEMIS-related classroom materials and activities
- **Outreach activities/dissemination**—current or planned activities for disseminating information to other educators and the community at large

- **Magnetometer installations**—problems associated with magnetometer, its installation or data/computer output

Interview findings for each of these topic areas are summarized in the remainder of this document. Data from the more quantitative questions are presented in tabular form with highlights and details outlined below each table.

Information from qualitative questions is organized by themes that emerged along with illustrative, paraphrased comments offered by the teachers. Demographic information is provided by state and can thus be linked to specific GEONS teachers. Their paraphrased comments about the program, however, are not linked to them or their state—we have made every effort to disguise teachers' identities so that their opinions and views remain confidential.

DEMOGRAPHICS

My school has a 30% turnover each year...Volunteer teachers come to serve here, but only stay for one year...Only four of the 25 faculty have been here over 9 years...

It's a small enough district so that teachers all know each other and the superintendent makes a point of dropping in everywhere.

My school is nearly on the Canadian border...it's an economically impoverished area...65% of the students are on free or reduced lunches and 50% are from non-traditional families. We have an excellent faculty that puts into practice the goal of educating the individual student...lots of cooperative learning is accomplished.

This district serves the largest geographic area in our state's lower peninsula.

Teachers were asked to provide two types of demographic information—statistics about their school/environment and about themselves personally. These data appear in Tables 1 and 2.

In these two tables, the states are presented alphabetically in two groups—the state's appearing in red had magnetometers installed at the time of the interview, while those in black had no magnetometers.

School data presented in Table 1 include information about the school environment as well as the size of the school and the district.

SCHOOL DEMOGRAPHICS						
TEACHERS' STATES	SCHOOL ENVIRONMENT	SIZE OF SCHOOL			SIZE OF DISTRICT	
		# Students	# Faculty	Grade Levels	# Students	# Schools
AK	Rural	650	37	K-12	650	1 school
NV	Suburban	1,400	70	7&8	10,000	1H, 2M, 8E
OR	Rural	60	6	K-12	60	1 school
SD	Rural	250+	25	9-12	---	1H; 2E/M
MI	Rural	820	45	9-12	2,500	1H; 1M; 4E
VT	Rural	360	25	7&8	---	---
WI	Rural	700	60	9-12	---	1H; 1M; 2E

TABLE 1. GEONS school demographics.

All GEONS teachers save one work at rural schools. Six of the GEONS teachers described their school environment as rural, while one said his school was suburban—surrounded by neighborhoods.

The majority of schools in which GEONS teachers work are middle and high schools. Three GEONS teachers work in high school (9-12), two teach in middle schools (7-8) and two work in comprehensive schools (K-12).

The average number of students in GEONS schools is slightly over 600. GEONS teachers estimated that, on average, there are 605 students in their schools.

The average number of faculty in GEONS schools is slightly under 40. GEONS teachers estimated that, on average, there are 38 teaching faculty in their schools. This makes a student-teacher ratio of approximately 16:1.

The average school district—for those having districts—is quite small. Only four GEONS teachers guessed the number of students in their districts and these estimates ranged from 60 to 10,000 with an average of 3,300.

However, all but one teacher provided estimates of the number of schools in the district. These estimates ranged from 1 to 11 with an average of 4.3 schools per district. Two of the six respondents came from districts with only one school. Of the four remaining respondents, all were in districts with just one high school, one or two middle schools and anywhere from 2 to 8 elementary schools.

Table 2 focuses on teacher information like their educational backgrounds, teaching experience and current teaching circumstances.

GEONS TEACHER DEMOGRAPHICS						
TEACHERS' STATES	EDUCATION		TEACHING EXPERIENCE		CURRENT TEACHING	
	<u>BS</u>	<u>MS/EdD</u>	<u>Years Teaching</u>	<u>Years Teaching Science</u>	<u>Courses</u>	<u>Grade Levels</u>
AK	Bio/chem; physics	---	30	30	Phys science Chem & Physiology	9 11,12
NV	Math	EdD—Bio/chem	21	21	Science	8
OR	Physics	Science Ed & Meteorology	2	2	General, physical, life, environmental sciences; chemistry & astronomy	6-12
SD	Life Science	Life Science	16	16	Anatomy, physiology, bio, chem., phys	11
MI	Bio/Earth Science	Bio	20	20	Earth science Earth system science	9 10, 11
VT	Eng/French Minor—Microbiology	Science Ed	16	14	Physical science	7,8
WI	Geology/geophysics; Physical Science	---	13	13	Physical science Geology Astronomy	9 11, 12 11,12

TABLE 2. GEONS teacher demographics.

All GEONS teachers save two have undergraduate degrees in the sciences. Five of the seven GEONS teachers have undergraduate degrees in science—spanning the gamut from basics like biology, chemistry and physics to less common majors like life science, earth science, physical science, geology and geophysics.

The two teachers not having science backgrounds got their undergraduate degrees in mathematics and English/French. The language major has a minor, however, in microbiology and is pursuing an advanced degree in science education. The math major has advanced degrees in biology and chemistry.

Five GEONS teachers have science degrees beyond their bachelors. Five of the GEONS teachers have earned masters or doctorate degrees. The masters degrees are in science education, life science, biology and meteorology. The doctorate is in biology and chemistry.

The average GEONS teacher has almost 17 years of teaching experience. On average, GEONS teachers have been teaching for 16.9 years.

All GEONS teachers save one have been teaching science for their entire careers. While six of the seven GEONS teachers have been teaching science for their entire careers, the language major has spent two years of her 16-year career teaching something other than science.

Currently all GEONS teachers are teaching at the middle and high school levels. Four of the GEONS teachers are currently teaching strictly at the high school level, two are working solely at the middle school level and one is teaching students from 6th to 12th grades.

GEONS teachers are teaching a wide range of science courses spanning from the basics to the more unusual. All teachers save two teach a wide variety of science courses. These include the basics of biology, chemistry and physics. In addition, they teach physical science, life science, environmental science, earth/earth systems science, astronomy, anatomy, physiology, and geology.

The two teachers who are responsible for only one course are the non-science majors—the math major with advanced degrees in biology and chemistry reported that he taught middle school science, while the foreign language major with a science education masters teaches only physical science.

INITIAL INTRODUCTION TO THEMIS PROJECT

Teachers were asked to share information about their initial introduction to the THEMIS project—how did they hear about it, from whom and when. Seven teachers gave information about their introduction to the THEMIS project. Their responses are displayed thematically...

SOURCES FOR INTRODUCTION TO THEMIS PROJECT

7 teachers responded

Colleagues outside school (n=4)

Former High School science teacher told this GEONS teacher about the project. The GEONS teacher completed the prep work in one day to apply for the project. She believes a major factor in being selected was geography—there is no magnetic interference in the region.

Former school grants writer told the GEONS teacher about this great new project. The GEONS teacher had approached the THEMIS project with some skepticism, as he was involved in a couple of other big projects where the ball was dropped and he was left with problems.

Faculty member of nearby School of Mining and Technology thought there would be a good fit with the THEMIS program. As the Science Department Chair, the GEONS teacher indicated he is always looking for ways to have the kids use data so he wants to make the project fit. He wants to give them as many opportunities as possible to be involved with what's going on in the scientific community.

Learned about THEMIS project from a major player in upcoming summer program that will be offered in the GEONS teacher's school district. This 'big-wig' visited the GEONS teacher's classroom and suggested that he check it out.

Professional associations/NASA (n=2)

Teacher is member of an Earth Science Teachers Association through which he learned that the state's grants consortium was soliciting participation among its members. This GEONS teacher was the only one in the state who applied.

Teacher received an e-mail from their school's AES coordinator through NASA.

Colleagues within school (n=1)

Assistant Superintendent asked if teacher had interest in participating.

COMMUNICATION AND CONTINUED SUPPORT

GEONS teachers were asked to share their perceptions of communication and continued support in the THEMIS project. More specifically, they were asked...

- **THEMIS team connecting with GEONS teachers**—To discuss the success of the various ways the THEMIS team is reaching out to the GEONS teachers; to rate the THEMIS team's communication strategies—e-mail, Yahoo! Group, web site and telephone—according to whether or not the GEONS teachers used the strategy and it's value in providing them with information about the project; to discuss the positives and negatives of each of these modalities
- **GEONS teachers reaching out to THEMIS team**—To describe any contact that GEONS teachers initiated with the THEMIS team
- **GEONS teachers connecting with each other**—To describe and comment on contact among the GEONS teachers
- **Continued support needed**—To discuss any continued support that GEONS teachers feel they need from the THEMIS team

THEMIS Team Connects With GEONS Teachers

Table 3 presents the number of GEONS teachers using each communication strategy and the mean rating of each strategy's value in providing critical information about the project.

USE AND VALUE OF THEMIS TEAM'S COMMUNICATION STRATEGIES							
E-MAIL		YAHOO! GROUP		WEB SITE		TELEPHONE	
# Use	Mean Value	# Use	Mean Value	# Use	Mean Value	# Use	Mean Value
n=7*	n=7	n=7	n=4	n=7	n=7	n=6	n=2
7	4.1	4	3.3	7	3.7	3	3.0

TABLE 3. Use and value of THEMIS team's communication strategies.

*The numbers in this row indicate the number of GEONS teachers who were queried.

E-mail and the THEMIS web site are the most popular and most valuable means of communication with the THEMIS project, while the telephone is the least used and the least valued mode of connecting. All seven GEONS teachers have received e-mails from the THEMIS team and have visited the THEMIS web site. Only four of the seven (57%) GEONS teachers have experienced the Yahoo! Group, while only three of six respondents (50%) had had telephone communication with the THEMIS team.

On a 5-point scale of 'value', e-mails were rated highest (4.1) as a means of getting information about the project, the web site came in second with a 3.7 value rating, the Yahoo! Group had a mean value rating of 3.3 and the telephone rated a 3.0. Note the varying number of respondents on both the use questions and value ratings across strategies.

Once the teachers rated the strategies, they were asked to comment on positives or negatives that particularly stood out for them. All seven teachers offered comments about E-mails and the Yahoo! Group, six offered comments about the THEMIS Web site and four gave views about phone calls. Multiple responses were permitted.

**OPEN-ENDED COMMENTS ABOUT
THEMIS TEAM'S COMMUNICATION STRATEGIES**

E-MAILS

7 teachers responded

Positive comments (n=6 teachers made 8 positive comments)

No changes needed; no problems (n=3)—Teachers indicated they have no problems with E-mails and can cite no changes that need to be made to eliminate negatives.

Source of varied information (n=3)—E-mails provide information about a broad range of subjects, new topics and the activities of other GEONS teachers.

Convenient (n=2)—Teachers cited the convenience of receiving THEMIS e-mail information along with their other e-mails that they access regularly and at any hour of the day.

Negative comments (n=2 teachers made 2 negative comments)

Not conducive to accomplishing the efficient completion of some tasks (n=1)—Sometimes a personal phone call is preferable, because it is hard to put down a question. This was especially true when having to write about the installation and other details.

Content currently not relevant (n=1)—The E-mails provide nice pieces of information—that will be useful in the future—but don't fit in right now with what the teacher is doing.

YAHOO! GROUP

7 teachers responded

Positive comments (n=4 teachers made 8 positive comments)

Sense of community—interacting, sharing (n=4)—Teachers feel it is good to be in the loop by following others' dialogue, even when not personally involved in the dialogue. It is useful to interact with others having common interests. The group is opening lines of communications.

Source of information and validation (n=3)—Teachers find it helpful to follow the dialogues of others to gain information, validation and alerts about checking out the Web site. The Problem of the Week provides useful information. It helps to know if others involved in the project have the same expectations of their students, as well as how others are using the materials and fitting them into the curriculum.

No changes needed; no problems (n=1)—Teacher doesn't see a need to do anything differently with the Yahoo! Group.

Negative comments (n=5 teachers made 5 negative comments)

Have barriers to use (n=2)—One teacher is unable to access Yahoo! Web site in school, because their firewall blocks it. Another teacher cites lack of time to access the group.

Have multiple places to retrieve messages (n=1)—Teacher reports that he has to check for messages in three different places.

Inexperience working in yahoo! group environment (n=1)—Teacher indicates discomfort with accessing group, since it feels like you're reading someone else's E-mails or listening in on their private conversation. Teacher feels that 'conversations' are very specific and not useful to him, plus he is unsure how to use what is posted. Teacher acknowledges these feelings may be due to his lack of knowledge about working in Yahoo! Groups.

Dialogue history proves cumbersome (n=1)—Teacher reports that entire history of E-mail gets in the way by creating a multiple-page E-mail that contains information that has to be reread. This is generally annoying more often than being useful.

THEMIS WEB SITE

6 teachers responded

Positive comments (n=6 teachers made 12 positive comments)

Great site for general overview of entire program and useful when embarking on project (n=6)—Teachers report having used the site fairly regularly at the beginning and found it useful for initial set up. Additionally, teachers report visiting site when preparing for conferences or seeking latest information available.

No problems using the web site (n=4)—Teachers report that overall it is a nice site and that they have no problems using the Web site.

Potential for personal connection for students (n=2)—Teacher looks forward to seeing all of the data from all of the Magnetometer sites on the Web site, so that his students can see how their data compare with data of other sites. It was also good for students to see their own site/school featured on the THEMIS Web site, since it became personal to them and they now have some ownership in it.

Negative comments (n=2 teachers made 2 negative comments)

Insufficient new material (n=2)—Teachers report using the site less frequently or not all, since they have not found sufficient new material on the site. Also, the site has not yet updated with any of the Magnetometer data.

PERSONAL PHONE CALLS

4 teachers responded

Excellent mode for addressing specific issues

- For setting up travel plans
 - Dealing with reimbursements
 - Setting up installations
 - Obtaining other specific information
-

GEONS Teachers Reach Out To THEMIS Team

The GEONS teachers were asked to comment about their experiences when reaching out to members of the THEMIS team. Four teachers offered comments...

OPEN-ENDED COMMENTS ABOUT GEONS TEACHERS CONNECTING WITH THEMIS TEAM

4 teachers responded

Teachers plan to contact THEMIS team when they have questions (n=2)

Teachers report that they have not reached out to the THEMIS team so far, but plan to when they run into questions.

Teacher had positive experiences connecting with THEMIS team (n=2)

A teacher reports that she has called and E-mailed back and forth to the THEMIS team and adds that they were wonderful and extremely helpful. She was impressed with how quickly someone worked to get a response to her.

One of the teachers found and shared an article with a member of the THEMIS team resulting in his feeling good about introducing the team member to something she didn't know about.

GEONS Teachers Connect With One Another

The GEONS teachers were asked to comment about their experiences when contacting one another. Four teachers offered multiple comments...

OPEN-ENDED COMMENTS ABOUT GEONS TEACHERS CONNECTING WITH ONE ANOTHER

4 teachers responded

GEONS teachers have contacted other GEONS teachers minimally and use Yahoo! Group and E-mails to do so (n=4)

Teachers reported they have used the Yahoo! Group for contacting each other, the few times that they do. E-mails have also been cited as a preferred mode of contact, especially when teleconferences have been difficult to set up.

GEONS teachers anticipate collaboration primarily by E-mail to begin when all installations are completed (n=2)

Teachers who have not yet begun to contact others, believe they will do so when all teachers have common experiences to share. E-mail is cited as the mode most likely to be the most efficient way to communicate with different teachers, especially given the range of time zones spanned by GEONS teachers.

Some interest expressed in having GEONS students connect (n=1)

Teacher expressed belief that the 25 or 30 students in his district that tune into the project will be the ones that need to connect with other students in other GEONS locations.

GEONS Teachers Request Continued Support

The GEONS teachers were asked to comment about the kinds of support they need now or in the future from either the THEMIS team members or other teachers. Six teachers offered multiple comments...

**OPEN-ENDED COMMENTS ABOUT GEONS TEACHERS
NEED FOR CONTINUED SUPPORT**

6 teachers responded

Anticipate needing continued support from the THEMIS team in several areas (n=4)

- For technical issues such as assistance with firewall issues
- For assistance analyzing magnetometer data and reporting it
- For administrative issues related to finances and reimbursements

Anticipate needing support from other GEONS teachers once all installations are completed (n=3)

- Needs to see data from other installations to see what 'normal' activity looks like
 - Exchange ideas about classroom activities
-
-

CURRICULUM, TEACHING MATERIALS AND CLASSROOM ACTIVITIES

GEONS teachers were asked to share their views of the THEMIS materials—not only the guides and hands-on materials, but also the videos/CDs/DVDs they were given at the workshop. More specifically, they were asked...

- To rate teachers guides and materials as well as CDs/DVDs/videos with regard to their familiarity with the material and their use or planned use of it
- To describe which materials they have found most valuable and which ones they have had problems with
- To discuss what they have done or plan to do to incorporate the THEMIS project into their curriculum
- To describe student activities that they have implemented or plan to try out

THEMIS Materials—Familiarity With And Use Of

Table 4 presents the number of GEONS teachers who have perused each of the THEMIS materials and the number using/intending to use these guides, manuals and audio-visuals.

FAMILIARITY AND USE OF TEACHING MATERIALS						
	FAMILIARITY		USE WITH STUDENTS			
	N*	# (%) Perusing Materials	N*	# (%) Who Have Used	# (%) Who Intend To Use	# (%) Who Will Not Use
Northern Lights	n=7	6 (83%)	n=6	2 (33%)	4 (67%)	---
Sunspots	n=7	6 (83)	n=6	1 (17)	5 (83)	---
Earth's Magnetosphere	n=7	6 (83)	n=6	3 (50)	3 (50)	---
Auroras Guide	n=7	6 (83)	n=6	2 (33)	4 (67)	---
Problem of the Week	n=7	5 (71)	n=5	1 (20)	3 (60)	1 (20)
GEONS User's Manual	n=7	5 (71)	n=4	1 (25)	2 (50)	1 (25)
Magnetism Guide and Activities	n=7	7 (100)	n=7	4 (57)	2 (29)	1 (14)
PowerPoint presentation of workshop	n=7	5 (71)	n=5	2 (40)	2 (40)	1 (20)
Blackout video	n=5	5 (100)	n=5	4 (80)	---	1 (20)
S.O.N. DVD	n=6	4 (67)	n=4	2 (50)	1 (25)	1 (25)

TABLE 4. Familiarity with and use of THEMIS teaching materials.

*The shaded numbers in these columns indicate the number of GEONS teachers who were queried. The first seven rows—above the horizontal, double line—are written materials such as guides and manuals. The last three rows are audio-visual materials.

The vast majority of GEONS teachers reported having perused the THEMIS materials. When GEONS teachers were asked if they had looked at or reviewed the curricular materials they received at the 2004 workshop, the majority said they had perused these guides and videos. Anywhere from 67% to 100% said that they had gone over these materials—this represents from 4 to all 7 teachers.

The majority of GEONS teachers intend to use the written materials, about a third have already tried them out and a handful of teachers anticipate not using some of the guides. Those who had reviewed the materials were asked about their use. Taking an average of percentages across all written materials, approximately 58% of the teachers intend to use the written materials and 33% have already done so. An average of about 8% said that they were unlikely to use three of the seven written guides—the Problem of the Week, the GEONS User's Manual and the Magnetism Guide.

A majority of the GEONS teachers have used the videos, while an equal percentage either intend to use them or anticipate not using them. Those who had reviewed the videos were asked about their use. Taking an average of percentages across all three videos, approximately 56% of the teachers have used the videos with their students, 22% plan to do so and another 22% expect that they will not use these materials.

THEMIS Materials—Most Valued and Improvements

Teachers were asked to comment on the THEMIS materials they have used so far—which ones they found to be most valuable as well as improvements they could suggest. Five teachers offered their comments, which are summarized in Table 5...

THEMIS MATERIALS—MOST VALUED AND NECESSARY IMPROVEMENTS		
<u>THEMIS Materials</u>	<u>Positive Comments</u>	<u>Improvements Needed</u>
Northern Lights	Valuable for students	
Sunspots	Valuable for students	
Earth's Magnetosphere	No problems with materials	
Aurora Guide	No problems with materials	
Problem of the Week	Challenging but not too math intensive	Problems may be too mathematically based and do not promote higher level thinking
GEONS User's Manual	Provides background for teachers	
Magnetism Guide and Activities	Simple way to promote student learning	Magnets and compasses not received as part of THEMIS Project—school had to supply them
PowerPoint presentation of Workshop	Valued for schematics and similar visuals	
Blackout Video	Excellent—students like it and respond to differences between now and 1980's.	Students have difficulty relating to history.
SON DVD	Directed to teachers of 5 th – 7 th	
Hands-on materials/lab	All valuable	

TABLE 5. Most valuable THEMIS materials and those needing improvement.

Incorporating the THEMIS Project Into Current Curriculum

The GEONS teachers were asked to describe how they are currently incorporating or how they envision incorporating the THEMIS project into their curriculum. Six teachers drew vivid pictures of what they are doing or envision doing...

The majority of teachers talked about incorporating the THEMIS project as an integral part of their current curriculum...

...looking for a way to teach physics in a non-traditional manner by using all aspect of the THEMIS project.

This teacher discussed with her Superintendent the possibility of dropping the magnetism and electricity portion of her physical science course in order to replace it with the THEMIS project.

This teacher sees the THEMIS activities as a way to embellish what he already does; he does not see THEMIS activities as an add-on.

Some teachers, however, mentioned the THEMIS activities as 'add-ons' to their basic courses...

...has the THEMIS activities sitting out there as extra credit projects for anyone who wants to do something extra that is related to what's being taught in the physical science or physics classes.

One teacher saw the THEMIS activities as add-on at the time of the interview, but said that he planned to eventually tie everything together...

At this point, he has taken little bits of the THEMIS project and added it to his curriculum here and there, so he would call it an add-on. But his final focus is to tie it all together...to integrate THEMIS into what he is teaching...by the end of the year, everything should tie back together.

There was a concern for at least one teacher that integration of any sort would be difficult since there seems to be a mismatch between the intellectual demands of the project and student ability...

This teacher is concerned that THEMIS involves advanced science and that she does not have many advanced science kids...While her geographic location works well for the THEMIS project, the demographics of her region may not be right. The reservations and rural areas do not have the people resources necessary for the project. She speculated that when the data are on the web site, she could alert other locales about it—other near-by places having students who are more advanced, interested and motivated to learn this level of material. Then she felt that she could create workshops and integrate more teachers.

The six teachers offering ideas for integrating THEMIS activities mentioned a wide array of courses into which they said they planned to incorporate THEMIS. Table 6 presents this information...

POSSIBLE TOPIC AREAS FOR INTEGRATING THEMIS	
<u>Topics</u>	<u># Teachers</u>
Astronomy	3
Biology	1
Elementary Science	1
General Science	1
Geology	1
Language Arts	1
Light production	1
Magnetism/electricity	4
Mythology	1
Physical Science/Physics	4

TABLE 6. Possible integration points for THEMIS project.

The richness of their ideas for incorporating THEMIS can only be enjoyed by looking at their paraphrased descriptions that appear in the display below...

OPEN-ENDED COMMENTS ABOUT INCORPORATING THEMIS ACTIVITIES

6 teachers responded

Incorporating or planning to incorporate THEMIS project into physics/physical science (n=4)

As a private school, not bound by the No-Child Left Behind mandate, they have more flexibility. When he got involved with the THEMIS project, he was looking for a way to **teach physics in a non-traditional manner** by using all aspects of the THEMIS project. So looking back, the project has been the predominant thing he's been using this year.

Will use the THEMIS materials partly as add-on resources and also integrate the materials into her curriculum...she has looked to see where the topics could fit in with **physical science or physics classes**. She has the materials sitting out there as extra credit projects for anyone who wants to do something even remotely related to their classes.

Teaches **physical science** and there are two places where the THEMIS information fits—in dealing with production of light and magnetism...Next year, when he teaches physics—which he does every other year alternating with chemistry—he will use THEMIS materials for **physics**, too.

Planning for the THEMIS materials to be integrated into the whole curriculum instead of just remaining an add-on piece. This year's **physical science class** has already had an Interactive Learning Network (ILN) unit on magnetometers. Had a scientist from the Goddard Space Flight Center give a presentation on magnetometers. So, she had her students make both simple and advanced magnetometers so they would see how the devices work. In this way, she feels that her students have a good understanding of why their school would be selected as a magnetometer site.

Incorporating or planning to incorporate THEMIS project into the study of magnetism and electricity (n=4)

Physical science students are freshmen who have to be prepared to take a state sophomore test...the unit on **magnetism and electricity** usually comes at the end of the year in the course and is not included on the test. So this teacher has asked her Superintendent about the possibility of dropping the magnetism and electricity portion of her lesson to allow classes to work on the THEMIS project.

Magnetism is another topic he always teaches and one in which the THEMIS information fits in. He can really embellish the magnetism unit now because he has the magnetometer. Can make more detail than was possible in the past. The THEMIS materials will embellish what he already does...it's not just an add-on, but an integrated part of what he is going to teach.

Just now entering the **magnetism unit**...he has one day a week he calls Sun Day where the classes do sun-related projects. Have shown the THEMIS videos and gotten on the web site...When they have a unit on **electricity**, they have to talk about magnetism. When they did a unit on energy, they had to talk about magnetism...Also tying magnetism to a state-funded project on electricity generation and electromagnetic induction.

Incorporating or planning to incorporate THEMIS project into the study of astronomy (n=3)

Will use the THEMIS materials partly as add-on resources and also integrate the materials into her curriculum...has already looked through general plans for next semester's **astronomy** class and through the THEMIS materials to see where labs, experiments and activities could fit into the subject and the topics she has to talk about in class.

Astronomy will have a unit called Earth-Sun connection for the 11th and 12th graders. Astronomy is another class where she would need to decide what to drop in order to make room for the THEMIS project materials.

His final unit is always **astronomy**. He likes to be able to get the kids out at night and can't do that in the winter. Will set up a portable magnetometer in the classroom and look at that every day and map the data many times during the day.

Incorporating or planning to incorporate the THEMIS project into other, science topics (n=2)

Plans to do a bit of THEMIS in her **Geology class** when they study the earth's magnetic field.

Teaches physical science and there are two places where the THEMIS information fits—in dealing with the **production of light** he has always incorporated information about the auroras.

Incorporating or planning to incorporate the THEMIS project into other, non-science topics (n=1)

Used the compasses and magnets in an Interactive Learning Network unit about constellations embedded in **mythology**.

Blackout video was shown in all of her **language arts classes** where students did a free write on the subject. Also used the student observation network video.

Incorporating or planning to incorporate the THEMIS project into the overall science curriculum (n=1)

Teacher envisions that each of her school's four teams will be responsible for collecting all of the data for the THEMIS project in each of the four quarters of the school year. This will give all of the group's exposure to the project in collecting raw data. With all of these science classes collecting the data, they will be coming to class, getting what they need to do the readings and reporting to the school. Then, as a school, they will report to the community, making it a community impact project as well as school impact project.

Interesting Student Activities

As teachers spoke about integrating the THEMIS project into their curriculum, they shared a variety of student activities that they had already tried out or planned to implement in the future. Since developing activities that work well with students is an integral part of successful teaching, we thought that it was important to note these activities here...

INTERESTING STUDENT ACTIVITIES

Activities for teaching auroras

Teacher reports activity prompted by students finding the prediction of a solar flare event on the weather site. When students conducted observation, no auroras were seen. He then charged the students with discovering why they didn't see auroras. The result was that the auroras were visible in Europe at night, but their area in the afternoon, illustrating the problem of not actually getting the data. He will now be able to teach the students about what the magnetometer readings mean once archival data is available.

As part of a senior physics course, the seniors taught elementary students about auroras. The project also incorporated the local American cultural custom of having the older children teach the younger. One of the Lakota speaking students used the flash file about auroras to teach the class. The students ran the whole project including lesson plan writing and making all necessary arrangements with the elementary teachers.

Teacher of physical science reports he is incorporating information on auroras when he deals with a unit on the production of light.

Activities for teaching magnetism

Teacher reports using labs for his magnetism unit, some directly from the manual as well as others including the Jump Rope Generator. Additionally, he reports incorporating magnetism in state-sponsored electricity generation and electromagnetic induction project involving the placement of a windmill and solar panel on top of the school.

Teacher has used compasses and magnets in an Interactive Learning Network unit about constellations embedded in mythology.

The teacher had an entire unit on magnetometers including a presentation from a Goddard Space Flight Center scientist. Following the presentation, students made both simple and advanced magnetometers so they could see how the devices worked and understand why one would be at the school.

Activities for non-science courses

Teacher showed the Blackout Video to all of her language arts classes so that the students could do a free write on the subject. The Student Observation Network DVD was also used.

DISSEMINATION AND OUTREACH ACTIVITIES

GEONS teachers were asked to talk about the ways they have reached out to both educators and their communities at large. More specifically, they were asked...

- To talk about both the formal and informal ways they have shared the THEMIS project with other educators
- To talk about the ways they have impacted the community with their THEMIS work

Six of the teachers shared information about how they are currently reaching out to educators, what they plan to do in the future and how the educators are reacting. Additionally, these teachers indicated how they were reaching out to the community and what reactions they are encountering as a result of these efforts. Multiple responses were permitted.

TEACHER OUTREACH ACTIVITIES

6 teachers responded

TEACHERS OUTREACH TO EDUCATORS

Teachers have already reached out to fellow teachers within their own schools with mostly positive reactions (n=6)

Teacher reports sharing materials with six other teachers in own school, half of whom are willing to help and be involved. Two additional faculty members have shown interest, but are non-science teachers, so active participation would most likely be limited.

Teacher reports that as an outcome of a group meeting, teachers in her area are anxiously anticipating the installation. Teachers for a wide range of subjects have shown a keen interest from the science, math and computer people who are 'drooling' to the geography teacher, who is excited, and even the language arts teacher, who can use some of the material.

Teacher has contacted ten teachers in his building and seven at the grade school level about the THEMIS project.

Teacher has discussed the project with ten or twelve different teachers and administrators within the school on topics ranging from the pre-installation to current status.

Teacher has shared the information of the project publications with five other teachers at his school and is awaiting their feedback about what they would be interested in using for their classes.

Teacher reports that although he has made other teachers in his school aware of the THEMIS project, he is the only one in his facility that will be involved in implementation.

Teachers have reached out to teachers outside their own schools in varied venues (n=3)

Teacher has done demonstrations in relation to the THEMIS project at two conferences of teachers.

Teacher got together with six or eight teachers at an 'in-service' and described the program.

Teacher has been in contact with science teachers in the surrounding area who want to know what her school is doing and how they can participate even though they themselves do not have a magnetometer.

Teachers are planning additional ways to reach out to other educators (n=3)

Teachers plan to create formal presentations or activities and workshops to share information about the project with other educators outside their schools.

Teachers seek ways to facilitate active participation by others as one plans to share some material with intermediate teachers located in an adjacent building and another looks for ways to assist other teachers in incorporating aspects of the project into their classes.

Teacher plans to enlist the involvement of a fourth grade teacher, whose class is close to the magnetometer installation spot to get her class involved in the project.

TEACHERS OUTREACH TO COMMUNITY

All teachers cite local newspapers and community newsletters most frequently as dissemination tool with some noting positive tangible results (n=6)

Teacher reported that five community members came to help with the installation as a result of seeing article in local newsletter. Other interested adults in the community have approached her to ask about the project.

Teacher reports that a newspaper published in a nearby city, with circulation reaching half the state published an article that resulted in her receiving feedback from people in that city that included not only praise for getting the students involved in the project but also offering help.

Teacher feels that approximately 1,000 people, including educators and members of the community have been reached with information about the project. Another teacher reports close to 40 may have been reached in his community.

Although journalists may not always have gotten the science right in articles they have published, teachers still get positive feedback from the readers, who think the project and pictures of activities related to the project and its science are 'cool'.

Teachers would like to have a PowerPoint presentation to use for educating the public (n=4)

In a common theme, teachers mentioned that they would like to take a look a PowerPoint presentation of the THEMIS project that might be usable for the layperson audience to assist them in making presentation to interested groups.

Teachers continue to plan outreach activities (n=3)

Teacher reports that once installation begins, a weekly blurb will appear in the local newspaper.

Teacher plans to showcase the project in a public science night.

Teacher plans to determine what needs to be done to best use and educate the people from the community who have offered to help with the project.

Teacher mentions school-based activities as venue for dissemination of THEMIS information (n=1)

Teacher advised that he has already mentioned the project during back-to-school nights and parent-teacher conferences.

MAGNETOMETER INSTALLATION

Four of the seven GEONS teachers interviewed had had magnetometer installations in the Fall of 2004. The remaining three teachers were looking forward to a Spring 2005 installation.

The four GEONS teachers who already had magnetometers were asked to talk about its installation and the data they were now receiving from it. More specifically, they were asked...

- To discuss any problems that had emerged during installation
- To reveal any concerns they had with the data

MAGNATOMETER INSTALLATIONS

INSTALLATION ISSUES

Teachers cite initial installation as being particularly easy (N=3)

Teacher notes that his installation went very well because of readiness—his IT people were ready, ports were ready etc.—and installers were at the school until installation was complete.

Teacher reports that she is not aware of any problems with the installation. She observed the testing for the right signals, facilitated by its close location, 150 feet from her classroom.

Teacher noted that installation was kind of easy.

Magnetometer is sensitive to interference resulting in having to locate it in less convenient locations (N=3)

Teachers report magnetometer had to be located in areas with less traffic and interference resulting in locations in buildings not immediately accessible to the GEONS teachers, some as much as three blocks away.

Locations, although selected for least interference, can still present challenges for magnetometer sensitivity (N=1)

Magnetometer site at an observatory has readings affected by the observatory's sliding roof as it moves, iron ore bearing rocks placed to cover trough dug for the magnetometer and a nearby metal fence were found to affect the readings.

DATA ISSUES

Port connections issue cited by teachers—data gets to magnetometer, but is not transmitted to UCLA (N=2)

Teachers report that schools are receiving data, but it is not transferring properly to UCLA.

Firewall issue cited by teacher who has experienced insufficient support from his school's IT department (N=1)

School's firewall has not yet been modified to allow data to come in due to his IT guy being too busy to address it.

Teacher reports he has no issues with data collection (N=1)

Teacher has had good data collection all along. Her routine is to check the magnetometer as soon as the Space Weather Internet site tells her there is activity. She does not monitor it unless she knows something is going on.
